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AND

WORLD OF SCIENCE.

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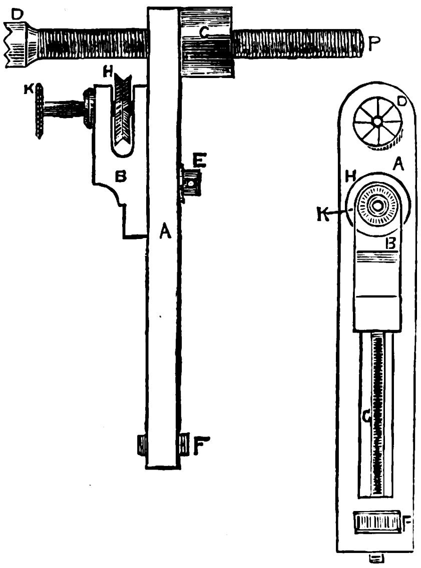
THE ENGLISH MECHANIC

AND WORLD OF SCIENCE.

COLONEL DUMBLETON'S SCREW-CHASER.

A REQUEST has been made in the ENGLISH MECHANIC for a drawing and description of the above. I have therefore sketched it one-half of the full size—viz., 4¾in. long by ¾in. wide and 5-16ths in. thick in the main frame made of brass. This is marked A in the profile and in the front view. This frame is cast with a slot reaching nearly up to C, the cylindrical boss, which slot is accurately worked to 5-16ths in. wide, to receive the tenon of the part B, which slides within it, and which is moved by the screw G and milled wheel F. It can be clamped at any position by the washer and screw E. Through C is fitted the guide-screw D of the desired pitch, which in mine is 20 to the inch; but I believe different ferrules tapped to take screws of other pitch are now made to screw into the boss C. At the end D the screw is finished with a head cut into coarse teeth, by which it is made to revolve when in use. K is the cutter, which is formed as a counterpart of the screw-thread, and is driven from the overhead by means of the pulley H. The end P of the guide-screw has a hollow centre, and rests upon the point of the back poppet, while D rests in a recess turned inside the bottom of the box or its cover. Suppose now a box to have been turned, and D resting in the recess, while P is on the back centre, D being caught by the radial teeth will revolve with the box, causing C and the frame to travel along according to the rate of the screw. A is supposed to lie horizontally on the T of the rest. Now let E be loosened, and by means of F let the screw G draw down the slide B until the cutter K just presses on the outside of the flange or neck of the box on which the thread is to be cut. Attach the overhead, and, while the mandrel is made to revolve by hand, the cutter will form a clean and perfect thread of the pitch of the leading screw. For the inside or female screw, the only difference is that the cutter is arranged inside instead of out. The limit of size of box or other similar article is this: It must allow D to fit inside it, and K to be adjusted outside. A very small article cannot be so managed. The centres of D and K are 11-16 apart when the slide B is at the upper end of the slot, as shown. When at the opposite end they are 2½in. apart. Within these limits any size of work can be screwed to perfection, and the tool is altogether a remarkable specimen of ingenuity. As the leading screw is, *pro tem.*, centred and held securely at both ends, the cutter must be always true and square to the work, so that a slanting or drunken thread is not possible. The thumb-wheel F is merely tapped as a nut to fit the screw G, which latter projects as B is drawn down. The other end is pinned through the slide. It is evident that a deep or shallow thread can be cut according as the cutter is advanced nearer to the work or *vice versâ*. If my old friend and schoolfellow, the inventor, sees this, I hope he will supplement it by giving us other mechanical dodges, as he is a walking dictionary of practical mechanics, with any number of years' experience at home and abroad. My own attention was first drawn to this screw-chaser by a brother-officer of Colonel Dumbleton's, General Cunningham, who also kindly sent me as a present the one I have copied for this paper. It is one of Plant's make, and very well put together. Some will consider the necessity of an overhead a drawback; but the cleanness of cut made by the revolving cutter, and its independent action—the speed at which the mandrel revolves being thus unimportant, quite makes up for the above drawback. It is just the thing for screwing microscope or telescope tubes, where an accurate thread is so important, and for ivory and hard wood nothing can beat it. The only drawback that struck me was having but one pitch of screw; but I wrote to G. Plant, suggesting screw ferrules to fit into C, and that each instrument should be fitted with a set of three screws, 8, 16, and 20 pitch, and was informed that recent ones had been so fitted. Of course, it is easy to turn down to a level after the chasing is finished, the recess made to take the end, D, of the screw. In making this tool, it would be essential that the spindle of K be parallel to the guide-screw, and that the latter stand at right angles to the frame A. I may state, however, that I do not know if this tool is registered or patented, or whether Mr. Plant has a monopoly of manufacture. It is a tool far too little known, and one which deserves especially the attention of amateur mechanics, who would often find it a true friend in need.



O. J. L.

THE CAT.*

"THIS beaste," says old John Bossewell in his "Works of Armorie," "is called a Musion for that he is enemie to Myse and Rattes. He is slye and wittie, and seeth so sharply that he overcommeth darkness of the night by the shyninge lyghte of his eyne. In shape of body he is like unto a Leoparde, and hathe a great mouth. He dothe delighte that he enioyeth his libertie; and in his youthe he is swifte, plyante, and merie. He maketh a rufull noyse, and a gastefull when he profereth to fighte with an other. He is a cruell beaste when he is wilde, and falleth on his owne feete from most highe places, and neth is hurt therewith. When he hath a fayre skinne, he is, as it were, prowde thereof, and then he goeth faste aboute to be scene." Certainly from the day when this quaint description was penned down to the present time, no such exhaustive an account of "the harmless, necessary cat" of the familiar poem has ever been given as that of Professor Mivart, in the book whose title heads our notice. The author's object, as he informs us in his preface, has been to furnish an introduction to Biology generally, more especially, however, to the study of that class of animals to which we ourselves belong—the Mammalia. To this end he has selected the

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* The Cat: an Introduction to the Study of Backboned Animals, especially Mammals. By ST. GEORGE MIVART, Ph.D., F.R.S. London: John Murray.

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Cat for description as "an animal easily obtained and of convenient size: one belonging to man's class, and one not so different from him in structure but that comparisons between it and him (as to limbs and other larger portions of its frame) may readily suggest themselves to the student." Now there can be no possible doubt that any one who could, and would, seriously master the 530 pages of Dr. Mivart's book, must rise from its perusal in possession of a very solid groundwork, indeed, for the study of biology generally; whether, though, it is cast in a form either sufficiently popular and attractive throughout to induce any one to do so may legitimately be a subject for discussion. To the student who has passed two or three sessions in dissection in one of our hospitals, the anatomical details given will afford a large amount of information. To anyone of ordinary education, however, who may be induced to take up the subject of biology through the medium of the work now before us, the enormous mass of technicalities which swarm and pullulate all over its pages can scarcely fail to be repulsive. Here and there our author seems to awake to the necessity of rendering his descriptions intelligible to the ordinary layman; and at such times he defines the terms which he is about to employ. Soon, however, he lapses into his seemingly chronic belief that he is addressing a class of medical students, and paragraph after paragraph of utterly crack-jaw and unintelligible terms affords evidence of the fact. Let us, however, examine the work a little more in detail. After a short preliminary chapter, we are introduced to the subject of the general form of the Cat. The chapter devoted to this is succeeded by nine others containing a most minute and exhaustive account of the smallest details of the animal's anatomy. Chapter X., on the Development of the Cat, is very interesting; and would be more so, but for a redundance of that exceedingly technical detail against which we have previously protested. The succeeding Chapter XI., on the Psychology of the Cat, conforms much more nearly to our idea of the manner in which the subject should be treated with which it deals, than do the preceding ones; the cacophonous terminology with which they are filled being here practically discarded, and a very instructive and readable essay on the mental powers and constitution of the Cat being the result. Our chief disagreement with the author in this portion of his work lies in our belief that his assertion that human and brute intellect differ in kind is a fallacious one. That their diversity in degree is enormous, few, we apprehend, would be concerned to deny. That, on the other hand, any difference between them in kind exists, hardly anyone now, we conceive, would be ready to admit. We trust that we are doing Dr. Mivart no injustice in the assumption that some theological exigencies are at the bottom of the views which he advances. The manner in which he elsewhere cites Aristotle seems to lend considerable force to this idea. Unquestionably, the great Stagyrite did good service both to the inductive and deductive methods of inquiry; but it must not be forgotten that he wholly ignored the need of the method of verification, and was very very far from himself being infallible. Chapter XII., on Different Kinds of Cats, gives an exact and comprehensive description of all known species of Felidæ, recent and extinct; and in the succeeding one, XIII., The Cat's Place in Nature is discussed, and the position of the animal with reference to other orders of animated beings defined. The Cat's Hexicology (or relation to its surroundings or environment) forms the theme of Chapter XIV.; the concluding one, XV., being devoted to the Pedigree and Origin of the Cat. Here again, the quotation of St. Augustine lends colour to the belief that the treatment of the subject is not wholly and entirely *scientific.* Profound and intimate as is obviously the acquaintance of Dr. Mivart with natural history, we venture to think that an adequate knowledge of Physical Science would be of the greatest advantage to him in treating on subjects so extensive as some of those he discusses in the pages of his latest book. On p. 306 he gives the velocity of the electric current quite erroneously, and that of light at nearly one-fifth of its true amount! Furthermore, a protest on his part against force being considered as an entity, would seem pretty plainly to indicate that the Conservation of Energy is a fact of which he is in happy ignorance; or that he has wholly failed to grasp its signification. Having, though, pointed out what we regard as faults—and some of them sufficiently grave ones—in "The Cat," we now must reiterate what we have said above as to its value to anyone who will work steadily through it, and verify what he reads by actual dissection. The fine and numerous woodcuts which illustrate the book no doubt render work with the scalpel superfluous for the general reader; but they will not supersede the necessity for the direct method of experiment by the earnest student. To such a one who will carefully master the contents of Professor Mivart's work, and see practically for himself what it describes, we can unhesitatingly promise a considerable and valuable addition to his store of biological knowledge. We have pointed out the shortcomings of the book quite unsparingly; but with all its faults it will remain as one of the most able and exhaustive monographs in the English language on the subject of which it treats.

THE ORGAN: AND HOW TO MAKE IT.—XV.

By J. Dresser.

The Action-Work (*continued.*)

BUTTONS are used as nuts on the tapped wires to regulate the action. They are made out of good sole leather, and are sometimes punched out with a quarter or five-sixteenth punch, and a centre-hole made with a bradawl; but a much better plan is to get a quarter or five-sixteenth centre-bit, and file off the scraping or scooping side, leaving only the centre-pin and the scoring side. This will cut out, shape, and centre the buttons very nicely, and the only question is whether they can be made or bought most cheaply; but certainly, the home-made are quite as good as the bought. A rather thin, but firm and good, sole leather is required for button-making.

Cloth washers are made by punching with a quarter or five-sixteenth punch. Scarlet cloth is the nicest looking, but any other colour does equally as well; the use of these washers is to prevent noise through the movement of the action work.

Rollers are long bars of wood, generally pine, and are of various sizes, according to their length and the work they have to do. They are usually rounded on the top and bottom sides to allow room for them to work; rollers are also frequently made of iron—sometimes of solid rod-iron, but more frequently of small gas-tubing; when they are made of solid iron they are usually of quarter-inch rod; holes are drilled for the arms which are riveted in, and at each end a hole about an eighth of an inch deep is drilled; into this a screw-pin is adjusted, the screw-pin working through either a wood or iron stud. (Fig. 1) shows the arrangement. Where hollow or gas-tube rollers are used, the rollers are cut to the required length, the holes are next drilled for the arms, then a plug of wood is driven firmly into the end of the roller, the arms may then be either screwed into the wood centre, or they may be riveted in the same way as if the rollers were solid; the centre pins are then used in the same way as for wood rollers. In some cases wood arms are used on iron rollers; when this is done, a hole is drilled through the roller in the usual way. The arm is hollowed out at the roller-end to fit on the roller, and a thin screw is put through the roller into the arm. (See Fig. 2.)

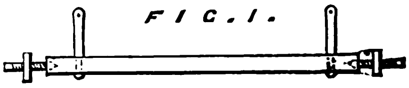
FIG. 1.

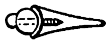
FIG. 2.

Roller-studs are little blocks fixed into the roller-board, and project so far that the roller can lie between and be centered into them; in the case of solid iron arms, the studs are either iron or wood, with a screw through the end of the stud, fitting into the hole in the roller; where wood, or hollow iron rollers are used, a hole is bored through the stud and bushed with cloth, a pointed wire is put through the hole, and inserted for about ¾in. into the roller; the wire pin should fix quite tight in the roller, and work easily, but without any looseness in the bushed hole in the stud.

The above are about all the small parts of the action, and the next thing is to put these separate parts together. The one essential idea is this—viz., a key is pressed down by the finger, and a corresponding valve must be opened in the wind-chest; but the means of communication between the key and the valve may be arranged in any manner at the discretion of the builder. A few organs have been built in which tape carried over small rollers was the only movement, and in a room that is kept at, or nearly at, an even temperature, it answers very well, and will last a good many years.

The simplest form of ordinary action is the fan frame, in which the smallest pipe is at the treble, or right hand, and the largest at the bass end. This pattern, however, is not often adopted for small organs, although, after a number of trials, I look upon it as the best arrangement, although some little room is lost at the treble end; but my experience about the size of chamber, and often also of church organs, is this. *Purchaser*—"I can only allow so much room." *Organ Builder*—"I will endeavour to meet your wishes." The organ arrives, and organ builder says, after he has the organ erected, "I should have liked a few inches more, as I have been obliged, slightly, to crowd some of the pipes." Purchaser replies: "If I had thought the organ would look so nice, you might have had another foot." This is only a fair specimen of conversation I have often met with, and I only give it to show the ideas of persons who do not understand organ work; to those who purpose building an organ, I would say, Do not crowd the pipes, or the action work, but give plenty of room.

PRACTICAL NOTES ON PLUMBING.—XXVIII.*

By P. J. Davies, H.M.A.S.P., &c.

Closet-Valves.

VALVES should have a clear-water way or passage through the seating, and the valve should lift at least half the height of the diameter of the water passage through the seating (for the proper lift of valves for the discharge of liquids it is only one-third the diameter; this, however, has nothing to do with the case in point). The instant the lever of the closet-valve begins to descend the valve begins to close, so that the higher the valve is lifted the longer will the water be allowed to run full bore.

Stool-Valves.

The best kind of valve for fixing under the seat of a w.c. is shown at Fig. 148: it is known in the trade as the stool-valve with stuffing-box, excepting that this diagram shows an improvement at M, consisting of the rocking standard instead of its being fixed. Now, were it a fixed standard, the pin at P could not be used, but the lever would then slide through an eye fixed upon the spindle D, as in Fig. 160 at J G L. The parts are as follows:—R is the lever which actuates and governs the valve, A is the inlet, C the indiarubber valve, S the seating, D the spindle working through the stuffing-box F, but may otherwise be made to work an indiarubber or some other flexible diaphragm, in lieu of the stuffing-box (which will be described and illustrated further on at Fig. 160); B is the outlet, which must be connected by a short piece of pipe (see I, Fig. 142, also 143), about 18in. long, to the arm of the closet-basin. This connection is usually made with a putty joint; but in some instances, and not unfrequently, effected by a properly-made soldered joint. These fittings are generally attached to the spreader (this spreader is by some persons wrongly yclept a fan; the proper title, however, is "spreader," inasmuch as it serves to spread out the water into a thin layer over the surface of the basin).

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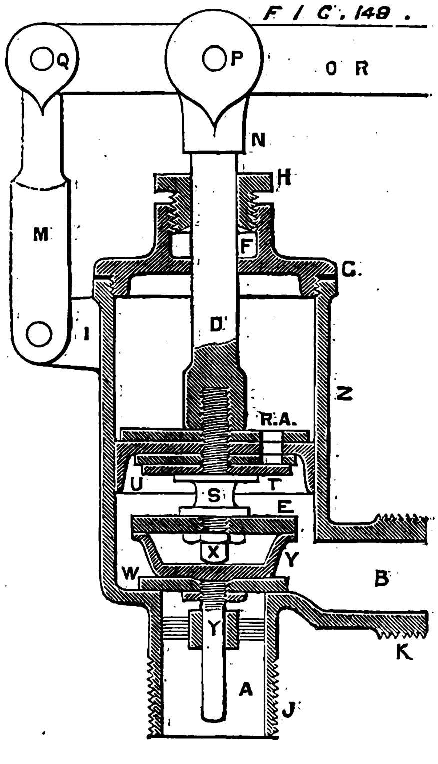
* From the *Building News.* All rights reserved.

Fig. 149 is a representation of the same kind of valve, only that it has some additional working parts which, in my opinion, should be fitted (or their equivalent) to every closet; these parts are for the purpose of retarding the descent of the lever R. This retarding mechanism is simply a solid piston, bucket, or sometimes an indiarubber or other flexible diaphragm is substituted: in this diaphragm is shown a cupped bucket U. The action of this valve is, that the raising of the lever R brings up the piston-rod or spindle D, and with it the inverted cup leather or bucket U; but, on suddenly dropping the lever, the valve T will close and prevent the too quick return of the water from below to above the bucket, so that this would keep the valve V W always suspended from off its seating. This would render the valve useless if not allowed to descend; but to counteract this contingency it is usual to employ a regulator-cock, or something equal thereto—vide Z, C, D (end elevation) Fig. 150; this tap, or other regulator, regulates to the greatest nicety the fall of the lever, also the valve V W, Fig. 149, within a given time, and in proportion to the opening of the water-passage through the tap and from below to above the piston. In this diagram the valve is converted into a waste preventer by the simple use of my "boy's" sucker E, which, on raising the spindle D, and the sucker E, takes up the valve-dish and with it the valve; this valve after a few seconds drops off again, and so closes the valve-seating. Notice: In this case B is the inlet and A the outlet.

FIG. 149.



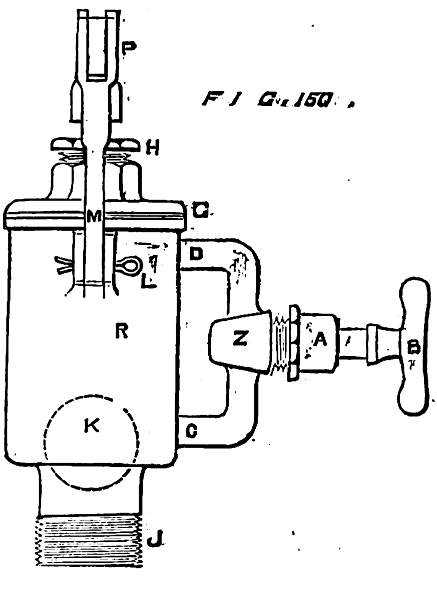


FIG. 150.

Fig. 151 is an elevation of the above valves, showing the lever as weighted at W; it also shows the end of the pull, R S. Fig. 151A illustrates the valve with lugs E, for screwing the valve to wood or brick, &c., as the case may be, also the dish and pull as fixed.

FIG. 151.

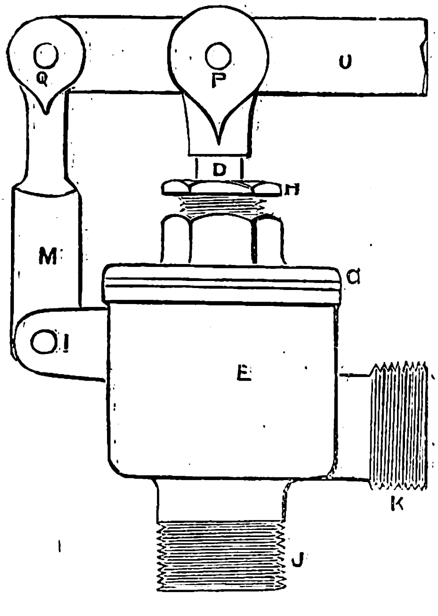
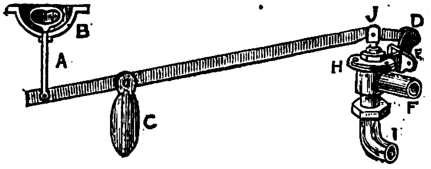


FIG. 151 A



The Waste-Not Closet-Valve, Made by J. Tylor and Sons.

This valve is illustrated at Fig. 152, and works as follows:—R is the inlet; D the valve-seating, P the outlet, B the top part of the valve, H the indiarubber washer, X the screw, with a diminishing or cone-shaped head, which, by the way, answers two purposes—viz., as a screw to hold the washer, and as a reducer for the flow of water through the valve-seating before the valve returns and finally rests upon the seating. A is the regulating screw-valve or cock, to prevent the valve remaining too long open; it also prevents the too-sudden closing of the valve, as illustrated at Figs. 149 and 150. Assume the valve H to be at rest upon its seating D. Raise the lever Q, which will, as exemplified, bring up the spindle T, and the cylinder or socket F, with it also the loose piston B C H off the valve-seating; but, by reason of the slackness of the fit of this piston, it allows the water to pass between its sides from below to above, or into the top of the cylinder E, and in proportion to its size and the amount of fit within these parts, or the distance travelled, so long will the water continue at each upward movement of the lever. My personal experience in the manufacture of these valves led me to make the plunger as large as possible, and to fit easily.

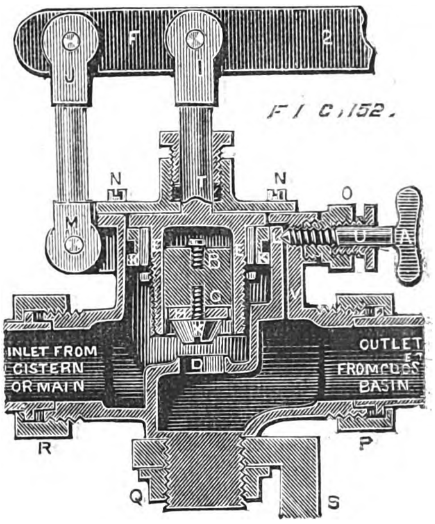


Fig. 153 also illustrates the retarding mechanism F G E fixed below the valve; this kind of retarder has been very extensively used in large Cornish steam pumping engines, and are known by the title of the "Cataract" (*vide* "Bourne on the Steam Engine"). Fig. 153: A is an elevation showing the lever unions and lugs for fixing.

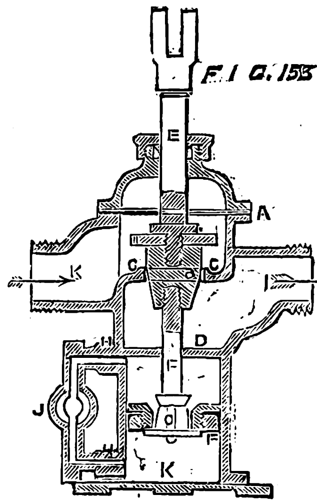
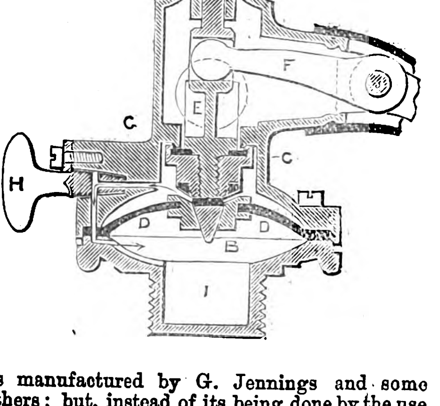


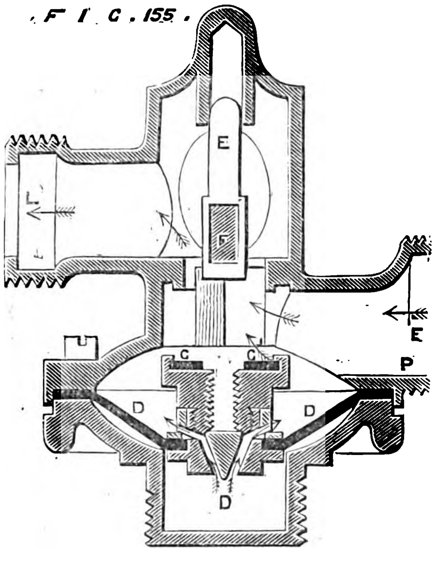
Fig. 154 illustrates this retarding mechanism as manufactured by G. Jennings and some others; but, instead of its being done by the rigid piston, it is here a flexible one (see D, Fig. 154); F is the end of the lever, E the valve-spindle, B the relief-valve to allow the diaphragm to pass one way without hindrance, but

FIG. 154.



which afterwards closes, and so allows the valve to close accordingly as the pass or regulating cock H is opened. Fig. 155 is an end screw of the regulator 154, and illustrates the inlet waterway P, and the outlet L; it also shows the valve G opened.

FIG. 155.



(*To be continued.*)

THE STORAGE OF ENERGY.

LAST week, Prof. W. E. Ayrton delivered a lecture at the London Institutien on the "Storage of Power," in which he referred to the various appliances in use for that purpose, but especially to Faure's accumulator. Among the experiments shown, the lecture theatre was lighted, a circular saw driven, and a hoist for raising boxes worked by means of electric energy which had been stored the previous day in Faure accumulators, and conveyed to the Institution. The total quantity of energy was 50,000,000 foot-pounds—a little more than 25 h.-p. exerted for one hour. We omit the earlier portion, as it refers to matters well understood, and commence with that portion in which Prof. Ayrton describes the theoretical construction of the Faure battery:—In addition to having the plates near together, they must have large surface, in order to store much electric energy. And the way to give the plate a large surface, without making it inconveniently large, is to make it spongy. Hence, what is aimed at is two spongy lead plates near together. Now, Planté made spongy lead plates thus: he placed two or more sheets of ordinary lead in dilute acid, and sent a current from one to the other. This produced brown peroxide of lead on one plate, and liberated hydrogen at the other. After a while the cell was discharged by allowing it to send by itself a current through an external circuit. The effect of this was to reduce the peroxide to spongy lead and to oxidise the other plate, an action which was continued by again sending a current through the cell from an extraneous source, only in this case in the opposite direction from that in which the first charge or current was sent. Reverse currents were now sent in succession for longer and longer times, the cell being discharged between the sending of each, also for longer and longer periods, until at length, after some months, a "well-formed" Planté's cell was the result. To subsequently charge it when required, a current is sent through it in one direction only, and a return current is produced when the cell discharges.

In 1880 M. Faure thought of the device of putting a thick layer of red-lead on his lead-plates, a substance which can easily be reduced to spongy lead by the passage of a current. The plates, after being coated with red-lead, are then wrapped in flannel jackets, and put side by side in a box, every alternate plate being connected together so as to practically form two plates with very large surface very near together. To form the cells, reverse currents are sent somewhat in the same way that they are sent in forming the Planté's cell, with the exception that days only, and not months, are required in the formation. The red-lead on the one side is reduced to a spongy material, which is probably lead very slightly oxidised; on the other side, it is reduced to lead peroxide. Charging the cell by sending a current in the direction of the last current sent reduces the sub-oxide to pure lead, and the lead peroxide on the other side to an even more oxidised salt. On using the cell to produce an external useful current the pure spongy lead becomes again slightly more oxidised and the peroxide slightly less oxidised. In fact, there is a small quantity of oxygen which travels backwards and forwards as the cell is charged and discharged. Now, does such a cell store electricity? No! emphatically no! When charging it, just as much electricity passes out as passes in, and, when discharging it, just as much electricity passes in as passes out. A secondary battery does not store electricity, but electric energy. The pith then of Faure's discovery was the mechanical placing of a salt of lead on the leaden plates, the presence of which layer of lead salt enables spongy lead to be produced in a few days, instead of requiring many months, when the spongy lead is electrically formed out of the lead plates themselves by the long passage of electric currents.

The next point to consider is—1st, the storing capacity of such an accumulator; 2nd, its efficiency; 3rd, its durability. Now I am able to give you more than hearsay evidence on this point, since Professor Perry and myself have been engaged on rather a long series of experiments on this subject.

Let us take a single example of the storing capacity. A certain cell, containing 81lb. of lead and red-lead, was charged and then discharged, discharge lasting eighteen hours—six hours on three successive days; and it was found that the total discharge represented an amount of electric energy exceeding 1,440,000 foot-pounds of work. This is equivalent to one horse-power for three-quarters of an hour, or 18,000 foot-pounds of work stored per pound weight of lead and red-lead. On the second day we made it give out energy more rapidly than the first, and on the third more rapidly than on the second—this being done, of course, by diminishing the total resistance in circuit. During the last day we were discharging with a current of about 25 ampères. But in connection with the storing power there is a very curious phenomenon to which I think not nearly sufficient attention has been directed, and that is the resuscitating power of a Faure's cell. When a cell has been apparently completely discharged, and is left for a few hours by itself, it appears to have obtained a new charge. For example after the 18 hours' discharge just referred to, although there apparently was no electric energy left in the cell, it was found that after a few hours' insulation, the accumulator could give a current of over 50 ampères, and produce, therefore, bright flashes of fire. The phenomenon is wonderfully like the invigorating action of sleep. In one case, during our experiments with an extremely rapid and powerful discharge, we found that in subsequent discharges after rest, the cell gave out three times as much energy as it did in the first discharge. The neglect of considering this resuscitating power has doubtless misled many people who have possibly discharged a Faure's cell very rapidly, into under-estimating its storing capacity. Not getting out, perhaps, so very much energy in the first discharge, they have erroneously concluded that a considerable portion of the energy originally put in had leaked away, whereas, in fact, the electric energy really was remaining there in the cell, but their experiments were conducted too hurriedly to allow it to come out. This resuscitating power may be observed even after very short periods of rest, is of great importance when a large amount of energy is required at the commencement, after periods of rest, as for example in starting a tramcar after each stoppage, which tells most fearfully on the horses. Secondly, as regards efficiency. The efficiency of an electric accumulator—that is, the ratio of the work put into it to the work given out, depends on the speed with which it is charged and the speed with which it is discharged. If charged or discharged too quickly, a certain amount of power will be wasted, heating the cell itself; since, whenever a current passes through a body, some heat is developed, and the greater the currents the greater the heat, the latter, indeed, increasing much more rapidly than the current. Now, it is possible, in a way I will not at the moment trouble you by explaining, to distinguish between the work given to the cell to produce chemical decomposition and the work wasted by too hurried charging. Similarly, in discharging, it is also possible to find out how much of the electric energy stored up in the cell is wasted in heating it by too hurried discharging. Allowing for such unnecessary waste, experience shows that, for a million foot-pounds of charge discharged with a mean current of 17 ampéres, the loss in charging and discharging combined need not exceed 18 per cent.; indeed, in some cases, for very slow discharges, we have found it not to exceed 10 per cent. I do not, of course, mean by this, as some people have mistakenly imagined from the published numbers of Professor Perry and myself, that a current of only 17 ampères can be obtained by discharging a single cell; since, of course, far greater discharge-currents can be produced if the external resistance be low; indeed, I shall show you a constant discharge of about 70 ampères presently. In speaking of the number 17, I merely mean to say that was the average current when the experiments on the efficiency above referred to were made.

I have said that a cell containing 81lb. of lead and red-lead stored 1,440,000 foot-pounds of work. Now, consider what that means. It represents all the energy required to be expended to pull a tramcar containing 46 passengers over two miles, after allowing for considerable waste of power in the electrical arrangements. The electromotor need not weigh more than about 200lb. to produce about two horse-power. We have therefore this wonderful conclusion, that about 300lb. dead weight, contains all the energy and all the machinery necessary for over two miles run of a tramcar with 46 passengers. Now is this result actually obtained at present in the tramcar running at Leytonstone, which is propelled by Faure's accumulators? No, and why? Partly because the electromotor has not been made to suit the accumulators, nor the accumulators the electromotor, nor is the gearing adapted to either. The cells, as at present made, would not give off their energy quickly enough; hence a greater number are employed, but which, consequently, require to be charged much less frequently than would otherwise be necessary. Indeed, in a ton of the cells as at present constructed there is about 50 miles run of a tramcar containing 46 passengers. Spacious as is the Lecture Theatre of the London Institution, it is unfortunately not large enough to admit a tramcar. I have, therefore, done the next best thing to prove to you that the Faure's accumulators really contain a vast store of available energy. We have here a circular saw, which is now cutting wood over an inch in thickness. As you see, the circular saw is driven by that Gramme electro-motor, and the electro-motor itself is fed by the energy stored up in these accumulators, and which was put into them by a dynamo machine yesterday on the other side of London.

The main use of the accumulators will be as stationary reservoirs corresponding with cisterns for water or gasometers for gas. But in certain cases where the accumulators can be used to propel a cart, as in the case of tramcars, not the cart employed solely to carry the accumulators, then there is not the same objection to their being moved about, seeing that the total weight necessary is small compared with that necessary for a steam-engine or a compressed air-engine for tramlines to develop the same horse-power.

Again, just as ordinary electromotors are not made to discharge a Faure's cell rapidly, so ordinary electric lamps are unsuited for this purpose; and, therefore, although there is enough energy in a 100lb. dead weight of Faure accumulator, to give a light of 1,500 candles for 30 minutes, an ordinary electric lamp cannot be illuminated at all by a single cell. Mr. Edison, however, has been turning his attention to this subject, and here is the result of his handiwork, which arrived last night from America, and which is, therefore, shown for the first time in England this evening. This incandescent lamp, as you see, only requires four Faure accumulators to illuminate it, this one 8, and this other one 12. But must the accumulators be even as large as those I am using on the table? The answer is No, if you do not require them to give out the light for a very long time. Four much smaller boxes would give just as much light as you see at the present moment; but, of course, would not keep the light burning so long. It is, therefore, now possible to have a box of accumulators and an incandescent lamp, and the whole thing quite easily carried by one man.

I have, during this evening, been talking of the measurements of electric energy put into or taken out of an accumulator in foot-pounds, and you may have wondered how it was possible to measure electric energy in the engineer's unit of foot-pounds. In reality it is very simple. The maximum amount of work a waterfall can do depends on two things: the current of water and the height of the fall. In the same way, the work a galvanic cell or accumulator can do depends on two things: the current it is producing, and what is called its electromotive force, the latter being analogous with the difference of pressure or head of water. Again, when electric energy is being turned into mechanical work by means of an electromotor, the energy which is being put into the motor can be measured by the product of the current sent through the motor and the electromotive force maintained between the terminals of the motor. Now here I have two instruments devised by Prof. Perry and myself, an Am-meter and a Volt-meter, the one for measuring a strong current, and the other a large electromotive force. With these we will now make simultaneous measurement when we allow this motor, which is driving the lathe, and which is itself driven by an electric current, to run at different speeds. First we will start with the motor absolutely at rest, by putting a brake on it, and ending by allowing it to run as fast as possible.

Experiment performed and the following results were obtained :—

Speed of Motor.	Current in Ampères.	Electromotive Force between terminals of the motor in volts.	Electric Energy put into the Motor in foot-pounds per minute.	Power wasted by the current heating the wires of the Motor in foot-pounds per minute.
0	15	15	$15 \times 15 \times 44{\cdot}25$ *i.e.* 9956·25	$15^2 \times 1 \times 44{\cdot}25$ *i.e.* 9956·25
Slow	10	21	$10 \times 21 \times 44{\cdot}25$ *i.e.* 9292· 5	$10^2 \times 1 \times 44{\cdot}25$ *i.e.* 4425
Fast	4	28	$4 \times 28 \times 44{\cdot}25$ *i.e.* 4956	$4^2 \times 1 \times 44{\cdot}25$ *i.e.* 708

We see in the last case, when the load was light and the speed of the motor very great, there was less than one-tenth of the waste of power arising from the current heating the wires when the speed was very slow. On the other hand, we observe that the electromotive force between the terminals of the motor has been practically doubled. This simple experiment really points to the solution of economic transmission of power by electricity, and to which Professor Perry and myself have on numerous occasions directed attention. It is, to allow only a very small current to pass through the wires connecting the electromotor with the generator, and to maintain a very great electromotive force between them; since, in this way, the amount of power transmitted can be made as large as we like, and the waste from the heating of the wires from the passage of the current as small as we like.

Reasoning in this way, Sir W. Thomson showed, in his inaugural address last year to the British Association, that, if we desire to transmit 26,250 horse-power by a copper wire $\frac{1}{2}$in. in diameter, from Niagara to New York, which is about 300 miles distance, and if we desire not to lose more than one-fifth of the whole amount of work—that is, to deliver up in New York 21,000 horse-power —the electro-motive force between the two wires must be 80,000 volts. Now, what are we to do with this enormous electromotive force at the New York end of the wires? Fancy a servant dusting a wire having this enormous electromotive force. You might as well, as far as her peace of mind is concerned, ask her to put a lightning-flash tidy.

The solution of this problem was also given by Sir W. Thomson on the same occasion, and it consists in using large numbers of accumulators. All that is necessary to do in order to subdivide this enormous electromotive into what may be called small commercial electromotive forces is to keep a Faure battery of 40,000 cells always charged direct from the main current, and apply a methodical system of removing sets of 50 and placing them on the town-supply circuits while other sets of 50 are being regularly introduced into the main circuit that is being charged. Of course this removal does not mean bodily removal of the cells, but merely disconnecting the wires. It is probable that this employment of secondary batteries will be of great importance, since it overcomes the last difficulty in the economical electrical transmission of power over long distances.

I will conclude my lecture by illustrating one of the other important uses to which the accumulator can be applied, and that is the practical lighting of railway trains, which may be seen in daily operation in the Pullman cars on the Brighton line. The most natural method of lighting a railway train would be to attach a dynamo-machine to the axle of one of the carriages, the guard's van for example, and the rotation of which, necessarily very rapid when the train is going fast, would, without the use of any gearing, produce the necessary current. But the difficulty that immediately meets us is that as soon as the train slows, or stops at a station, or in consequence of the signal being against it, the speed of the dynamo-machine will diminish and the lights will go out. If, however, while the train is going fast the dynamo performs two operations, the one to keep the lights burning, the other to charge a battery of Faure's accumulators on the train, then the electric energy so stored can be applied to maintain the lights while the train is going slowly or stopping. With such an arrangement there would be of course an automatic contrivance for disconnecting the dynamo-machine from the circuit when the speed becomes too low: otherwise the Faure's accumulators would simply discharge themselves back through the dynamo machine.

Imagine now we are in a train which is going slowly, or which has actually stopped, and that the Faure accumulator lying on the floor here is the Faure battery in the train, which have been charged when the train was going fast; that then it has sufficient store of power to continue lighting is proved, because, on connecting these two wires, those 50 Maxim lamps and eight Edison lamps before you are instantly brilliantly illuminated, each possessing about 40 candle-power, and giving, therefore, far more light than is, at present, ever supplied to a whole train of twelve carriages. The light, you observe, is perfectly steady, and is turned on and off at will. Imagine now we are in a tunnel in the daytime, and the lights, therefore, burning. We now emerge from the tunnel into daylight. I disconnect the wires, and the lights are instantly extinguished. Again, it may be we are entering a second tunnel. The wires are again connected by the guard, and we have the whole of this lecture-theatre, which represents the train, brilliantly illuminated.

There has been an erroneous impression existing lately that the Faure accumulator could not produce a constant current of more than 17 ampères; but that this is a mistake is clearly seen from the fact that, at the present moment, each of the cells in this room is producing a current of about 75 ampères.

A CHEAP FORM OF VOLTAIC CELL.

THE following details of a cheap and, we believe, new form of voltaic cell are abstracted from a paper by Mr. A. R. Bennett, M.S.T.E. and E., read recently before the Glasgow Philosophical Society. The cell has not yet had a prolonged trial, but it has been tested for some months side by side with the Leclanché—with which it is comparable—and has not exhibited any signs of inferiority either as regards power or durability.

The idea of the combination was suggested by the well-known fact that iron will not rust in solutions of the caustic alkalies, a fact probably due to the non-existence in such solutions of free oxygen and free carbonic acid. It was argued from this that if a plate of iron and a plate of zinc were immersed in such a solution, the iron, not being attackable by the alkali, would be strongly electro-negative to the zinc. Trial proved the idea to be strictly correct. Not only iron, but nickel and cobalt, as well as gold and silver, and the metals of the platinum group, were found to be practically as electronegative to zinc as carbon itself. Carbon is at first a little more strongly electro-negative than iron; but, owing to the absorption of hydrogen in its pores, as soon as the circuit is closed, it is in practice in no wise superior. Silver is the most electronegative of all the metals in the solutions. The use of iron, if practicable, has obviously several advantages. The cheapness of the metal, and its freedom from liability to fracture, as compared with carbon, are strong points in its favour, and it affords, besides, the possibility of making a perfect and permanent connection on the negative plate for the binding screw, an end so difficult to attain when carbon is used. It was discovered, however, that a simple iron plate polarised very rapidly, the hydrogen set free by the action of the battery clinging to it and greatly increasing the resistance. By surrounding the plate with a packet of small fragments of iron, such as clean turnings or borings, in the same manner as the carbon plate in the original type of Leclanché is surrounded by fragments of carbon and manganese dioxide, this deleterious action is considerably modified, and the cell acquires to a great extent the power of keeping up its electromotive force when working continuously through a low external resistance. The number of points presented by the turnings or borings is probably the cause of this, as it is well known that hydrogen escapes with much greater freedom from a rough than from a smooth surface. The greatest efficiency is obtained when the iron fragments are thoroughly damped by the solution, but not immersed in it, the obstacles to the escape of the hydrogen being then at their minimum. Although not quite constant when working through an external resistance of 20 ohms, the battery recovers its original electromotive force when allowed to rest, with a rapidity sufficient to allow of its employment on the busiest telegraphic circuits, and for most other practical purposes. The electromotive force of the iron battery varies somewhat with the nature of the iron and the purity of the exciting salt employed; also with the degree to which the iron fragments are saturated or covered by the solution. The Daniell being 1, and the Leclanché, at its best, 1·30, the iron varies from 1·15 to 1·33. The last was an exceptionally good cell, and the average may be taken at 1·23, or ·07 less than the best Leclanché. But after working for some days continuously through a low external resistance, the iron keeps up its electromotive force much better than the Leclanché.

There is here an old tinned iron can, which, as the legend upon it distinctly states, was originally packed with corned beef in Chicago. There is also here a quantity of iron borings swept from the floor of an engineer's workshop, the cost being simply the time and trouble consumed in sweeping. There is also a strip of common zinc cut from an old roof ventilator; a porous cell, and a bottle containing a solution of 4oz. of commercial potassium hydroxide. The porous cell being placed in the tinned iron can, and packed with borings, the solution is poured in, and the zinc strip immersed in it. The ends of an electric bell circuit being attached to the can and zinc strap, the fact that a powerful current has already been set up is made sufficiently obvious. After a few minutes it will become still more powerful; and if left to itself the cell would ring the bell night and day for at least three weeks without any noticeable loss of energy.

The tendency of the caustic alkalies to absorb carbonic acid from the air renders it desirable, although not absolutely necessary, to keep the porous cell which contains the solution tightly covered. On the other hand, the iron portion of the battery should be exposed as freely to the air as possible to facilitate the escape of the hydrogen. These contrary conditions are rather vexatious, but by no mean impossible of attainment. The most practicable mode of solving the difficulty appears to be the placing of the positive portion of the combination in an earthernware cell about seven inches in height, but porous only for four inches from its bottom, which porous cell is fitted with an air-tight stopper, through which the zinc rod is brought and terminated by a binding-screw. The earthenware cell is placed in an iron can five inches in height and of a like diameter, and packed in firmly with turnings or borings. The earthernware cell having been filled with solution almost to overflowing, the air-tight stopper is fitted in, and the battery is ready for use. The advantages of this arrangement are the exclusion of carbonic acid from the caustic solution while the iron is left exposed to the air, the prevention of evaporation, and the preservation of the packing from too profuse a wetting. There being no air pressure on the surface of the solution in the earthenware cell, it can only percolate with extreme slowness, being opposed by the pressure of the air acting through the iron borings and the pores of the cell. The presence of carbonic acid in ordinary water renders it desirable to make the solution with distilled or newly-boiled water. If this is done, and the cell instantly closed with an air-tight stopper, the conditions necessary to secure the best results have been complied with. Instead of distilled or boiled, common water may be used if a portion of newly-slaked lime is added to the solution before closing the cell.

Now, as to cost. The tinned iron can be used without detriment. The tin, being strongly electropositive to iron, sets up a local action with the borings as soon as the solution reaches it, and, being small in quantity, is soon resolved into tin oxide without injury to the battery. The soldered joints of American preserve cans are but very little affected by the solution, and can be depended upon not to leak if tight in the first instance. The borings never need renewal, as they do not rust, and are not changed in any way by the action of the battery. The zinc may be of the commonest kind, as no local action of importance has been observed unless the caustic alkali used is very impure. Amalgamation is therefore useless. Strips of common roofing-zinc rolled into cylinders answer perfectly well. The porous cell is the most expensive item, but this can be dispensed with by the use of diaphragms of canvas, or other fabric of vegetable origin. It must be remembered that the caustic alkalis destroy all animal tissues, so leather, bladders, &c., are not admissible. The author has tried cells of thin wood, such as willow-boxes, with success; but the earthenware is more permanent, and, in spite of its prime cost, probably the most satisfactory in the end. Such as the one before you can be procured wholesale at 2d. each. A diaphragm of some kind is absolutely necessary. Caustic soda, in a state of reasonable purity, is made in the neighbourhood of Glasgow, and can be obtained wholesale at a little over 1d. per lb. Whether this is sufficiently pure for long-continued action has, however, yet to be determined. To sum up the cost of one cell in its simplest form, we have can and borings $\frac{1}{4}$d.; porous cell 2d.; zinc, say 1d.; soda, 4oz. $\frac{1}{2}$d.; soldered wires for connections 1d.; labour $1\frac{1}{4}$d.; total, 6d., which is quite a liberal allowance.

The battery is, consequently, probably the cheapest ever devised, in proportion to its power and durability, when regarded in the light of prime cost, but it becomes even cheaper when it is considered that the chief product of its action is zinc oxide, known in the paint trade as zinc white, which is extensively used as a pigment and as a substitute for white-lead generally. It can easily be recovered in an approximately pure state from the used-up battery. From the cell which rang the bell for a month 1,458 grains, or 3·04oz. troy, were recovered, the zinc consumed being 1,170·7 grains, or 2·44oz. troy. Some of it—one sixth of the quantity recovered—is on the table before you

Its price in the market ranges from 6d. to 1s. 6d. per lb., according to purity. As this is by no means a bad sample, containing only a very slight trace of iron, its value exceeds that of the zinc consumed. I has been said that voltaic batteries can never compete with dynamo-machines, because the zinc used takes coal to reduce it from its ores to the metallic state, which coal would have produced the energy direct if burned in the furnace of a steam-engine driving a dynamo. But if the product of the consumption of zinc in a voltaic battery can be made to defray the cost of the zinc, that oft-quoted argument somewhat loses its force.

THE CAUSES OF COLLIERY EXPLOSIONS.

In the course of a lecture "On Colliery Explosions," delivered at Firth College, Sheffield, last Saturday, Prof. Carnelley introduced a number of experiments showing how colliery explosions are produced. Amongst the principal causes of explosions mentioned by the lecturer were insufficient ventilation, the result of which was that the fire-damp was not diluted to such an extent as to render it inexplosive; the sudden emission of gas by blowers; and the temptation which the poor light of the lamps afforded to the men to use naked lights. Since gunpowder and other explosive bodies had been used for removing coal by blasting, a very serious source of accident had been introduced, which had been the cause of a good number of fatal catastrophes. Accidents of this class arose in four ways: the carelessness with which gunpowder and other explosive bodies were handled and stored by the men; the direct ignition of the explosive gas by the flame from the shot; the concussion of the report dislodging fire-damp from the cavities in the roof and workings, and coming in contact with a naked flame or defective lamp, causing an explosion; and, fourthly, the discovery of Mr. Galloway, that explosions might be due to the sound-wave produced by a blown-out shot driving the flame through the gauze of the lamp, thus igniting any explosive mixture outside. This important discovery, which accounted for many terrible explosions, was thus illustrated by Dr. Carnelley: He took a zinc tube 15ft. long and 6in. internal diameter, and at one end suspended a lighted Davy-lamp, which, by an arrangement of gas-jets, he surrounded with an explosive atmosphere of gas and air. At the other end of the tube he placed a little glass bulb, containing a mixture of hydrogen and chlorine. On bringing near it a bright light, produced by burning magnesium, the hydrogen and chlorine united with great force, causing a loud explosion. The sound-wave passing along the tube drove the flame of the Davy-lamp through the gauze and ignited the gas outside, proving that sound-waves were capable of causing explosions in the way discovered by Mr. Galloway. Another important element in colliery explosions is coal-dust. A combustible body such as flour or coal-dust in a very fine state of division, and suspended in air, and especially if the atmosphere contained small quantities of explosive gas, is capable of forming an inflammable mixture, and of increasing considerably the force of an explosion of a mixture of fire-damp and air. When a single particle of such a substance is ignited, the ignition is communicated to the neighbouring particles with increasing rapidity, till at last an explosion results. Dr. Carnelley illustrated this statement by pouring some well-powdered coal-dust down the mouth of a glass vessel containing a mixture of of air and coal-gas. On applying a light a violent explosion took place, and at the same time the ignition of the particles of coal caused the globe to be filled with a number of luminous points. In this case Dr. Carnelley explained that the force of the explosion was considerably greater than the one produced by a mixture of air and coal-gas only. These facts showed how great explosions might occur in mines containing air and dry coal-dust with but little fire-damp. The force of the explosion, too, was much increased by the fact that a great part of the solid coal-dust, of small volume, became converted into gases occupying a volume very much larger. Looked at in the light of these facts, there was no doubt that the attempt recently made in some mines to screen the coal below ground was a most serious and dangerous mistake, as it would lead to a largely-increased diffusion of finely-divided coal-dust through the air of the mine. The action of coal-dust was chiefly of importance, and could only lead to explosions in dry mines. In damp mines no explosions had been traced to this cause; the most effectual preventive, therefore, was to keep the floor of the mine continually wet, either with water alone, or with a weak solution of calcium chloride. Many persons had denied that sudden changes of weather could have any effect upon the frequency of explosions in coal-mines, but this point had been apparently conclusively proved by Scott and Galloway, who had constructed a series of tables showing the connection between the number of explosions and sudden changes in the weather. Thus, for 1873 it was shown that 58 per cent. of the explosions were due to changes of pressure, 17 per cent. to heat of the weather, and 25 per cent. were not attributed to meteorological agencies. It was thus proved that fire-damp was more prevalent in mines with a low barometer and high temperature than under the reverse conditions. He illustrated this by means of an oblong box, divided into two unequal compartments by a plate of plaster of Paris. The smaller compartment was filled with coal-gas, which diffused slowly through the plaster partition (supposed to represent the face of the coal) into the other compartment, the further end of which was closed with a paper drum. The second compartment contained a burning candle, which at first burned quietly, because the gas only diffused very slowly through the plaster; but when the pressure in the compartment containing the candle was suddenly lowered, the gas passed more rapidly through the plaster division, and an explosion occurred. In a similar manner fire-damp issued more rapidly from the face of the coal in a mine when the atmospheric pressure suddenly fell. A sudden change of weather, especially a turn to the south-west, with low barometer and high temperature, would cause a great evolution of fire-damp from coal. It was, therefore, important that a constant watch should be kept over barometer and thermometer, and that only safety-lamps should be employed during an unsettled state of the weather. With a good ventilation, however, the above effect of weather might in most cases be eliminated.

ELEMENTARY LESSONS ON DRY PLATE PHOTOGRAPHY.*

Selection of Apparatus.

The first thing the beginner has to do, is to determine what size of "plate" he will work—that is to say, how large his pictures are to be. As a matter of course, he should begin work upon the smallest plates which he can buy, as the first few results are sure to be far from perfect, and the cheaper the plates spoiled the better. That does not, however, bind him to the smallest size. In considering size of plate to be worked, it must be borne in mind that the larger the plate the greater the weight to be carried into the field, the greater the difficulty of manipulation, and the heavier the expense at every turn. This being the case, we would suggest as a good size that known as "half plate"; that is a plate measuring $6\frac{1}{2}$in. by $4\frac{3}{4}$in., which allows of pictures being taken of the popular cabinet size, and the apparatus necessary can very easily be manipulated in the field. Having decided the size, the next thing to consider is in what manner to purchase the apparatus; and here we must say emphatically that the only way in which to be sure of getting reliable photographic requisites is to go to a first-rate dealer, and to purchase them new from him. There is a general idea in the mind of the non-photographic public, probably gained from seeing numbers of old cameras and lenses exposed for sale in pawn-shops and such like, that great bargains are to be made in second-hand photographic apparatus, and that the beginner may "pick up" what he wants very cheaply by a little looking about. There can be no greater mistake. The experienced photographer may occasionally pick up an article very cheap; but the man without technical knowledge will be sure, if he attempts to do the like, to find on his hands goods which will be useless to him when he has somewhat advanced in his art. The "sets" made up by most of the chief photographic dealers are most excellent and complete; but the sum charged for them is greater than many are willing to lay out at once. These may buy at first only those articles which are absolutely necessary to begin with, and may add to their store from time to time, as they think fit. We give a list of the articles most necessary for working quarter-plates, a camera, a lens, a tripod stand, three flat dishes or trays of porcelain or other material, a graduated measure, holding a $\frac{1}{4}$oz., a graduated measure holding 4oz., a dozen gelatine quarter-plates, a dark-room lamp.

A photographic camera is, as probably everyone knows, a sort of box, at one end of which is held the sensitive plate, and at the other end of which is held the "lens"—which latter throws an inverted image of any object in front of it on to the plate—and that there is a means of adjusting the distance between the lens and the plate, or of "focussing" the camera. Every camera has, besides this, a piece of ground glass, which can be put in the exact place to be afterwards occupied by the plate, and upon which the image can be seen so as to facilitate focussing. It is also fitted with a "dark-slide,"—a sort of case in which a sensitive plate may be fixed. After the camera has been focussed, the dark-slide is placed in the position before occupied by the ground glass, which latter is removable. The "shutter" or sliding-door of the dark-slide is then removed, and, on taking the cap off the lens, the image falls on the plate. As many dark-slides as are desired may accompany a camera, and thus a number of plates may be carried into the field. Slides are also constructed to hold two plates each, and are called "double dark-slides." These are by far the best and most convenient to use for dry plates. Three slides are a common number to accompany a camera. This enables half-a-dozen plates to be carried out. Each dark-slide should be fitted with a set of carriers. "These enable plates smaller than the largest size for which it is constructed to be placed in it."

All modern cameras for use in the field are made with bellows-bodies so that they can fold up into small compass for ease in carrying. In purchasing a camera, the photographer should get one which will open to a considerable distance—if possible, as much as twice the length of the largest size plate which it will work. In some part of his career the amateur is sure to aspire to the taking of portraits. His attempts in this direction are almost certain to be failures, and to cause great pain to his friends, but nothing is surer than that the portraiture fit will attack him. When it comes to this, he will find a camera which opens to a considerable length a great advantage.

There are various adjustments attached to modern cameras which, although of little use in the hands of the beginner, will be found of great convenience to him when he is more advanced. These are chiefly a vertical and horizontal adjustment of the front on to which the lens is screwed, and what is called a "swing-back." This latter provides a means of varying to a certain extent the angle between the sensitive plate and the axis of the lens. A leather case into which the camera and the dark-slides fit, should be provided. A "single achromatic" lens of such a length of focus as to enable the largest plate which the camera will hold to be covered should be purchased. The lens should be bought direct from some reputed maker. The particular form of lens known as the "wide-angle landscape" lens is the best. The tripod stand calls for little special remark. The only requirements of the camera stand are that it should be light, should be easy to fit up and take down, and should be quite rigid when fixed up. The flat dishes or trays—or, as they are sometimes called, flat baths—are for use in the operations of developing, fixing, &c. Such dishes, made of so-called porcelain, can be had for a few pence each, and we should reccommend that such be purchased for quarter-plate work. When the photographer advances to larger sizes, he may indulge in the more expensive and more convenient dishes made of ebonite and other light material.

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* Condensed from the *Photographic News*.

SCIENTIFIC SOCIETIES.

SOCIETY OF ENGINEERS.

At a meeting of the Society of Engineers, held on Monday evening, the 6th instant, a paper was read entitled "Notes on Electric Light Engineering," by Mr. C. H. W. Biggs, and Mr. W. Worby Beaumont. The few fatal accidents which have attended the employment of powerful electric currents for lighting purposes were first touched upon, and it was shown that these were entirely due to insufficient care in insulation and need never recur. The calculation of resistances was next touched upon, especially with relation to the best arrangement of circuits and internal and external resistances of dynamo-machines, so as to secure the most economical results. The substitution of iron for conductors of large size, in place of copper, was next touched upon, in view of the possible rise in the cost of copper, when many miles of conductors of large size are required for large installations, iron being shown to be cheaper, though the weight required would be about as 2·7 to 1. The different sources of motive powers were considered, steam-engines being preferred as more economical, more uniform in velocity of rotation, more reliable, and as being capable of more precise regulation than gas engines as at present employed. Secondary batteries as accumulators and regulators were also referred to as having an important place in electric lighting and power transmitting plant, and descriptions were given of some forms of these as now before the public, which were published nearly twenty years ago. The cost of electric lighting on a large scale was given as about two-thirds that of gas.

The ports of Quebec and Montreal are nearer to Europe by 430 and 250 miles respectively, and nearer Chicago, the great central grain depot of the West, by 140 miles, than New York, and are better situated for the shipment of the products of the Western States.

SCIENTIFIC NEWS.

THE Rev. Thomas Romney Robinson, D.D., died on the last day of February in his 90th year. So long ago as 1815 he was appointed Astronomer-Royal in Ireland, and held the post for many years, pursuing the study of astronomy with enthusiasm, and publishing works on the science which have been translated into foreign languages. He retained his mental faculties up to the last, and a letter from his pen on the "endowment" question, which we printed on p. 82, Vol. XXXIII., remains as evidence of his love of science for its own sake.

Dr. J. Palisa, of the Imperial Observatory, Vienna, discovered another small planet on February 9th, the second he has found this year and the thirtieth of his list. It is No. 222. The two planets discovered this year have been observed at Paris; but they are very faint, one being equal in brightness to a star of the 12th mag.; while the other is only equal to a star of the 13th mag. Names have been given by Dr. Palisa to the four planets he discovered in 1880. No. 212, Feb. 6, has been named Medea; No. 216, April 10, Cleopatra; No. 218, Sept. 4, Bianca; and No. 219, Sept. 30, Thusnelda.

In a lecture on the storage of energy, which we print elsewhere, it will be seen that Professor Ayrton referred to the experimental tramcar driven by Faure batteries, and an electromotor. This vehicle has scarcely had fair-play, as it was not adapted to the rails, and moreover, was limited to the short piece of line leading to the company's yard at Leytonstone. The car which has been used in France weighs with its accumulators and electromotor about 5¼ tons, the battery being capable of yielding 25 horse-power for one hour. It ran at a speed of about seven miles an hour, starting and stopping being effected with great ease by means of a small switch.

Dr. Werner Siemens has published his lecture on fire-risks of electric lighting, which he says is a subject demanding closer attention than it has yet received. There are especial dangers attending the introduction of the light into collieries, and he suggests that it should be sent through the workings by reflectors or by means of luminous paint, the painted surfaces being charged at a central lamp, and distributed throughout the mine.

The Victoria Cross Gallery at the Crystal Palace has been fitted up by the Domestic Electric Lighting Co., with a suite of elegantly-furnished rooms, to give an idea of the effect of the electric light as applied to modern mansions. There are an entrance morning-room, a smoking-room, a dining-room, and a drawing-room and boudoir. The system of lighting used is based on that of Edison.

The installation of the electric light at the Mansion House will be one of the sights of London, as it is complete so far as it goes. A Crossley gas-engine drives three Bürgin machines (a fourth is kept in reserve), which supply current to six Crompton arc lights in the Egyptian Hall, and a number of Swan incandescent lamps, arranged in electroliers in the saloon. If a statement of the cost of installation and working is forthcoming, say at the end of three months, such an experiment will be of considerable value.

A trial boring for coal is being made at Snaith, near Goole, on the estate of Lord Beaumont. It is known that the coal-measures of the West Riding extend eastwards, but it is not known how far, and as it is considered unlikely that they lie beneath Lincolnshire in workable shape, considerable interest is taken in the boring at Snaith, which was commenced last year.

The experiment of throwing oil upon the waters carried out at Peterhead by Mr. Shields, of Perth, seems to have been successful, and to have borne out the statements of mariners. Crested waves, as soon as they reached the oil-covered portion, assumed the appearance of undulating waves, and presented an unbroken surface; but it is stated that the effect does not last so long as is desired.

The third lecture delivered by Prof. S. P. Thompson, at the Crystal Palace, was on electric arc lights. The electric arc was discovered about the year 1804 by Sir Humphry Davy, when experimenting upon the different kinds of sparks produced between wires of various materials attached to the terminals of a large voltaic battery. Pencils of hard artificially-prepared coke-carbon are now universally used instead of wood charcoal. To control the light the carbon pencils are held by an instrument called a regulator or electric lamp. The regulator has to perform the office of feeding the carbon pencils into the arc as fast as they burn away, the rate of feeding being controlled electrically by the strength of the current that passes through the lamp. Diagrams of the construction of the principal forms of lamp were shown, and several lamps of the various leading systems were exhibited in action. Illustrations were also given of the method of calculating the actual amount of energy used up in the lamp, as well as of its light as compared with that of a standard candle. The lecturer stated that the gas which would yield a horse-power of energy would burn with a steady light of 42 candle-power per hour, while the same amount of gas burned in a gas-engine and used to drive a dynamo-electric generator might maintain an electric arc light equal to that of 2,000 candles.

Vipers abound in some parts of France, more especially in Vendeé, Loire-Inférieure, Haute-Marne, Lot, and Côte d'Or. In Haute-Marne 57,045 were destroyed in six years (a premium of about 2d. having been offered on each animal). According to M. de Quatrefages, the larger domestic animals recover pretty quickly (without treatment) from a viper's bite; but goats, sheep, and dogs often succumb if not treated. A bitten man may recover spontaneously, after considerable suffering; but the issue is often fatal. In view of these facts, M. de Quatrefages has called attention to the treatment with permanganate of potash recently found successful by the Brazilian, Dr. de Lacerda. The doctor insists on the importance of preparing the solution only at the time it is required, and advises keeping small packets of about 1½ grain of the salt and a flask holding about ⅓oz. of water (0·1 gramme and 10gr.). The Pravaz syringe is used in injection; a ligature is placed above the bite, and the tissues are compressed to promote diffusion. The method is applicable to domestic animals as well as men. M. de Quatrefages throws out a suggestion that the permanganate might be effective against the diseases which M. Pasteur has recently done so much to elucidate.

The monks of Mount Athos, the "Holy Hill," have now the opportunity of telegraphic communication with Salonica, in the Turkish system. The mountain, it is known, is situated on a promontory, and rises more than 6,000ft. above the sea-level. The monasteries contain some 6,000 Greek monks of the Order of St. Basilius. They are seminaries of the Greek clergy, and are visited every year by thousands of pilgrims.

An extraordinary proposal made a few years ago by Prof. Shaler, of Harvard, has been lately revived and is being discussed in American papers. The climate of the northern portion of America has, during a few centuries, been growing colder, and this Prof. Shaler attributes to rise of the land at Behring's Straits, interrupting the warm Japanese current which penetrated the Arctic Ocean, and turning it towards California and Oregon. The upheaval has now ceased, and will probably be followed by subsidence, restoring the old state of things. Prof. Shaler proposes to hasten the result by clearing away three small islands in the narrowest part of Behring's Straits (which is thirty-six miles wide, with a depth of thirty or forty fathoms), as also some obstructing rocks and reefs along the shore. If civilised nations would unite in giving the money, men, and energy, they now devote to keeping themselves ready to fight each other, the thing might easily be done (Prof. Shaler thinks) and a vast empire reclaimed for civilisation.

The behaviour of so-called "compass plants" has been lately studied by Prof. Stahl. The common one is *Silphium laciniatum*, but Prof. Stahl has noticed in the case of *Lactuca scariola* also, that its leaves generally point in a north-south direction. The peculiar position of the leaves is best seen in bright sunlight. In *Lactuca*, the leaves on the north side of the stem become vertical by twisting of the leaf-stalk, the upper surface of the leaf facing the east. Those on the south side become vertical with the upper surface to the west. The leaves on the east and west become upright with their upper surfaces approximated to the stem. Leaves of plants exposed to direct sunlight only from 10 to 3 did not take the meridional position, but those exposed only before 10 and after 3 did. That this position is produced by the sun when near the horizon is clearly shown thus :—A pot with several young plants was placed in a window facing the north, getting direct sunlight a few hours after sunrise and before sunset. Here the leaves bent towards the north with their upper surfaces turning either east or west. The pot was then placed further back, beyond the reach of direct sunlight. The leaves then took a position at right angles to the diffuse light from the window. Prof. Stahl mentions three other plants in which a meridional position of the leaves may be clearly seen.

A new mode of lighting has been introduced in a lighthouse south of Macquarie Head, near Sydney (New South Wales). The apparatus is adapted for either gas or the electric light, the former being used in clear, the latter in dull and foggy weather. The gas is conveyed from Sydney, 2½ miles off, and the electricity is generated by one of De Meritens' machines. An arrangement of prisms has been contrived, through which a dioptric apparatus can be satisfactorily utilised with the electric light.

There were 7,177 applications for patents in Germany last year, and the number has been continuously increasing of late years (in 1878 it was 5982). The number of patents granted was 4339. This was exceeded in 1879 (4410). In the United States last year the number of patents was 13,947; and since 1860 no fewer than 200,000 patents have been granted.

To free bones and other substances of fatty matter, Herr Richter, of Breslau, first subjects them to vacuum, then admits a little benzine to saturate the bones, works the air-pump again, and after some time, admits air, so that the solvent returns from the vaporous to the liquid state, and the fat is dissolved. The fat solution having collected at the bottom of the vessel, the air-pump is again worked to vaporise the solvent.

The laying of a telegraph-cable through the St. Gothard Tunnel has been completed. The cable is about 1·4in. thick, and consists of seven independent lines.

In Germany there are 16 locomotive works which supply large locomotives for the normal lines. They deliver 1,600 to 1,900 locomotives in a year. Nine of them are in Prussia, three in Bavaria, and one each in Saxony, Baden, Wurtemburg, and Alsace-Lorraine. The largest works are those of Borsig, in Berlin, and of the Hanover Machine-making Company in Linden, Hanover, each delivering 200 to 250 locomotives a year. There are, further, four works which supply small locomotives almost exclusively (65 to 80 a year). Austria-Hungary has four locomotive works with a yearly delivery of 350 to 420 locomotives. Switzerland one (Winterthur), with a yearly delivery of 40 to 50.

Most deaf-mutes, it has been shown by M. Boucheron, have become deaf through affections of the ear, not through brain affections or malformation. He considers the deafness to be produced through compression of the acoustic nerve, the result of a vacuum occurring in the tympanic cavity, so that the tympanum is pressed in. The compression of the nerve results in degeneration, and, perhaps, destruction. Further, many young deaf mutes have difficulty in keeping their balance, frequent giddiness, &c., and M. Boucheron attributes this also to *otopiesis* (*i.e.*, ear-pressure), acting on the nerves of the semicircular canals of the ear, which are well known to be concerned in equilibration. On this theory, if the compression be relieved, the patient should benefit. M. Boucheron has verified this in several cases: he introduced a few bubbles of air into the tympanic cavity. Deaf-mute children that had been unable to walk, were enabled to walk normally, and both hearing and speech returned. Moreover, the tendency to times of excitement, utterance of hoarse cries, &c., often manifested by deaf-mutes, disappeared.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 81, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

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"HEDGING" IN SUNSPOTTERY—THE TRAPEZIUM OF θ^1 ORIONIS—AREA OF A SEGMENT OF A CIRCLE—PRIVATE MUNIFICENCE IN CONNECTION WITH REAL SCIENTIFIC WORK—AMATEUR OBSERVATIONS OF THE COMING TRANSIT OF VENUS—URANUS IN A 2 7-8in. TELESCOPE.

[19790.]—THERE is an operation in the sporting world familiarly known among betting men as "hedging," and I should like to invite especial attention to the artful way in which a cognate course of proceeding is being adopted by the gentlemen who believe (or make believe they believe) in Sunspottery. We have been told, over and over again, on the highest authority (among the Sunspot gentry), that increased solar activity, as manifested by the appearance of numerous spots, faculæ and prominences, is always accompanied by a marked and notable increase of terrestrial heat, and that the temperature in years of few sunspots is below the average. It is then rather amusing to find a Mr. Archibald writing in the official organ of the Sunspot party, that a table of certain Indian meteorological details "most decidedly favours the hypothesis Prof. Hill and myself have all along regarded as the best working hypothesis—viz., that the Sun radiates *most* heat to the earth in the years of *fewest* spots" (!) This is highly instructive. One famous Heliostigmatist—say Smith—asserts that increased solar activity means increased terrestrial heat; another, quite as famous—call him Jones—states with equal confidence that such increase of heat occurs coincidently with solar quiescence. Observe the use which can, and will, be made of the public expression of two such diametrically opposite opinions. Should the present year (in which, as is well known, we are close upon a maximum period) prove an abnormally dry and hot one; we shall have certain persons proclaiming it upon the house-tops with the addendum—"This affords a striking and most appreciable corroboration of the views so consistently maintained by Smith." On the other hand, should it turn out a particularly cold one, then will our attention be pointedly called to "the exact accordance between the observed meteorological conditions, and those following from the adoption of the theory of Jones." All this is irresistibly suggestive of the prophecy in the *Weather Almanack*, "It will be wet on the 27th, unless it is fine, in which case it will not rain." It is, however, rather difficult to imagine whom it is intended to delude by so very transparent an artifice as this.

Apropos of the Trapezium of θ^1 Orionis (letter 19760, Vol XXXIV. p. 592), it may not be without interest to note that while, at the beginning of the season I found the 5th Star by no means an easy object: it has apparently brightened considerably during the last few weeks. I am convinced that trustworthy photometrical observations would show this Star to be variable.

I have repeatedly said, in these columns, that I will not do sums. Inasmuch, however, as a full answer to query 46204 (Vol. XXXIV., p. 603) involves the exhibition of some rather interesting principles, I will reply to it somewhat in detail, even if such reply does involve a certain amount of calculation. The most obvious way of attaining the result sought by Mr. Pendrill is then evidently to find, in the first place, the area of his whole circle, and to deduct from this the area of the segment of the smaller arc of 114° 15′. We, therefore, begin with the circle. And here we say: rad.$^2 \times \pi =$ area—i.e., $24{\cdot}375^2$ft. × 3·1415927 = 1866·518 square feet, the area of the whole circle. Our next proceeding is to ascertain the area of the sector, whose angle is 114° 15′. This we do by the proportion 360° : 114° 15′ : : 1866·548 : (what we shall find to be) 592·3697ft. From the area of this sector, however, we must evidently subtract that of the triangle formed by the two radii and the chord of (equal to twice the sine of half) the arc. Assuming that, as a matter of course, your correspondent knows how to compute the area of this triangle, it may suffice to say here that it is 270·858 square feet. Then 592·3697 − 270·8580 = 321·5117, the area of the segment whose angle is 114° 15′. Finally, taking this from the area of the whole circle thus: 1866·548 − 321·512, we get 1545·036 square feet as the area of the segment whose arc contains 245° 45′ in a circle whose radius is 24ft. 4½in. This seems a very operose piece of work, but I know of no way of simplifying it for the purpose of practical calculation.

The first paragraph of your "Scientific News," on p. 610 of Vol. XXXIV., is both interesting and instructive, illustrating as it does the facility which exists for obtaining money for any absolutely defined and legitimate scientific purpose. Our American cousins have set us a noble example in this way; nor do British colonists seem much behind them in munificence, when they are assured on such unimpeachable authority as that of the Astronomer Royal at the Cape, that their money will be devoted to the real advancement of Astronomical knowledge. In curious contrast to this is the fact that a "Committee of Solar Physics" had to be secretly and surreptitiously established at Brompton, and subsidised from the National Exchequer for many months before the general public could hear one syllable of the matter. The reason for this, however, is not far to seek: the fact being that no Scientific man, competent to judge, could or would subscribe five shillings towards the sustenance of such a contemptible little sham; and so the money had to be got out of Government officials, who were in sublime ignorance of the purpose to which it was to be devoted. But for the way in which the "Solar Physics" juggle has been exposed, it is an insult to common-sense to believe that a subject of such (alleged) enormous importance would not long ago have been investigated at the cost of men to whose princely donations to science (anonymous and avowed) it owes so much of its recent rapid progress in this country. Once show Englishmen that "endowment" is intended to forward the study of legitimate science, and is not being artfully worked merely to obtain a genteel form of outdoor relief, and I will answer for my fellow countrymen that their money will be forthcoming as freely as that of any English-speaking race on either side of the Atlantic.

All that "E. J. B." (query 46229, Vol. XXX., p. 626), or anyone else, can do on the 6th of next December is to observe, with all conceivable accuracy, the instants of the external and internal contacts of Venus at the time of her entrance on to the Sun's disc. External contact, as my querist doubtless knows well, is the appulse of the planet's preceding limb to that of the Sun. Internal contact that of her following limb (after she has begun to cross the Solar disc) with the Solar limb. For such observations to possess any scientific value, it is imperatively necessary that your correspondent should, imprimis, possess a telescope of at least 4in. aperture; and, secondly, a clock beating seconds, rigidly regulated to Sidereal or local Mean Time. I assume of course, too, that his latitude and longitude are both accurately known. Any observations, however accurate, must be valueless until the discussion and reduction of those made at other stations, as it is by taking into account the difference of times at which Venus apparently enters on to the Sun's disc, as viewed from stations widely separated in longitude, that the parallax will be mainly determined. It will be only some 4 minutes to 2 on the afternoon of the 6th that external contact at ingress will occur, and the Sun sets at 3h. 50m., so that comparatively little of the Transit will be observable under at all favourable circumstances in this country.

Certainly "Aidris" (query 46257, p. 626, Vol. XXXIV.), can find Uranus easily with a 2⅞in. telescope. A power of 220 would raise quite a perceptible blue disc upon Uranus, rendering him instantly distinguishable from any fixed stars in his immediate neighbourhood. His diameter at present subtends an angle of 4″, and that of Saturn one of about 16″, so that the diameter of Uranus would seem to be only one-fourth that of Saturn, and his superficial area only one-sixteenth of that of the former planet.

A Fellow of the Royal Astronomical Society.

DOUBLE STARS—P XXIII. 100—β DELPHINI—TRAPEZIUM OF ORION.

[19791.]—REFERRING to Mr. Hunt's communication with regard to P XXIII. 100 (letter 19299, page 133), I may say that I have measured the close companion to A on four nights, twice with 18·5in., and twice with 15·5in. At the time of writing the article quoted by Mr. Hunt, I had only observed it once, and, it may be, rather underrated the difficulty of this pair in stating that it could possibly be seen with an 8in. aperture. I am inclined to think now that it would be too severe a test for such an instrument, unless in a very favoured locality, and under the best atmospheric conditions; but there is no doubt that any good 10in. or 12in. refractor will show it properly under suitable conditions. This star belongs to a distinct class of doubles, not found in "Mensuræ Micrometricæ" at all, for the detection of which a telescope of first-class defining power is indispensable. A poor, or only moderately good, instrument in this respect will fail, however large it may be, to discover or even measure the more difficult examples of this class of unequal and close pairs. My own catalogues will furnish a large number of discoveries of this kind, many of them much more difficult than OΣ 496. It is not improbable that these excessively unequal pairs may furnish a distinct order of binary systems. The mean of the four measures of AB gives 1·37″, and the magnitude of the smaller component 10·9. The other pair, CD, I have measured on six nights in 1880-81, giving for the distance 1·43″, the distance between the two pairs being by the same series of measures, 75·75″. The faint stars in the field have no special interest other than as tests for small apertures, as they have evidently no connection with the brighter members.

With regard to β Delphini, M. Gaudibert (letter 19280, page 112) could not have seen the real elongation in the direction of 45°. During the past season, I measured this pair on five nights, the mean giving a positive angle of 14·92°. It is still a very difficult object, much more difficult now than I supposed when measuring it in 1880 it would be. The indications are, that it will be materially easier when available during the present season. An increase of one-tenth of a second in the distance will make it comparatively easy of measurement. It is hardly necessary to say that γ Andromedæ is now a very easy pair compared with this, and that the distance is much larger than the present distance of β Delphini. The last series of measures give the distance 0·26″, and I am certain these figures are not larger than the real distance. A correspondent of the *Astronomical Register* for June, 1881, in giving the provisional elements of the orbit, erroneously applied a correction of 180° to my angles of 1879, probably based upon the fact of my having noted the star as single in 1878. It must be borne in mind that although examined a good many times during that year with the 18·5in., there were only two nights when it seemed worth while recording the negative results, and then a distance of something less than 0·2″ might easily have escaped notice, as the seeing at the time was not the best; and it by no means follows because no certain elongation could be detected at that time, that an occultation really occurred between 1876 and 1879. In fact, the subsequent measures show this could not have happened, though the distance was probably less than at any time since the close pair was discovered. There never need be any uncertainty about the quadrant in measuring this with a suitable aperture, as there is a decided difference in magnitude between the components. I trust we shall soon have sufficient data for, at least, an approximate orbit of this very rapid binary system.

Mr. Sadler's history of the alleged discoveries in the trapezium of Orion will be read with interest by all who are familiar with this stellar group. Whether or not it may be worth while for observers, who have already looked for these supposed stars, to waste any more time in that direction may be an open question; but it certainly was the duty of the astronomers who claim to have seen what larger and better instruments utterly fail to show, to follow up these stars, if they had any faith in their existence, and measure their distances and angles, instead of leaving that entirely a matter of guesswork. The announcement of these discoveries by that method of proceeding would have been either deferred a week or two or postponed altogether. The corroborating evidence by several observers in favour of the existence of these stars should receive little or no weight, when it is remembered that nearly all the discoveries of purely imaginary stars, from the first down to Polaris and ε Lyræ, have been confirmed in the most unqualified way by subsequent observers. Unfortunately, these observers at this point drop out of sight, and nothing more is heard, so far as new observations and measures are concerned, of things so easily seen at the outset.

Chicago, February 22. **S. W. Burnham.**

TO MR. BRASHEAR.

[19792.]—WE are very much obliged to Mr. Brashear for his very interesting letter on plane-making; some points are especially interesting.

I edge my planes by screwing a plate of sheet-iron, well baked to make it tough and soft, on a long cast-iron bar, L-shaped, into the tool-holder of a slide-rest lathe, bending the iron over to suit the position of plane to be ground. The lathe is run at a quick speed, and fed with fine emery and water. In the absence of the slide-rest, the iron plate can be fixed to a joint on bed of lathe, and raised by a screw from underneath; but the slide-rest is by far the best. **G. Calver.**

WEBB'S MAP OF THE MOON.

[19793.]—Your astronomical readers will be gratified to learn that Messrs. Longmans have at last determined to confer a great boon on them by publishing, separately, the map of the moon, in Webb's "Celestial Objects."

More Light.

CLIMATE FOR ASTRONOMICAL OBSERVATION.

[19794.]—The Rev. J. J. M. Perry, in his letter 19680, p. 516, asked your correspondents to give him particulars of the nights on which observations could be made that he might compare them with his own.

I cannot give them for the year, but the last three months may afford him a comparison during the same period. My notes are as follows:—

December.—Nine clear nights, two partially clear, and twenty overcast.

January.—Nine clear nights, two partially clear, and twenty overcast.

February.—Nine clear nights, three partially clear, and sixteen overcast.

I cannot speak very positively as to the condition of the air on the nights on which I opened the telescope. December was, on the whole, fair, with one or two good nights. The same applies to January, with one bad night. In February, I have two fair and one bad night.

Fordingbridge. **T. Westlake.**

OBJECT-GLASSES AND EYEPIECES—TO "ORDERIC VITAL" AND OTHERS.

[19795.]—Those who are able to follow the contributions of "Orderic Vital," and others of your optical correspondents, will doubtless appreciate to the full their value as mathematical investigations, while even to others they will be found to contain many practical hints. May I, then, ask for certain particulars which are only indirectly touched upon, but which will I think prove useful to many of us if put into a simple form. Let us take an achromatic object-glass of, say, 5ft. focus and 4in. diameter, and combine with it an eyepiece of 1in. focus. Then, when adjusted for astronomical observation, we measure in the usual way the light-spot at eyepiece and find it (as the telescope would magnify 60 times) to be 4-60th in. = 1-15th in. diameter. But as a lens of an inch focus magnifies (at a standard distance of 10in.) ten times, it would follow that the o.g. alone would magnify six times, and that therefore the diameter of the light-spot at focus when the eyepiece is removed would be 4-6in. = $\frac{2}{3}$in. If tried, however, the size of light-spot differs considerably from such determination. What, then, determines the diameter of the focal light-spot in any given object-glass? Next, as regards eyepieces. The usual form of the Huyghenian is that with two plano-convex lenses; but if it were desired to employ two crossed lenses, of which the radii are as 6 to 1, how should the radii be determined in order that the combination may have any desired focus? Also, would the chromatic or spherical aberrations be increased or diminished as compared with the ordinary form. Lastly, if a single lens be used for an eyepiece, would it be advantageous to use a periscopic lens instead of a bi-convex or bi-concave; and, if so, what proportion should the radii bear to one another to obtain the best effect? Also, how can the radii be determined to procure a lens of any required focus.

I should, perhaps, also remark that in testing the focus of a lens or eyepiece, we use parallel rays, whereas, when used in a telescope, the rays that fall on it from the object-glass are convergent, and it would thus seem that to divide the focal length of the one by the other should only give an approximation to the truth.

Certain other considerations, which are of more difficulty, I must let stand over, or my letter will be too long. **Lens.**

TRICYCLES—SCREW-PROPELLERS.

[19796.]—No, "Sunlight"; I have tried sundry dodges anent sloping the seat at will, but didn't find them answer. I used to have the seat slightly tilted forward, like the driving-seat of a coach, and found it work very well; but a moving seat is uncomfortable and shaky. The fear of the Salvo type of machine tilting back is purely imaginary. As I have said before, the balance of the weight is a mere matter of adjustment, and as much or as little weight can be put on the steerer as the owner thinks fit.

Could not "White Swallow" give us a sketch, or at least, a rather more lucid exposition, of his new propeller? The more he describes it, the more he puzzles the reader to make him out. His paddles, or whatever they are, revolve, and describe a circle half in and half out of the water, entering and leaving the water perpendicularly. What can it be but a feathering paddle-wheel? And yet it isn't, but has direct thrust. Our curiosity is whetted, and not gratified. **Treadle.**

SCREW-PROPELLERS.

[19797.]—The discussion on the above subject has, very naturally, drifted from an inclined propeller fitted to a twin-boat, to ordinary screw-propellers fitted to sea-going ships. The subject is a very interesting one, and if any of your readers can so improve the efficiency of the screw or other propeller as to get a quarter of a knot an hour more than at present, they will find those interested neither confined to a certain groove, nor so wedded to the screw as to think that its principle cannot be bettered.

The late Mr. Froude found that the ship received in propulsive effect, by means of the screw propeller, only about 30 to 35 per cent. of the engine-power exerted. Let us, therefore, examine some of the sources of loss.

The water, following a vessel in motion, is found to do so at varying velocities. At the water-line, close behind the rudder, it generally travels as fast as the ship, and at the level of the keel it does not follow the vessel at all. The intermediate heights between these two extremes vary between zero and the speed of the vessel. But these currents are not horizontal, for they are partially broken up by the currents rising upwards under the buttock lines of the ship.

The water following the ship, at or near the water-line, cannot be interfered with without loss. The screw, however, in its usual place, acts forcibly upon all these currents: it breaks up and interferes, detrimentally, with the following water at the water-line, and it acts beneficially on the lower currents. The intermediate currents are not at all economically dealt with. If I treat the propeller blades as revolving as the hands of a clock, I may say at 12 o'clock it is absolutely doing mischief, and is quite in the way; at 3 o'clock it may be meeting the upward rush of water edgwise to the blade; at 6 o'clock it is doing its best, and at 9 o'clock it may receive the upward rush of water on the back of the blade, and thereby receive as much backward thrust from the water as it is able to obtain upon its driving face. This is the reason why propellers are much more efficient when placed further aft, and not in the conflicting currents.

Now, if the above reasoning is sound, it follows as a matter of course, that a simple sculling action would be more efficient than the screw. The scull should not be vertical,, but *square to the buttock lines*. The fulcrum of the scull should be near the water line; conveniently above it for renewal or repair, while at sea, and, of course, at the stern. The scull should oscillate through a distance of from 60° to 90°. The effect would be that the driving face of the blade would act very nearly in accordance with the varying currents mentioned above. The least effect would be at the surface, as it would be near the fulcrum, and the greatest at its outer end: in fact it should be designed to suit the shape of the vessel.

In case of the scull breaking in a heavy sea, it could be unshipped and another fitted in its place, and there would be no stuffing-box under water to give trouble, as with the screw. In case of the rudder being disabled, the scull can be used for steering, by stopping the engine for a few seconds when the scull is at port or starboard, and also if the ship is under sail only.

I have given a great deal of thought to the palpable defects of the screw-propeller, and also to the efficiency of sculling as a probable future propeller for steam-vessels, and I think the scull deserves a full trial. **Thomas Moy,**

37, Farringdon-street, March 3.

ON THE PRODUCTION OF CURVED FORMS BY MEANS OF A LINK ATTACHMENT TO THE SLIDE-REST.

[19798.]—When it is required to produce a surface of irregular or varying curvature, a template cut to the desired form is the means generally employed; but when a surface of regular curvature is needed, there seems no practical reason, why the motion of the cutting-tool, should not be controlled by a link attachment to the slide-rest.

It is not difficult to devise an arrangement of three bars, which shall give a circular motion. I remember reading a description of such an apparatus, which I think was called Anderson's circular attachment. But three bars can also be made to give an elliptical motion. Take two slotted bars A D and B C of equal length, and pivot them at the extremities, C, D, of a shorter bar C D. In a plate, attached to the under side of the longitudinal slide, fasten two steel studs, A and B, at a known distance apart, having extremities which will move easily but accurately in the slots of the bars. A suitable bolt, with a clamping nut, must be passed through the intersection of the bars, and its lower extremity turn in a hole in a rigid piece, which lengthens the tool-box slide. By means of the nut E clamp the bars at any angle A E B: then the simultaneous movement of the carriage on the long slide, and of the slotted bars about the fixed studs A, B, will cause the cutting point to describe the arc of a circle, of the same radius as that which passes through the three points A, E, B. To find the radius of this circle, or to fix the apparatus to describe a given radius, move it until the point E is equally distant from the centres of the studs A B. To find the radius described, carefully measure the distance apart of the centres of the studs A B; call half this distance b. Next, measure one of the distances A E or E B, and call this a; then, if r be the radius, it is given by the formula, $r = a^2 / 2 \sqrt{a^2 - b^2}$. Or, if it be required to set the bars to a given radius, we have, $a = \sqrt{2r(r \pm \sqrt{r^2 - b^2})}$. And the point E, that is, the centre of the bolt, must be at this distance from each of the points A B.

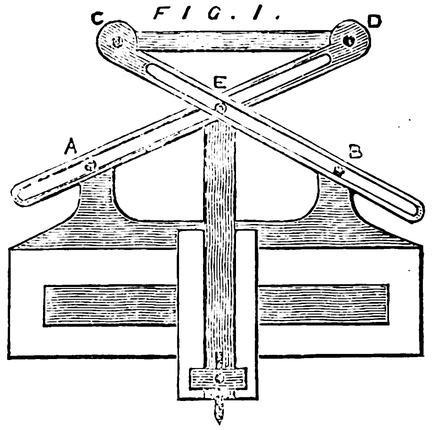


FIG. 1.

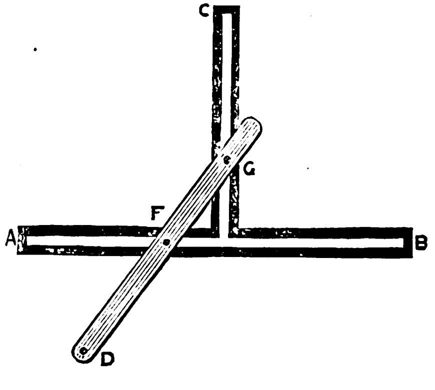
By a slight alteration, the same apparatus will give an elliptical motion. Instead of the bars being free to move about the fixed points, pivot them at the points A and B, and release the clamping-nut E. Then, if the bolt be free to follow the point of intersection of the bars, when they are moved about A B as fixed, and C D as movable, centres, it will describe an elliptical curve, whose major axis is A D or B C, and the distance between the foci A B or C D.

There is another way of describing an ellipse, which is perhaps more convenient than the above. Take a T square A B C, having channels or slots cut down each arm. D E is a movable lever, into which two pins F and G are inserted. When the pins are made to move, one in the vertical and the other in the horizontal channel, the extremity D will describe a portion of an ellipse.

In the position shown in the figure, it will describe the flatter portion of the ellipse; but if the bar be reversed, so that F moves vertically and G horizontally, the more curved part will be traced. The proportions of the ellipse will depend upon the adjustment of the pins F and G with regard to the extremity D. D F is half the shorter axis, and D G half the longer or transverse axis.

I am not aware that the parabola and hyperbola can be traced by any simple arrangement of levers similar to the above. Perhaps someone will tell us whether the usual lever and string movement can be obtained in any other simple way.

FIG. 2.



Apart from the consideration of this subject with regard to the lathe, can any of our practical opticians tell us whether any of the above or simila devices could be utilised in the production of lenses or specula? If a small polisher had its motion controlled by an apparatus similar to Fig. 2, of course, properly arranged, would not its *pressure*, and therefore its effect, be so regulated as to tend to the production of an elliptical surface?

With regard to Mr. Brashear's interesting letter, could not he persuade Dr. Hastings to contribute to these pages? He is, I presume, an amateur; and one of the very few who can use theory as a guide to practice. After the clever performance that Mr. Brashear speaks of, a few letters from such a master would be highly valuable to a large circle of readers. **Orderic Vital.**

DYNAMO-ELECTRIC GENERATORS.

[19799.]—"Quæstor" (letter 19773), implores someone to come forward to keep up the interest on this subject; therefore, though I may not be able to say much of value, I will contribute my little bit.

I cannot understand why it should subside just when one would expect it to be at its maximum. Mr. Caplatzi alone offers to give us an article, and I hope he will do so.

I have been studying and experimenting on the principles of dynamic generators for some time past, and it occurs to me very forcibly, in reviewing the present machines, that inventors have only troubled to produce something *different* from other machines, without inquiring whether their idea was *better* than those of others. Truly some have improved the very imperfect forms already existing; but it is impossible to make a perfect machine of one which is founded on erroneous principles, however it may be improved. Surely it were wiser to rake out the defects of the present machines, and then to devise one in which the said defects (or most of them) shall not exist.

In the Brush machine the armature is in the worst position to utilise the inductive power of the field-magnets, and it is impossible to place it in a better one, owing to the peculiarity of its construction. Also in all Brush machines I have examined, the various pairs of bobbins in revolving do not approach or recede from the poles of the field-magnets during more than a quarter of the revolution, and consequently it is only during this space that they contribute anything to the current. All the annular armature machines have this defect. Lastly, there is the great heating occasioned by the rapid reversions of the magnetism in the iron of the armature.

I have designed a machine in which all the defects I have mentioned, and one or two more are eliminated, and, the editor being willing, I shall be happy to send a brief description and diagram of it. **Conrad.**

[Please send.—Ed.]

MEDICAL REPLIES.

[19800.]—Troublesome Throat and Teasing Cough (46243).—I have seen scores of such cases permanently relieved by excising about a quarter of an inch from the end of the uvula. Of course this operation should not be performed without skilled opinion as to the case being really one to be benefited by it.

Rheumatism (46249).—If the daughter's joints or heart are not injured by the rheumatic fevers she may get quite well. To do that she should live in a dry, genial place, clothe herself carefully with flannel, live largely upon vegetable food, take regular exercise, avoid beer, wine and spirits, go to bed early. Of course she must avoid hot and crowded rooms, and attend in all points to the re-establishment of her general health, and the avoidance of causes which produce chill.

Enlarged Tonsils (46281).—If the enlargement is considerable a portion of it should be excised. Enlargement of the tonsils generally deteriorates the voice, but singing does not make the enlarged tonsil worse, unless it leads to getting the system poisoned by the bad air of crowded concert-rooms.

James Edmunds, M.D., &c.

Grafton-street, Bond-street.

WATCHES.

[19801.]—Would you kindly insert following queries? I think they will be of interest to many English mechanics, who like to have a good watch.

What is the difference between a pocket chronometer and an ordinary watch of good quality? Does the difference simply consist in the former being isochronised and adjusted for temperature and positions, or is there some specific difference in construction, as, *e.g.*, the chronometer escapement and cylindrical hair-spring?

What is the average rate of a pocket chronometer—*i.e.*, supposing it to go with perfect regularity, how much would it deviate from true time in, say, a week?

I understand such watches have no regulator, and therefore must be allowed to go as set by maker.

What would be its greatest probable variation from above rate in, say, a day? It is supposed to be treated in the most favourable manner—*i.e.*, it is kept perfectly stationary, and as nearly as possible at a uniform temperature.

What would be the effect of wearing it, and treating it as watches usually are treated—*i.e.*, with ordinary care, but with no extraordinary precaution?

Answer with reference to a good "English lever."

Are pocket chronometers made with a going barrel instead of a fusee, and if so, will they compare with these having a fusee?

Kindly give some idea (not an account) of the principles adopted in isochronising and adjusting for temperature and positions.

I am induced to ask the above questions because I hear so much of what I consider nonsense talked by watch-owners; and I should like to know definitely what an ordinary watch of good quality might be expected to do, and also what can be done by one of the very best. **Watch-Man.**

CONTINUOUS BRAKES.

[19802.]—"A Driver" (letter 19788) will find an answer in my reply to 46261, which appears elsewhere. I should be glad to know the action of the Gresham brake, said to be the best in late trials, but contradicted by the Derby officials as a mistake of the printer.

Enderby. **W. B. Holbech.**

A CHEAP AND EFFICIENT DOUBLE DARK SLIDE.

[19803.]—Doubtless there are many readers of the English Mechanic possessing cameras who would like to increase their stock of dark slides, but are debarred from doing so on account of the cost entailed in their purchase—the price of a double back ranging from 15s. to 50s. each. Seeing several queries of late upon the subject, I have been induced to send a description of a double dark slide I have recently made to take 7¼ × 4½ plates, at a cost of less than 6d. each.

I am indebted to a writer in one of the photo. almanacs for the design. The wood I used consists of the thin boards placed as a backing to pictures. They are about 4ft. 6in. long by 11in. wide, and 3-32in. thick, and should be procured as free from knots as possible. I gave 3d. each for mine. They will have to be sandpapered until a smooth surface is obtained. Cut two pieces the size the slide is intended to be to fit the camera, and out of these two pieces cut openings slightly smaller than the size of plate used, say, ⅛in. each way (A). Glue three strips of wood on the face of one of these pieces round three of its sides (B, Fig. 1), and then fasten another of the pieces of wood, with the opening, over all; this will be the groove for the shutter to work in. Four more strips of wood are now to be glued on to the face of this last piece, forming a rebate to contain the sensitive plate (C, Fig. 2), it should be slightly larger each way than the plate. This will complete one-half of the double back; the other is made in exactly the same manner, and the two halves are neatly hinged together.

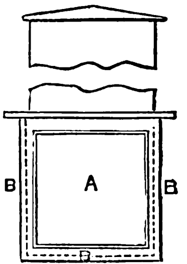


FIG. 1.

FIG. 3.

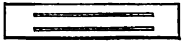
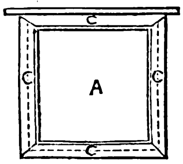


FIG. 2.



The top consists of a piece of wood about ¼in. thick, slightly longer than the body of the slide. It has two slits cut down its length for the shutters to pass through, Fig. 3, and care must be taken in fixing the top that these slits correspond with the openings in the slide. I have screwed this top piece on to one half of the slide, leaving the other half free to open. When the plates are in position the two halves are kept together by closing them and inserting the shutters.

I use the same wood for the shutters, and give it an extra sand-papering to make it work easily in the grooves. Two narrow strips of wood are glued each side of the top of the shutter, which is made to project above the top rail. The parts which enter the camera, as also the inner face of the shutters, should be stained black, and some opaque material interposed between the sensitive plates.

Care should be taken that the plates occupy the same position as the focussing screen. This should be accurately measured from the front of the camera. With regard to tools, I find a penknife answer every purpose, and in cutting the wood something should be used as a guide to the knife. The most difficult and tedious operation is cutting the slits in the top rail for the shutters. A small circular saw would be invaluable for this work.

I trust I have made my description clear, and should anyone feel inclined to make a dark slide, and be in doubt upon any point, I shall be pleased to help them through the query columns.

I have given few dimensions, as these must necessarily vary in each individual case.

J. B. Stephen.

PLANING AND MILLING ATTACHMENT TO LATHE.

[19804.]—With regard to what Fred Carre says, letter 19749, about not having a vertical feed on my milling arrangement, I never found the want of it, or I would have contrived one. The work can be set to any height by means of the vertical slots in the angle chuck, and the horizontal traversing motion and feed is all that is required for slot-drilling, with a proper-sized drill. And such work as drilling the recess for the screw of an eccentric chuck, or the radial slots in an ellipse or dome-chuck, could not be done under the planer head, as you could not commence the cut with a planing-tool close to the end of the slot, as the heel of the tool would be in the way. Of course, in drilling slots, it is necessary to have a couple of fluting-stops on the slide-rest. With respect also to what Fred Carre states about the strain being unduly severe in planing on the bottom slide of rest, I never found it so, and practice is better than theory. My metal-turning slide-rest is very massive, and the traversing screw is a square-threaded one, ¾in. diameter. Of course I have a separate slide-rest fitted for ornamental turning, as no one could use one which had done much heavy work for such a purpose—an ornamental rest requiring to be absolutely free from backlash in its screws. Also regarding what he says about the small range of thickness which can be admitted under the planer head: he must recollect that I had it made for amateurs' use, and not for a jobbing engineer's shop, and mine takes in a range of thickness of 7½in., which I have found quite sufficient for my wants. **F. W. G.**

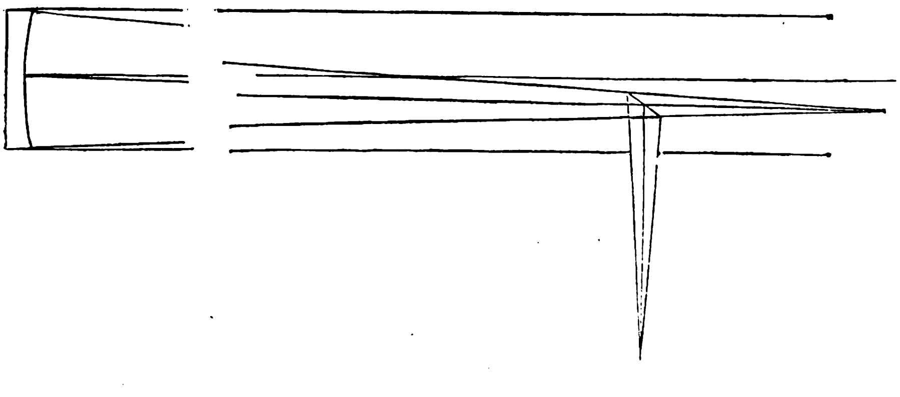
ADJUSTMENT OF MIRRORS.

[19805.]—I have read with much interest the valuable communications of Mr. Skelton, and of Mr. Westlake, on the refinement of the adjustments of reflecting telescopes, and as, in my opinion, there still remains an outstanding uncorrected imperfection in these adjustments, I wish to draw the attention of those gentlemen to this source of error, in the hope that they and the many other interested readers of the "E. M." may ponder on, and at length overcome, all the difficulties in the attainment of absolutely perfect adjustment.

It is my purpose to show that all the perfection of concentricity of mirror and flat, together with reflection of flat, and also the condition of perpendicularity of eyepiece with axis of tube, may exist, and yet the instrument be glaringly out of gear; but to render this clear I shall have to resort to a figure.

Let us suppose the mirror tilted in its cell, so that the focus will not coincide with the axis of the tube; let us place the flat so as to intercept the rays from the mirror, but on one side of the axis of tube. Now, by the usual adjustments, with all the refinement of the methods recently suggested, the flat mirror and reflection of flat can be adjusted into concentric circles with the e.p. tube, the flat being still in a line with the e.p. tube; there is nothing in this condition of reflection, however, to indicate that the flat is, or is not, in the centre of tube, nor that the mirror lies in its cell in such a manner that the axial ray will or will not return on itself; in other words, the focus of mirror will or will not fall in the axis of the tube. In short, the only difference which the condition indicated in the diagram will show on trial by the usual method is, that the flat, instead of appearing as a circle, will appear as an ellipse, either elongated in the direction of the axis of the tube or laterally, as the flat may be situated on the further or nearer side of the axis, the angle of incidence of the central ray on flat being either less or greater than a right angle; yet this difference in the appearance of flat, as viewed from the adjusting piece, will not be great enough to impress the observer, and consequently could not be readily detected. I do not deem it necessary to occupy valuable space to prove the possibility of concentricity of circles projected by mirror, flat, reflection, and inner end of e.p. tube. It can be proved both geometrically and experimentally. Of course, the irregularity in the adjustments above referred to, and indicated in the diagram, are such as deviate from the axial line only in the line of the eye-tube; a deviation laterally would be at once detected by ordinary means.

It is evident, therefore, that complete adjustment cannot be attained by merely securing extreme accuracy in the relative positions of e.p. flat and m. only to effect concentricity of reflections, and that it is essential to devise a method of ascertaining whether the focus of mirror lies in the axis of tube, no method that I am aware of having been devised that can at all compare with the ingenuity of methods devised to attain accuracy in the other adjustmentst. The one adjustment having been perfected, it is an easier matter to make the other adjustments. I therefore insist that it is of the first importance to know that the mirror is so placed that the axial ray will fall perpendicularly on the mirror, and am confident that an exact accomplishment of this will remove more than one half of the difficulties in the way of obtaining the best possible definition. An error introduced in this first setting must be transmitted through all the adjustments, and no degree of refinement and perfection lavished on the flat and central spot can remove the first error. The only method of ascertaining the position of mirror with regard to the axis of tube that I know of is to remove e.p. and observe the reflection of the end of telescope-tube, viewing the projection not from the centre of opening of e.p. tube, but by running the eye around the sides of the opening, and thus observing whether the tube projects equally all round. However, this is at best only a crude, indelicate test, and is, moreover, effected by the position of the flat as the projection is after all viewed from the flat. A slight change in the position of flat will cause a larger projection of the tube on one than on the other side.



I hope that some of your working correspondents will devote a little of their time to this subject, and work out a way to adjust the mirror to the axis of the telescope equally as perfect as the methods of adjustment of other parts of the instrument.

Wm. A. Haren.

St. Louis, Missouri, U.S.A.

ORNAMENTAL TURNING.

[19806.]—The thanks of all lovers of the lathe are due to Mr. J. H. Evans, for his kindness in communicating so much valuable information to our journal; and his willingness to do what he does so ably causes one to be somewhat reluctant to criticise adversely anything which he offers for our consideration. I hope, therefore, he will consider that I write in no unfriendly spirit when I plead generally for the production in ornamental turning of more artistic excellency of design than we usually see, and at the same time make some special reference to his design on page 605. With regard to this, and other similar designs which have from time to time appeared in our pages, I would remark that one looks in vain for simplicity and beauty of outline, as well as for artistic arrangement of the details of ornamentation. The circular form being the one naturally and most easily produced in the lathe, the turner is apt to fall back upon the circle as his chief item of ornamentation, and hence we find, in the general run of ornamental lathe-work, such a wearying repetition of circles and segments of circles. Nature (the imitation of which constitutes the perfection of art) rarely exhibits to us a circle or a circular curve, but generally parabolas, ovals, &c.; and in all good designs the circle, although sometimes freely used, is kept in due subordination to other forms. To do this in ornamental lathe-work requires no little amount of skill, and can only be accomplished by those who possess an artistic eye as well as a skilful hand. The specimen of work figured on page 605 shows a total absence of unity of design, and is composed of several pieces placed one on the top of the other, apparently without any definite purpose. The central stem also appears to be far too slender to support that which is placed upon it. I do not say that it "is" too slender, but that it "appears" to be so, which in the present case is the chief consideration, as the specimen is intended to be put under a glass case, and to serve merely as an ornament. It is necessary, therefore, that the design should satisfy the *eye*, which (in my case at least) it entirely fails to do. With regard to the details of ornamentation, these consist almost entirely of circles and segments of circles, which are themselves suggestive of circles.

An examination of the sketch of Mr. Coulson's vase on page 208, Vol. XXXIV., will show how beauty of outline is combined with ornamentation, the various details of which are in perfect harmony with each other; the circle especially, though freely used, not being allowed to appear too conspicuously. The outline of the vase consists chiefly of a beautiful flowing curve, no part of which can be said to be circular. The leading feature in the design is the large ellipse (of which there are four), and which is darker in colour than the inner ellipse and circle, though not shown so in the woodcut. The innner ellipse, consisting of the space between the two fine lines, is inlaid with wood set grain-on-end, giving a rich appearance to the work not shown in the engraving. This ellipse is not concentric with the outer one, but is placed rather higher up, thus giving "character" to the design. The inner-circle is not quite so dark as in the engraving, and is kept in due subordination by the outer ellipse. The small interior circles are interlaced in forms suggestive of triangles and squares, thus preventing the eye from dwelling too exclusively on the circular form. The same end is accomplished in the case of the circles round the neck, by their being connected together by narrow horizontal bands. This part of the work is inlaid with rosewood and boxwood. The small circles in other parts of the work are neither so large or so numerous as to interfere with the general harmony of the design, to which they contribute their share, but nothing more. The vase, viewed as a whole, may be said to be as faultless in design as it certainly is in workmanship; and to the combination of these excellences Mr. Coulson doubtless owes his success as winner of the first prize. The engraving only gives, as might be expected, a poor idea of the vase, photographs of which can be obtained by application to Mr. Clark, photographer, Thirsk.

A Country Parson.

[19807.] In again thanking Mr. Holtzapffel, I need only to mention the data which are still wanting in order to enable his clients to use their screws intelligently, and to understand the boring out and screwing of their lathe-chucks. For this I offer no apology, as Mr. Holtzapffel has already assured us that his firm never make an enigma of anything, and that he would willingly answer my questions. Moreover, as we all know, not only does Mr. Holtzapffel really mean what he says, but he is always prepared to assist in diffusing scientific knowledge upon the use of the lathe.

1. No diameters for the screws at bottom of thread have been stated. Without these diameters we have no means of sizing the drills, by which the holes to be tapped should be bored out. Skilled mechanics may instinctively allow for the depth of the threads, but amateurs, who work rather by trained brains than by trained fingers, need to see in their screw-threads an intelligible and coherent system. Do the Holtzapffel gauges define this second set of diameters?

2. In using the shallow-thread screw-tools (60° instead of 50°) some third set of diameters must be arrived at either by the holes to be tapped being drilled larger or by the finished screws being made smaller. Do the Holtzapffel gauges define this third set of diameters? If not, should we drill the holes larger inside or make the screws smaller outside?

3. Are two sets of the alphabet tools kept in stock, one for the deep threads and one for the shallow threads? If, as I rather gather, alphabet tools of the shallow thread are not kept and the shallow thread is only used *exceptionally*, one would like to know more precisely *when* this thread should be used. I understand that with certain materials we should use the shallow-thread tools, and that, in such case, we ought properly to bore out our chuck with a drill rather larger than the ordinary lathe-bit.

4. Holtzapffel's Catalogue and Vol. IV. shows that five mandrels are issued: *i.e.*, the 4, 5, 6, and 7in. centres for ordinary lathes, and a 6in. centre-mandrel with "truncated angular-screw," for the screw-cutting lathe. In the latter, Mr. Charles Holtzapffel's programme for aliquot threads has already been adopted; but the mandrel-noses otherwise appear to be rated by the numbered screw-tools, and to be sized by a special set of gauges. May we have the screw-threads and the sizes, top and bottom of thread, for the Holtzapffel mandrels so that we may understand how to choose a lathe-head, and know how to size the drills for boring out our lathe-chucks?

Once more I cordially thank Mr. Holtzapffel on the part of the readers of the English Mechanic. I am sure that Mr. Holtzapffel will rejoice to see a spirit of inquiry arising as to ornamental lathe questions, and that he has no wish to abdicate the leadership in matters on which further scientific developments are to come.

James Edmunds, M.D.

Grafton-street, Bond-street.

COMBINED ECCENTRIC CUTTER AND DRILLING INSTRUMENT.

[19808.]—Anyone who has done any ornamental work in the lathe, in which he has had occasion to use both the eccentric cutter and drilling instrument for different parts of the same work, must have experienced the nuisance of having to take out one instrument from the slide-rest and substitute another, which has to be set for height and parallelism; and sometimes the slide-rest has to be unfastened and fixed again, nearer to, or further from, the work. I therefore wish to describe a tool which I can guarantee from experience to be very handy, and to do the work of both instruments equally well. I have one of my own in use for about 12 years, and have also made one for a friend, who was much pleased with it. I have never seen a similar one described in any of the books on the lathe. Fig. 1 represents a side view of the instrument, and Fig. 2 a front one. A is the tool-holder, which is brazed into the plate B, which plate has two cone-pointed hardened steel screws E E, Fig. 3, tapped through it, and which engage in two radial V-shaped slots F F, Fig. 4, in the face of the head; these slots are readily made by a properly-shaped drill in the drilling instrument, traversed horizontally in the slide-rest. Of course I have a separate, strongly-made, drilling instrument for work of this kind in metal. The plate, Fig. 3, is clamped to the head by two small screws C C, Fig. 2, which pass through two slots G G in the plate, and thus permit the tool-holder to be set eccentric. I have found 1in. eccentricity to be sufficient, giving a circle of 2in. The eccentricity is read off by a scale of 20ths of an inch, on the side of the plate, with a zero line on the head. The screw-points E F engaging in the slots F F keep the plate radially true, and are much simpler, and equally effective as chamfered guide-bars would be. The screws C C have nicely-squared heads, to fit a small steel spanner D, which has a screwdriver at the other end. The adjustments for eccentricity are very easily made, though some men who have the usual form of eccentric cutter, with the tool-holder moved by a leading-screw having a milled and divided head, may think this a very rude way of doing it; but even in their instruments the tool-holder requires to be clamped with a binding-screw after each adjustment, to guard against backlash of the leading-screw, which would be fatal to good work. I have tried both plans, and would just as soon have my own. Figs. 5 and 6 are views of the working parts of the head and stem. H, Figs. 1 and 5, is the pulley for gut band. The head is coned at I, Fig. 5, to fit the corresponding part of the stem, Fig. 6, for the purpose of taking up wear. The head is secured to the stem by the flat-headed screw K, Fig. 6, the head of which lies in the recess J, Fig. 5, and which has between it and the stem a steel washer L, Fig. 6, which has a square hole to fit accurately the squared end of the stem M, Fig. 6; this prevents the screw, K, tightening or loosening during use. N is a shallow groove turned in the bearing of the stem, and its use is to retain a supply of oil, which is put through the oilhole O, Figs. 1 and 5, which is stopped by a small screw to prevent the oil flying about. The square shank of the stem, Figs. 1 and 6, is fixed in the tool-holder of slide-rest. P, Figs. 1 and 2, is a set-screw, to secure the tool in tool-holder. The tools are readily made from pieces of steel rod. The receptacle for them in the tool-holder is slightly tapered, and I have a corresponding chuck which fits my lathe mandrel for turning them up in, but I have turned them by hand, before I made the chuck, in their place in the instrument, driving it from the overhead. One advantage which this instrument possesses over the ordinary drilling instrument, is that it does away with the necessity of having a number of step-drills of different sizes, for doing some of the ornamental work that Mr. Evans describes, as by having one small-sized flat-ended drill, the tool-holder can be set out to suit any sized step. The best material to make this instrument of is, of course, steel for the head and stem, hardened afterwards, and my own, which is thus made, is in good condition now after 12 years' use. But for those who do not understand hardening work of this kind, and who cannot get it done for them, I would say, make the stem of steel left soft, and the head of gunmetal. The washer, L, must be steel, and the tool-holder with its plate may be wrought iron. By not always placing the same square of shank upwards in the slide-rest, the wear will be more equally distributed. Two more hints I will give. In turning the stem be sure to drill and tap the hole for the screw K first—otherwise you will probably find the head of the screw out of truth. And grind in the head in its place with oilstone powder—not emery; for want of these precautions the work of two friends of mine who made the instrument for themselves, did not prove successful. I may say, in conclusion, that the drawings are not to scale.

F. W. G.

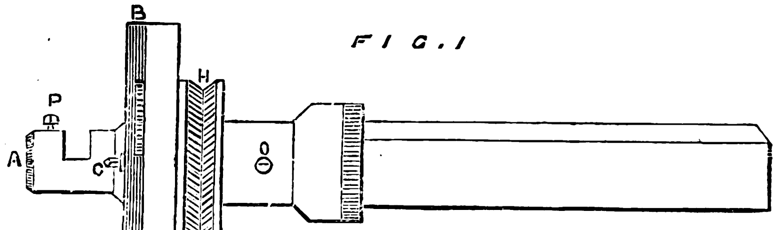


FIG. 1

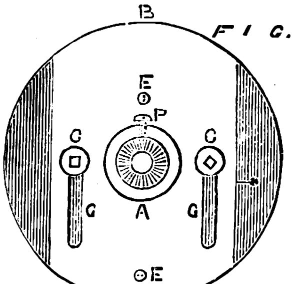


FIG. 2.

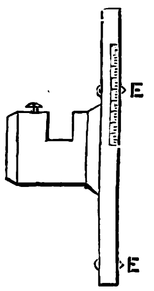


FIG. 3.

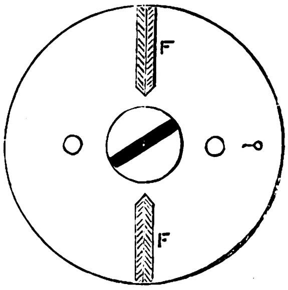


FIG. 4.

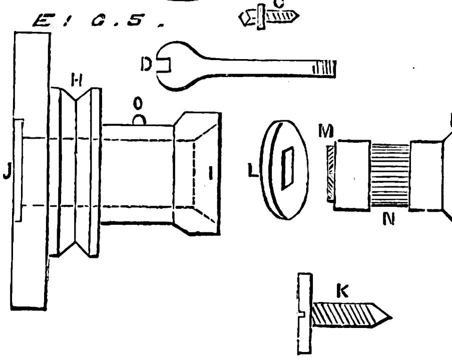


FIG. 5.

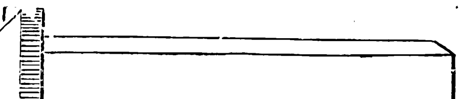


FIG. 6.

THE thirty-third annual report of the Prudential Assurance Company states the premiums on new business completed during the year 1881, in the Ordinary department, amounted to £31,603 4s. 8d., and in the Industrial department to £1,849,494 18s. 5d., the increase in the latter being the largest increase in the history of the Company. The claims paid in the Ordinary branch amounted to £69,677 17s. 1d., and in the industrial branch to £639,752 10s. 1d. The quinquennial report by Mr. A. H. Bailey, states that the general results of that gentleman's searching investigation "cannot but be most gratifying to all who are interested in the prosperity of the company."

M. PLANTE has found that the process of "forming" the lead plates of his secondary batteries is hastened by heating the whole cell during the charging to between 70 and 88° C.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[45392.]—**Manufacture of Soluble Cocoa.**—The description given by Mr. F. B. Cooke (p. 571) seems to apply to what is known as rock or navy cocoa, rather than to the true soluble preparations. Can anyone say how the pure powder cocoas are made, which are readily soluble in boiling water? Two well-known brands bear foreign names, but I believe they are prepared in England.—NUN. DOR.

[45516.]—**Hand-Thresher.**—Many thanks to "Was-heil" for his kind offer of assistance. The thresher is on ground floor; height from centre of drum to floor. I hope "Was-heil" will see his way to help me as nearly as possible in the way suggested, as my floor-space is rather small, and I have plenty of young lads willing to help. Could the attachment not be driven separately, the feed being so light? My own time is so limited, and when the "cleaning" is left to lads, I find a good deal of the grain finds its way into the straw.—D. A.

[45687.]—**Throttle-Valve.**—The two methods are in no respect identical, as, in the first place, I advise the use of metal for case, where you say, use brass. The question at issue is, that on page 549 you distinctly recommend the use of a "circular disc," and I object, and advise that the valve be of oval contour. Please to give us diagrams of the method of attaching "turning bosses" to the ends of an oval, and include the pattern of the "drill" which you say is used to "drill out a hole of flat section."—J. J. A., Liverpool.

[45774.]—**G.W.R. Engines.**—The date of the old 163, I know was 1862, but it is now one of a class numbered from 157 to 166, all of which were built at Swindon during 1879.—N. W., EALING.

[45774.—**G.W.R. Engines.**—In my reply on page 618, last Vol., in the fourth line from the bottom. For "L.C. & D. Co.," read, "purchased ....from the L.R. & D. Co." (Llanelly Railway and Dock Co.), &c.—R. N. H.

[45819.]—**G.W.R. Engines.**—The particulars "T. P." mentions are all of the 7ft. singles, but, since the insertion of my query I have ascertained the information I required. No. 2203 and 2204 are two four-coupled express engines, built at Swindon Works in October, 1881. Inside cylinders, diameter of leading-wheels, 4ft.; driving and trailing, 7ft.; outside bearings for leading; inside for coupled-wheels; no dome, cab; and are fitted with the Sanders vacuum brake. They work the 10.30 a.m. and 1.45 p.m. trains from Paddington alternately.—N. W., EALING.

[45864.]—**Universal Joints in Shafting.**—With the double Hooke joint, up to 140°, I believe. I fail to understand the part of the query about "increase of power"; the universal joint certainly gives no "increase." Yes, it can be done by means, preferably, of cup-and-ball universal joint tied together by one pin.—J. T. M.

[45876.]—**Science and the Civil Service.**—Several; but "Bramelia" must go in at the lower stage—it is always open to him to pass further exams. for higher posts when vacancies occur. He has merely to obtain the permission of his superior officer, and that is rarely refused.—SOMERSET HOUSE.

[45879.]—**Water-Wheel.**—To make use of 2,000 cubic feet per minute, fall 14in. This should be an undershot water-wheel with curved floats, 40 in number; the exterior diameter, 75in.; breadth, 60in.; floats, 11·25in. radial depth. Point of floats at periphery to be nearly angle 0°, with the centre of issuing stream of water passing over the sill and under the sluice. The remaining part of floats may be a portion of a circular curve, but preferably a parabola. The maximum height that the sluice should be lifted (vertically) above the sill is 3·75in. The revolutions of the wheel to be 12·725 per minute. The fluid stream issuing under the sluice should be directed at a tangent to the periphery of the wheel and in its line of motion. The velocity of the periphery should be 4·166ft. per second. The theoretical power of the water is 4·41 h.p., and the actual h.p. that may be developed in a properly-constructed wheel = ·60 theoretical = 2·646 h.p. As peculiar circumstances alter cases, the wheel may be made either of greater or lesser diameter, say from 3ft. to 12ft. The pitch of the floats in the periphery remaining the same, and the number in accordance with the variation in the diameter. A smaller wheel will not give so much useful effect, neither will a larger one, as it will be heavier and cause more friction in rotating upon its journals, besides being more costly. The floats may be No. 16 B.W.G. in thickness, and the wheels with four light plate-iron shrouds; the shaft 3·25in. diameter in the journals.—TUBAL-KAIN.

[45884.]—**Making Gas on a Small Scale.**—I think an apparatus, 3ft. long, 2ft. wide, and 3ft. high, divided into foot lengths, would be ample for a single light. It should be covered with lead-foil, which might be nailed down, the heads of the nails being covered afterwards with solder, to prevent the action of the acid on them. I am perfectly aware that benzoline air-gas does not produce an illuminating flame; but with the hydrogen, which is itself combustible, you only require sufficient carbon to give the illuminating flame. As Mr. Hezmalhalch observes, gasoline is the best for the purpose; but the difficulty of obtaining it in small quantities renders its use impracticable. The gasworks sell a sort of hydrocarbon (they call it carbon), which, when melted and gas passed through it, gives a most brilliant light, surpassing gasoline.—J. KENDALL.

[45885.] —**Yellow Wash for Funnel.** —Yellow-ochre, mixed with pale linseed-oil, and a liberal supply of varnish will do; but the heat will, no doubt, wear it off quick. The only thing is to repaint.—S. M.

[45907.]—**Automatic Musical Instruments.**—The suction principle is unquestionably the best for automatic instruments in which reeds are the sound-producers, and I think that Needham's invention was the first to be described in this country; but I have heard that, in the United States, a caveat had been previously filed in the patent office there by a person named Mc Tammany, and that in some recent suits he has proved his case as the original inventor of musical instruments of the orguinette type. The suction-bellows was, I imagine, unknown in this country, except in the familiar form of the accordion and concertina, until the introduction of the American organ.—GRAY'S INN.

[45943.]—**Pressure of Water.**—What I should require is a 1 horse-power motor to drive soda-water machine. Should I get any more power by using a larger supply-pipe than the makers advertise? And would the water passing through a loose valve stop-cock and meter check the pressure? or should the stop-cock be a straightway or sluice-cock? Also, should I get the 1 horse-power from the motor with a pressure of 36lb. to the square inch?—If "Labor Omnia Vincit" or "Sunlight" will kindly say, I should feel obliged.—WATER MOTOR.

[46007.]—**Turning Wooden Balls.**—If I were going to turn the balls in question I should begin as Wm. Owen has done, by using lengths of stuff. Having the wood properly fixed, first bore the hole say, 1in. up. The bit does not have so much, chance of "running" then. Turn down just where the centre of the first ball will be to the size required. Now mark off ⅜in. length, then take an ordinary turning chisel (not a bead tool, that is cause of the balls breaking off as you say). Now, if you want the balls very true, strike a quarter circle out of a piece of zinc, and use as a template. Apply the chisel, leading with the lower point of the level. Try the template occasionally, and you ought with beech to be able to go down to ¼in. dia. without any breaking off. If you can do them near enough without the template, don't use it. Expect to be foiled in the first few attempts; but when you have had a little practice you will turn out some smooth shiny round balls which will entirely satisfy you.—W. W. M.

[46061.]—**Model Engine.**—To "Sunlight."—The cylinder is of the beam-engine class. I want an externally-fired horizontal boiler. Will 3-16in. plates be thick enough for it?—Mechanic.

[46069.]—**Automatic Arrangement.**—I beg to suggest fitting up drum on vertical spindle (axis vertical); just a cylindrical tray or box in divisions. Projecting from lower side, at middle of each division, a pin or tooth-clack, to work a worm-screw, which said teeth take into. Say that worm revolves once every five minutes; then have three threads on it. At six o'clock set shaft carrying worm with that part of thread at which tooth leaves worm facing point of tooth (to make tooth take into worm right); turn box so that tooth at middle of first division is up to other end of worm and set a-going. Worm will keep middle of this division, under aperture, fifteen minutes, and then shift box at once to middle of next division: box to be shifted by a turn of cord round centre spindle (below box), and over a pulley with weight attached. The advantages of this plan would be, the partitions would pass aperture rapidly, and therefore insure greater accuracy. Divisions need not be all one size (the checks will likely come thicker at one period than another), and construction as simple. Put an extra half-thread on worm; it will be better than exactly three, and keep box same time in position. Would Mr. Lancaster kindly give his opinion of this plan?—S. W. M.

[46076.]—**Governors.**—I can quite indorse "Sunlight's" views about governors. My engine, a semi-portable, driving brick-machinery, was sent out with an old-style disc-tube, and a nice trouble it was. The nature of the work requires a very sensitive, quick-action regulator, as the load is continually varying as the pan is supplied with material. The engine-tenter could never leave his engine for five minutes, or it would start racing, tearing the belt to pieces, breaking gear, and playing the deuce generally, unless he was on hand to shut off steam by hand. I had an equilibrium valve put in and all was changed, the engine running as steadily as can be desired, and, if a belt runs off, or one of the machines put out of gear, never get up extra speed; though, for want of space, I only had a 4ft. fly-wheel to steady two 11in. cylinders, working at 75lb. pressure. The disc-tube seems to be unable to control an engine whose work is variable, and, when the load is steady, a governor is hardly needed at all.—Treadle.

[46082.]—**Driving Smith's Fan.**—Will J. Perry be kind enough to say when and where I can have ocular demonstration that a man can turn a 6in. fan at the rate of 3,000 revolutions per minute for any reasonable length of time, so as to get through the ordinary routine of a smith's shop? Then, in return for his kindness, I will show him how to make a perfect "weld" with a piece of hot to one of cold iron. Query: Can he weld a 4in. square cart-axle with either of his fans?—J. J. A., Liverpool.

[46083.]—**Tanah-Ampoh**—Is Kaolin, a soft, white earth, probably of organic formation. It is eaten by the Javanese, not as a delicacy, or even as a matter of course, but in emergency. The Malay word "perampohan," woman, is evidently a derivative.—R. B.

[46099.]—**Bronzing Brass.**—Take 1oz. crude flour-sulphur, ¼lb. of pearlash; mix well together, and place in an iron ladle, and put it over the fire, and keep stirring it until you get it well mixed and forms a reddish-brown mass; turn out upon some stone; when cold, pour about 3 pints of boiling soft water upon it, and when settled, pour off the clear for use. When your article is cleaned, dip until dark enough. They will not be dark by immediately dipping, but must be hung up for a time, and dipped again; but the articles must be thoroughly free from dirt or grease, and dipped into nitric acid before being dipped in the above. It is all a nosegay to use.—Jack of All Trades.

[46100.]—**Lever Escapement.**—You will find it difficult to alter the pallet-stones. You must put the escapement closer to the escape-wheel. You will find (if it is an English lever) that the holes are drilled out of the centre in a bush which is fitted in the plates; by shifting the position of these bushes you will be able to get the escapement nearer the escape-wheel. But I think you will find the following easier and less likely to deface the surface of the plates. Broach (or rimer) the holes larger, and file up a piece of brass wire to fit the holes you have made larger; now drill a hole out of the centre of the said brass wires; now fit the brass wires (which we will call bushes) into their holes, and put plates together with escape-wheel and escape, when, by turning the bushes, you will be able to adjust the escape to a nicety; by pressing the bushes against the shoulders of the escape, you will make it sufficiently tight so that it will keep its position while you try its depth, first one side and then the other. Now break off the bush (which has been previously cut the same as a bouchong), and place your plate with the inside of the bush resting on a riveting shake, take a round-head punch that will fit the old chamfer, and rivet the bush so that it shall not shift. This will leave your inside level with the plate, and your outside the same as before, with this exception—that the hole will not be in the centre of the chamfer. If the head of your punch is nice and smooth, your chamfer will be bright. You must not use any cutting tool for finishing, not even turkey stone. So sure as you do, you will spoil the surface of the gilded plates, and that is what you should always try and avoid. You must always bear in mind that escapements are made by practical and experienced men and good machinery, and you will hardly ever be able to better them. Also wheels may be spoiled but never improved.—A Fellow-Workman.

[46109.]—**Lathe-Oil.**—I think "A. T. F." must be mistaken in ascribing the clogging of the lathe to paraffin. I have always found it a most admirable oil for removing stickiness or old oil; but it is too volatile to use alone as a lubricant. I have tried all manner of oils. No vegetable oil ought ever to be put to good machinery, as they all corrode iron and steel. Castor-oil is the best of them, but it smells horribly when warm. I settled finally on half sperm, half paraffin, and found the mixture admirable for all shop purposes. In fact, the so-called "sewing-machine oil," "tricycle oil," &c., &c., are, I believe, just this mixture, and nothing else. For oil-stones, there is nothing like paraffin by itself. Also, to wash your hands in, after an extra dirty job, when soap and hot water won't fetch the grease out. Finish with soap and water to remove the paraffin.—Treadle.

[46117.]—**Daniell's Battery.**—I beg to thank Mr. Lancaster and others who have replied. This is a 10-cell battery in a long teak box, lined throughout with marine glue, with slate and porous slabs fixed alternately in grooves imbedded in the glue; zinc and copper plates coupled, charged with sulphate of copper in solution with copper plate, and water only with zinc plate. It is precisely the same as used by P.O. for telegraph work, and as I wanted a constant battery of a certain power for experiments, I thought this would answer my purpose; but hitherto it has been entirely useless. I was aware that I could quicken the action by the addition of acid, but I thought wrongly. I believe now that it would destroy its constancy to do so. With respect to the form of Daniell recommended by Mr. Lancaster with copper cell, it seems a good idea, but it struck me that unless used with great care, it would be very liable to become "short-circuited." I have lately changed three pint double-fluid bichromates into Bunsen, and am delighted with the change. I get all the power I want, and can use them continuously for four hours, and that is about as long as one ever wants them at a time. My great trouble is with the zincs. The zinc of commerce is such wretched stuff that, do what I will in the way of amalgamating, the acid will find its way in, and soon through the zinc. What I should like would be to change my 10-cell Daniell into Bunsen. Could I, and if so, how?—A Young Beginner.

[46118.]—**Slide-Valve and Piston.**—I have done as you told me, and I find that the valves leak. What should I do to make them tight? I have done engine valves, but don't mind taking a little advice from "Sunlight" or "L. O. V." Hoping they will oblige.—R.

[46120.]—**Oil Painting—Preparing Canvas.**—One part white-lead, two parts whiting; a small portion of litharge of lead and sulphate of zinc for driers; mix with equal parts of boiled linseed oil and raw linseed, tinted with either brown umber or lamp-black, for a neutral ground. The canvas was tacked upon a stretching-frame, and sized with weak glue-size, to which a small portion of zinc sulphate was added; when dry it was stippled over with some driers and raw linseed oil as thin as possible, not saturated. When very near dry, the white-lead, whiting, &c., was mixed up very smooth, and put upon it very thin and smooth with a large palette-knife, and hatched over with a large sash-tool, drawing it across one way and then at right angles until the face presented a face like a piece of fine linen or cartridge-paper, when it was left to dry.—Jack of All Trades.

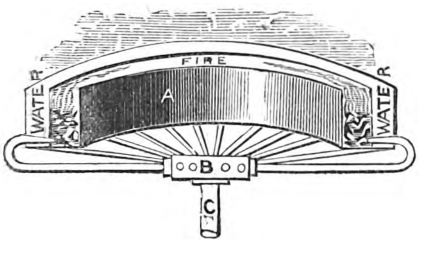
[46129.]—**Adhesive Weight of Locomotives.**—To "Guide Yoke."—The formula you have applied is used to determine the leading elements of the machinery. In order, therefore, to design an engine capable of performing a given work, it is necessary to deduct one element of the formula, $T = k\,d^2l\,/\,D$, the three others being already chosen. But this is not sufficient; there is a primary relation or inequality which has to be satisfied above all. It is, adhesion weight $\times f < k\,d^2l\,/\,D$; f = that co-efficient by which you multiply the weight on wheels to obtain the adhesion. For it can be proved easily that the tractive power of a locomotive engine is equal to the friction the driving-wheels develop on the rails. This friction or adhesion is represented by adhesion weight $\times f$ in the above formula of inequality. In order to move the train, the tractive power must be equal or superior to the sum of the resistances opposed to its motion at the intended speed, and not inferior to the adhesion or adhesion weight $\times f$. In return, if the adhesion is too little, the train will not move forward, but slip; as the adhesion weight may be considered as constant and f variable, this slipping will take place sometimes even in the best of engines when f has become low. It is known that f varies from 1-10th to ¼, the former value corresponding to very damp weather and ¼ to very dry of the same; 1-6th is the average value in our climate, but 1-5 or 0·2 is generally taken in the calculations of engines, for in that case we are sure to be well outside the requirements of an increased friction. One of these is already met with when we leave a station, for the friction at starting is greater than at full speed. It follows, from all what precedes, that the manner of calculating the elements of a locomotive is as follows:—Reckon the resistances opposed to motion caused by resistance of air, friction of journals, &c. (including engine and tender) at the intended speed. The result expressed in pounds multiplied by 6 expresses the load to be borne by the driving-wheels to obtain sufficient adhesion under ordinary circumstances. The same result multiplied by 1·2 will give the tractive power, or rather its maximum, a number by 1-5 greater than the adhesion obtained in taking only the sixth part of the above-determined adhesion weight. When the coefficient $f = 1/5$ and a full load is on the engine, which load is the maximum work to be done, the mean pressure is that obtained by the least cut-off—viz., when the link is lowered (or raised) to its full extent. Should the load be less than usual, the engine would not work very economically in these circumstances. When f decreases, the adhesion consequently decreases: it would not be much more economical to keep the same grade of cut-off. Take a less train in this case. It can be seen that engine-driving is not an indifferent affair. When you go down an incline, turn the handle of your screw reversing gear towards the middle of the stroke of its block. Abroad, and particularly in France, on the Chemins de fer du Nord and Midi, they have adopted the habit of marking in the cab of the engine the power in special units that can be developed by the engine under ordinary circumstances. A list of the engines, with the number of units they exert, is drawn up, so that the railway officials can judiciously compose their trains according to the tractive power at their disposal and the state of the weather. I shall conclude by working out the following example:—Required to find the proportions of cylinders of an engine to draw regularly a load of fifteen carriages weighing full 11 tons each, at a speed of 45 miles an hour on overruling gradients of 1 in 200, weight of engine (pre-supposed) with tender 63 tons; diameter of driving-wheels, 7ft. Weight of train $= 15 \times 11 + 63 = 228$ tons. Resistance per ton at 45 miles an hour, on 1/200 ascending gradient = 40lb. Total resistance $= 228 \times 40 = 9{,}120$lb. Multiplying by 6 and dividing by 2240; $9120 \times 6 / 2240 = 24$ tons, 8cwt. on wheels. Whence it follows that the engine will be a four-coupled locomotive. Multiplying by 1·2, we have $9120 \times 1{\cdot}2 = 10944$lb. tractive power, or 11000lb. in round numbers. Both diam. and stroke of piston are unknown, so is also the pressure; for the latter, let us choose 140lb. sq. in.: high pressure is economical. Admitting 1-10 loss of pressure to the cylinder, and 2lb. back pressure, the initial pressure is about $(140 - 14 - 15 - 2) = 109$, and taking ¾ of stroke as longest admission, then: Mean effective pressure $= 109\ (1 \times \log._{\varepsilon}\ 4\text{-}3\ /\ 4\text{-}3) = 105$. If we choose the stroke = 1·5 diameter, we have finally, x being this diameter, $11000 = 105 \times 1{\cdot}5\ x^3/84 \quad x = \sqrt[3]{11000 + 84/157{\cdot}5} = 18{\cdot}\ldots\ldots\ldots''$ the diameter being 18, and a trifle over. We shall take, therefore, 18in. for the diameter and 27in. for the stroke, for this gives when verified by the usual formula, $105 \times 324 \times 27\ /\ 84 =$

10935lb. a result not far off 10944. Had we chosen 1-6 of adhesive weight for tractive power, the results would have been different; but the engine might not have been able to perform its duty when the co-efficient of adhesion would have, I say, risen to 1-5. Should the co-efficient = 1-6, and the load less, such as 132 tons for the train, and cæteris paribus, the pressure will average 73lb., which would correspond to a cut-off at ⅜ stroke. To sum up, our engine is so calculated as to make it sure that it shall take regularly and under ordinary circumstances the working load, 228 tons. Some single engines have unusually large cylinders, such as the 8ft. on the G.N. Railway, and the 7ft. of the narrow gauge of the G.W. This would seem anomalous if it were not explained that these cylinders are capable of giving long expansions; in fact, the sectors of the reversing gear are finely notched. A long link should always be adopted when large cylinders are employed, with a view of prolonged expansions. Sometimes it happens, as I noticed abroad, that engines have no sufficient adhesion for the cylinder power: an additional mass of cast iron is resorted to—it is a miserable expedient. At the next big repairs, it is found necessary to reduce the diameter of the cylinders. The opposite is also met with: heavy engines, like the last express of the French Western, who have their cylinders too little. Of course, in these matters, the designing of a new engine is rather made dependent upon what has been done previously. I hope to have convinced "Guide Yoke" that adhesion plays a very important part in the designing of a locomotive, that the elements being determined after it, the formula $T = K\,pd^2\,l / D$ has a maximum, and is only resorted to to see whether the load to be conveyed under certain conditions is within the maximum—namely, the adhesion at a high coefficient of friction.—Ed. Gobert, B.Sc. (Paris), 39, Heskey-street, Nottingham.

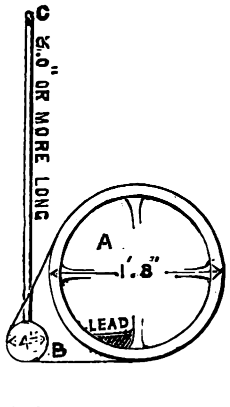
[46132.]—**Fluoric Acid for Soldering Iron.**—The following recipe was given me by an old hand for brazing cold or welding without heat. I have not yet had occasion to test it, but it is at the service of "Thanks." Mix in a guttapercha bottle, ½oz. fluoric acid, ½oz. nitric acid, ½oz. bismuth (metal), ½oz. brass spelter. Rub the above on to the broken parts, and close tight together for a minute. I would advise "Thanks" to be careful not to get any of the mixture on his fingers or hands.—W. W.

[46133.]—**Stencil Plates.**—Are best cut out with a narrow scorper—that is, a species of graver, whose section is of an acute lance shape. You can get them any section up to a knife or parting-scorper. The metal is either zinc, copper, brass, or silver, and German silver. These about 20 or 22 B.W.G., or the thin lateen brass is used by some, such as was used for French clogs (used to be called by some clog-brass); this is silvered or electro-plated, in many instances, which gives it a finish.—Jack of All Trades.

[46140.]—**Gas for Heating Iron Hoops.**—If "J. W. Smith" cares to follow out my idea as shown in sketch, I think he will find that it is cheaper to use the ordinary blacksmith's coke than to go to the expense of heating by gas. I have never seen anything after the same design as this. It could be adapted in the same manner for gas, by introducing a burner where the small tuyere is shown. A is a circular trough about 9in. deep, with a partition 3in. from the outer edge and running all round; the other space 6in. wide is for the fire and the hoops, the small space to be filled with water to keep the pipes cool. B is a cast-iron chamber attached to pipe C, which is in connection with a fan. The elbow-pipes as shown leading out of it should come into the trough at about 6in. apart and pitched off all round the said trough. Shall be glad to give further information if required.—Pattern-Maker.



[46148.]—**Fret-Saw and Lathe.**—A. My fly-wheel is 20in. diam., and heavy; this drives a drum with leather belt, the drum being 4in. diam. and about 1½in. thick, wood, as at B. This means five strokes of saw to one revolution of fly-wheel. I made a saw as well as I could, and Messrs. W. Makin and Sons, of Sheffield, made me some from my pattern; one saw thus made is worth a gross of the rubbish which is usually sold as saws. The connecting-rod should not be less than 3ft. long; but as much more as you like, as at C. What



thickness and class of wood does "J." intend cutting? More particulars if wanted.—Wm. Hosken, Penryn.

[46149.]—**Oil for Lathe.**—There is nothing I find better than some good lard-oil, with from 1 to 2 parts paraffin.—Jack of All Trades.

[46149.]—**Oil for Lathe.**—No one denies the fact that by successful lubrication a large item may be saved in a works where there is much machinery, and that even where there is but little, this item in a short time becomes more or less appreciable. Yet in spite of this, it is a very remarkable fact that there exists an almost universal ignorance of any scientific basis for lubrication. In a paper published in this journal (Feb. 17, 1882), I endeavoured to show that such a basis was to be founded on viscosity. That for light machinery we require a "thin" oil, and for heavy machinery a "thick" oil; and that, commencing with light machines and gradually advancing to the heavier ones, the viscosity of our oil must also gradually increase. And there can be no doubt but that if this simple rule be adhered to, we shall have the most economical, and at the same time most perfect, lubrication. "Cloture" asks what oil is most suitable for a lathe. Firstly, let him procure some American mineral oil of about 900 specific gravity, and some pure rape-seed oil; secondly, let him mix the two together in the proportion of one part of rape-seed to four parts mineral; thirdly, let him give his lathe a good cleaning with paraffin oil, and then lubricate with his mixture. If it should be a little too thin he can add more rape-seed; if a little too thick he can add less; by a little practice he will get an oil that exactly suits his lathe, and which neither stiffens nor clogs. The above makes an oil suitable for all light machinery. It may be mentioned that "paraffin" oil is quite unsuitable for lubricating purposes, on account of its being readily decomposed.—Thomas Farmer.

[46149.]—**Oil for Lathe.**—It is rather a difficult question to decide, there being so many opinions upon the subject. I have, however, given a deal of attention to it, and after trying many kinds, I am quite sure that there is nothing better than animal oil; it has more lubricating properties, although, at the same time, it is more corrosive, but this can be overcome by a process of refinement. We have for many years used nothing but the best neatsfoot oil, which I refine through charcoal filters, which latter, by the way, consist simply of a tin cone with a series of small holes towards the point: it is filled two-thirds with fine powdered charcoal, and the oil then placed on the top. It will take a long time to get through, but when it does it is perfectly clear, and quite free from corrosive matter. A few drops of paraffin I find an improvement. There is a deal of waste; but we use it all up for rough drilling purposes in the works. On an average I calculate upon getting only a 4oz. bottle from a quart of oil; probably this may be thought a roundabout way of obtaining oil; but as a small quantity will go a long way, and not make the bearing dirty and sticky as if glue instead of oil had been used, it is worth the trouble. I find it preferable to the Rangoon; for guns, &c., it has also been found the best.—J. H. Evans.

[46154.]—**Potash Carbonate.**—I should like to ask Mr. Duff whether he has ever prepared potassium-carbonate from potassium-sulphate in the way he directs "Pearlash" to proceed? I must say I am rather inclined to doubt.—Analyst.

[46156.]—**Pendulum Spring.**—Your question is not sufficient for a proper answer. Your hair-spring should lie uniform with the centre hole in cock-bar. It may be that the spring is too large. Is the stud (i.e., where the hairspring is pinned) shifted? If there is sufficient room between the coils you may sometimes alter it by opening the outer coil opposite the stud; but if the spring is too large, you can only make a good job by putting in another.—A Fellow Workman.

[46157.]—**Secondary Batteries.**—Apropos of Mr. Lancaster's remarks under this head on p. 622, may I venture to point out to that gentleman that we learn more, very often, by records of failures than by descriptions of successes. I suspect I am not alone in thinking that if Mr. Lancaster has been experimenting with secondary batteries—even if his experiments have not been satisfactory—an account of what he has done would be useful. —Nun. Dor.

[46160.]—**Birmingham Wire-Gauge.**—The relative values in decimals of an inch, of the Birmingham wire-gauge, are as follows:

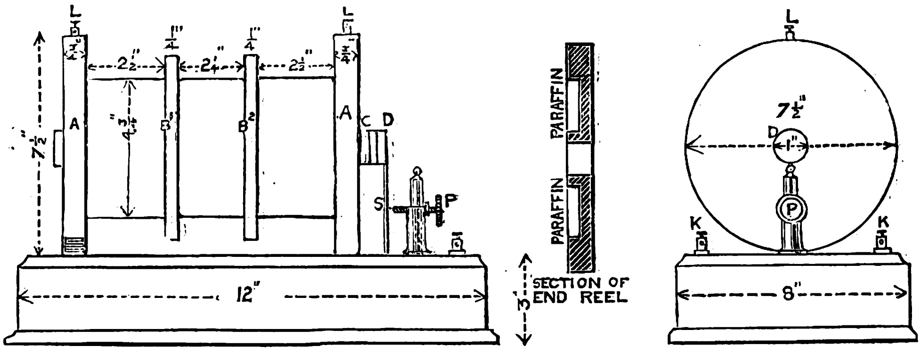
No. B.W.G.	Ins.	No. B.W.G.	Ins.
0000 =	·454	17 =	·058
000 =	·425	18 =	·049
00 =	·380	19 =	·042
0 =	·340	20 =	·035
1 =	·300	21 =	·032
2 =	·284	22 =	·028
3 =	·259	23 =	·025
4 =	·238	24 =	·022
5 =	·220	25 =	·020
6 =	·203	26 =	·018
7 =	·180	27 =	·016
8 =	·165	28 =	·014
9 =	·148	29 =	·013
10 =	·134	30 =	·012
11 =	·120	31 =	·010
12 =	·109	32 =	·009
13 =	·095	33 =	·008
14 =	·083	34 =	·007
15 =	·072	35 =	·005
16 =	·065	36 =	·004

—T. R. Saxton.

[46161.]—**Pumping to Pressure.**—The main from the pumps joins an 8in. main 500 yards from my engine-house. The 8in. main acts as a supply to the town, as well as a supply to the reservoir while pumping at this junction in the valve, and also the 3in. main branches off, and go side by side, the 8in. main to the reservoir, and the 3in. main 200 yards farther on, supplying, on its way, 18 villas. The reservoir is 800 yards from my engine-house, and the end of 3in. main 1,000 yards. I have thought, would it be practical and economical to fix a double self-acting valve on the 8in. main in the reservoir, weighted to 15lb. to the square inch, to pump against, so as always to have pressure enough while pumping to supply the high level, and when the pumps cease working, the other valve would open with the pressure from the reservoir, and so do away with walking 200 yards twice a day to open and shut the valve. If "Sunlight" or "Labor Omnia Vincit" will assist me, I should feel obliged.—Water Motor.

[46162.]—**Nascent Oxygen.**—Surely John Pickering makes some mistake when he inquires "under what conditions (if any) it may be dangerous to decompose chlorate of potash with manganese, by using for the purpose sulphuric acid." In the first place, manganese does not decompose chlorate of potash; but simply assists the action of heat thereon, without undergoing any apparent change in itself. Such action by contact, of which there are many other examples, has been called for want of a better name catalysis: its true nature is not clearly understood. The action of sulphuric acid upon chlorate of potash produces, not oxygen, but a very unstable gaseous compound of chlorine and oxygen called chloric peroxide (Cl_2O_4), which is decomposed with explosive violence by the mere warmth of the hand. Any attempt to prepare oxygen from such materials would certainly result in what John Pickering seems anxious to avoid—a dangerous explosion. Manganese, or more properly manganese dioxide, yields one-half its oxygen when heated with concentrated sulphuric acid; but the gas thus obtained is generally mixed with more or less carbon dioxide, derived from the carbonates nearly always present in commercial manganese; for this and other reasons the process is not to be recommended as a source of oxygen. Where it is required to apply oxygen in its nascent state, we generally employ certain substances containing a large amount of oxygen held by a very slight degree of chemical force, such as chromic or permanganic acids, which readily give up their oxygen to any oxidisable substance. If John Pickering will state to what purpose he wishes to apply nascent oxygen, I will try to recommend him a suitable oxidising agent.—Analyst.

[46153.]—**Induction Coil.**—In reply to "J. A. W." I send the following description with full drawings of a 1in. (spark) coil I have made. 1. *The Core.*—I made this of soft iron wire, size about 20, by first cutting it into lengths of about 10in. long, rolling them straight between two boards, then making them up into a round bundle 1in. in diameter. I twisted a piece of soft wire around them and placed them into a fire to soak for several hours, and then let the fire die out. The core was now soaked in melted paraffin for some time, and on taking it out, as I took off the wire binding the core together I twisted on a layer of soft cotton tape, and then soaked again in melted paraffin. II. *The Primary.*—I used two layers. No. 18 silk-covered, each layer insulated with paraffined foreign note-paper, and wound on the soft cotton tape of the core. After the first layer was on a smooth surface was made by ironing in paraffin with a flat iron previous to putting on the layer of foreign note-paper. I then soaked the whole in melted paraffin for some time. III. *The Tube.*—This I made of dry brown paper and glue wound round the primary until the tube was about 1-16in. thick. The whole was then soaked again in melted paraffin for some time. IV. *The Secondary Wire.*—Before commencing to wind the secondary, I prepared my end reels A A in the figure by turning them of hard wood, very dry, and filling up the space marked paraffin in the Figure with melted paraffin, after first soaking the ends in melted paraffin for about an hour. I divided the space on the tube into three parts, as shown in the Figure, with ebonite discs B B, as I had two pieces of sheet ebonite by me; but should not have bought it on purpose, but should have wound the secondary from end to end. The secondary consists of one pound No. 36 silk-covered wire from Rickards', Derby (I have always found their wire to be very good). The division to the left was first filled, one end being fixed to the binding-screw L, the other end passed through the ebonite disc B¹ and passing down close to B¹ on its right-hand face, with a disc of stout paraffin-paper to further insulate it from the secondary wire in the middle compartment, and so on for the third division, finally finishing at the other binding-screw L. Each layer of secondary is insulated with two layers of paraffined foreign notepaper, ironed on with a hot flat-iron. I used throughout plenty of paraffin. N.B. Take care to wind each compartment in the same direction. V. *The Stand.*—The base contains the condenser of sheets of tinfoil and paraffined foolscap paper, built up sheet by sheet until the spark at the spring S almost ceases, and connected the one series to the pillar P, and the other series to the spring S. K K are the primary screws for the battery connection. The ends are black varnished. I have used this coil with all kinds of batteries, and can get 1in. sparks—good thick sparks with a small four-cell Grove battery. I am now building a 12in. coil on the system of discs of paraffined paper with slices of coil between them, particulars of which I shall be glad to send when completed.—T. N. Andrews, Plymouth.



[46166.]—**Rangoon Oil.**—This is a lubricant with a basis of mineral oil, sp. gr. about 905. If it smells strongly of tallow, in all probability tallow or some other animal oil has been mixed with it to increase its lubricating power. It can hardly be called an adulteration, as "mixed" oils are more suitable for lubricating purposes than pure mineral, and again, any mixing oil, animal or vegetable, would be more expensive than the pure mineral oil itself. I do not think there is any degree of probability in the statement that the oil is made from the refuse of candle-manufacture. In future "Armourer" cannot do better than use pure mineral oil; he will find it to give him every satisfaction.—Thomas Farmer.

[46170.]—**Bending Wood.**—If you want to bend wood for furniture you must have it green and steam it, and for many purposes a breck is used; that is, two half-round pieces of wood bolted with the convex sides facing one another, with distance pieces between. The timber is put between these a short distance at the time when wet and hot, and gradually broken or bent, as you would a bar of iron for a cart-tire, and then taken to the moulds to be set up to what shape it is wanted; but sawn timber, unless very straight-grained, will seldom bend, and you can scarcely ever depend upon it; rift wood is the best for the job.—Jack of All Trades.

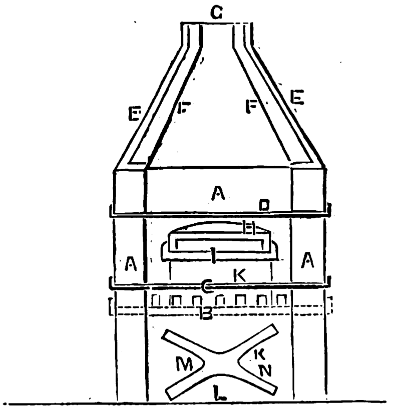
[46173.]—**China Paintings.**—See reply 46189; this will suit you, and you can mould your seggars or muffles to what shape you like.—Jack of All Trades.

[46176.]—**Burnishing Ink for Edges of Boots.**—Make a strong solution of nut-gall, 1oz. to half-pint of water, boiling; pour off the clear and add 3oz. acetate of iron, put no gum in it; but when dry, damp it with gum and rub round with a rag and tallow, and stick up with long stick, shoulder-stick, or jigger.—Jack of All Trades.

[46184.]—**Wringing-Machine Rollers.**—Here, again, I differ with "Sunlight." A flat plate with a square hole at the end of a roller, reversing its action repeatedly, is, I hesitate not to say, a very bungling way to endeavour to secure any axle. When making the windlasses used upon Ballarat gold-diggings (sinkings over 200ft.), we procured a barrel of, say, 6ft. long by 10in. diameter, of the best timber to be procured. Then a ring of 1¼in. by ¼in. iron was shrunk on at each end; next, a smaller ring, say, 2in. deep and 4in. diameter, bevelled to a cutting edge, was driven into each end. The spindle, where entering the axis of the barrel, was square, and, say, 1¼in. iron, 14in. long, slightly tapered at point, deeply "ragged" with keen cold chisel, and driven home with heavy forge-hammer into an auger hole, smaller than the square of the shaft, then brought to run true by wedges of iron.—J. J. A., L'pool.

[46187.]—**Watch and Clock Repairing.**—I hope that the instructions I gave "Hopeful" last week have proved of service to him. I here continue my reply to his letter. Respecting the fitting of new springs to Geneva watches: In either case, whether the barrel is a suspended one—i.e., one fitted with a solid arbor and ratchet-wheel, and not pivoted in the plate; or one which has the ratchet-wheel held on the arbor square by a screwed cap, and having a bearing in the plate—the stopwork must be removed, or at least the part fitted on the arbor. The star-wheel need not be removed unless dirt has collected underneath it. Having, then, removed the "stop" from the arbor square, take out the barrel lid by inserting a tool-point in the hole therein, and with a gentle leverage forcing it up. Whatever the make of barrel may be, the procedure as regards the stopwork is the same. In this particular instance, the barrel being a suspended one, I will limit my remarks to that. Some of the old makes of Geneva watches have the barrel lids between the barrel and the cock, while the more modern ones, excepting in few instances, have the lids underneath. If the watch in question has the lid underneath the barrel, the new spring may readily be coiled and wound in, by the inner end being hooked on the arbor-roller, and the arbor turned with the key, the left-hand thumb meanwhile being held firmly against the hooked-up spring during the process of winding. Previously, however, to doing this, the spring will have had to be measured off to the correct length; and the old spring will be a guide to this. If you have a gauge, and the new spring is the same thickness as the old one, you will, by that means, be pretty sure to get the correct length. A hole must be made at the extremity of the new spring, after it has been softened, about half an inch up it. This end of the spring must be made a little thinner than the remainder of the spring, if the hook in the barrel is a short one. If fairly long, it does not matter. Having wound the spring in the barrel and seen that it is safely hooked at both ends, and down level in all its coils, apply a small quantity of oil to it, and replace the lid. On looking closely round the edge of the barrel a drill-mark will be found. Place the hole in the barrel lid over this mark, press the barrel lid home to its seat, by holding the barrel in both hands and bringing it against the edge of the work-board. Do not use nippers to close it up, as many do, and thereby disfigure the barrel, and probably cause the spring to be bound. Now put a key on the square at the winding end, and fix the key in the vice. Wind the barrel round until the spring is felt to pull fairly, place the steel stop on the square, the polished side up, and set it, and the wheel, so that when the barrel is released the stop will prevent it unwinding any further. If the square is drilled for a pin, insert one, and keep it short and close. Now, holding the barrel very firmly by both hands, turn it round and round until it is found to stop securely against the star wheel. If all is rightly done, let the barrel revolve gently until down, and the operation is then complete, and, after brushing, is ready to be screwed in its place in the plate. It occasionally happens that when a mainspring breaks, one or more teeth become a little bent, so the teeth should be examined for this possible defect, and if found damaged, be corrected. This may easily be done by placing the edge of a penknife at the base of the tooth, and gently, but firmly, forcing it upright.—Alfojoe.

[46189.]—**Muffle for Firing Painted Glass.**—I give you a sketch which I think will suit you



A A A furnace, built of firebrick, inside 18in. wide, 15in. deep; B A, bar of iron for carrying firebars, of which there are two, one 3in. from back and the other front; the bars are all loose iron bars ¾in. sq.; C, bar to support brickwork-front up to opening for muffle, which should be 5in. or 6in. deep; then an opening 6in. and bar D to support upper brickwork about 9in., and the top E E may be of cast iron, lined with fireclay and sawdust; F F G flue, about 8in.; when lined with clay, about 4½in. opening; H muffle, consisting of two tiles, made of a mixture of pipeclay and fireclay, with sawdust, pollard, or fine charcoal-dust. 1, the bottom or bed; this should be covered with very finely-sifted air-slacked lime to bed the glass upon, made very smooth and level; the dotted line K is the stand for muffle to rest upon, made of the same material, the shape shown K. L is the ash-pit; the opening where the muffle is placed in may be closed with a cast-iron or wrought-iron box, lined with fireclay, with an opening in the centre in which a piece of brick may be put in loosely that it may be examined from time to time; and when it is vitrified you may either drop the fire or take the muffle out with a slice or peal, and pop another in its place; the whole of the bars may be taken out but two, M and N, left for the stand and muffle to rest upon; chimney about 12ft. high.—Jack of All Trades.

[46190.]—**Beat in Violoncello.**—To "Fiddler."—The 'cello is a small-sized one (youth's), and I strung it as an octave violin,—i.e., took away the C string, moved G, D, and A one peg lower, and added a thinner one for E. With its proper strings and at usual pitch the beat disappears; but I think I like the tone better when tuned G, D, A, E,—clear and more ringing, though good both ways. Further information will be valued.—Kanet.

[46193.]—**Staining of Floors.**—You should not use size—it is sure to look patchy; use beer.—Jack of All Trades.

[46195.]—**Photo. Washing-Machines.**—There are a great number of washing-machines, each one having some good point. You should get the catalogues of the different makers, then pick out the one most suitable to your requirements and make one for yourself.—W. J. Lancaster.

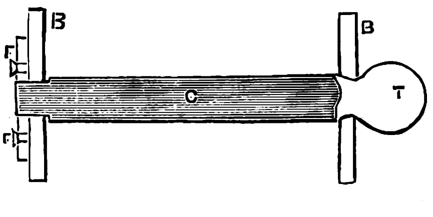
[46200.]—**Photographic Transparencies.**—You can take transparencies either by the old wet process, or on gelatine dry plates; but gelatine films will be useless to you: they would cockle when put into the lantern. You can take any number of transparencies by superposition, or much better in my phantasmograph; this is a chamber 12in. long, with a place at one end to hold the negative and dry plate, and a door at the other end to allow of correct exposure; the plates may be developed to any required tone, and will produce excellent transparencies.—W. J. Lancaster.

[46201.]—**Largest Gasometer.**—The dimensions of the gasholder for South Metropolitan Gas Company is as follows:—Inner lift, 208ft. diam. by 53ft. 6in. deep; middle lift, 211ft. diam. by 53ft. 3in.; outer lift, 214ft. diam. by 53ft., thus having a total height of 159ft. 9in. It has the greatest height and largest capacity of any gasholder that has ever been made, but I believe there is a gasholder 220ft. diameter, but has only a height of 90ft. It has a capacity of 5,500,000 cubic feet. The total weight of standards and body for this gasholder is 1,400 tons. The gasholder was made and erected by Messrs. Ashmore and White, Stockton.—M. Rees.

[46204.]—**Geometrical.**—There is a slight error in the reply given to this last week, arising chiefly in the computation of the area of the triangle; the area of circle is 1866·55; of sector, 1274·18; of triangle, 270·86; of required segment, 1545·04 square feet.—W. A. S.

[46205.] — **Induction-Coil.** — Double-covered wire takes up too much room: better have good single-covered and wind as closely as possible. I have seen coils made up with naked wire and unspun silk line run together, thus forming a thin layer between each successive coil of wire; but this takes up more room than nicely-wound wire, and consequently reduces the capabilities of the coil when finished.—W. J. Lancaster.

[46205.]—**Induction-Coil.** — I have made a small one which acts as well as any I have seen with the same amount of wire, and I wound both secondary and primary with single-covered wire, insulating the layers from each other by thin note-paper (foreign preferred). With regard to the latter part of query, as to the size: — Does "R. L. J." mean, (1) length of wire? or, (2) length of core? Certainly the strength of the induced current depends upon the length of wire, and the longer the core the stronger the current. (1) Because the magnet will be stronger, the poles being farther apart; (2) The longer the core the nearer the outside layers to the magnet, and, therefore, the more power the magnet has upon the secondary, for the magnetic force (as all other forces) "decreases inversely as the square of the distance"—*e.g.*, suppose a layer of wire is 1in. away from the core, the strength of the current is, say, 1. Now, suppose it to be 2in. away, and the strength of the current is $1/(2)^2 = \frac{1}{4}$; at 3in., it is $1/(3)^2 = 1\text{-}9$ at 4in., $1/(4)^2 = 1\text{-}16$, and so on; but do not carry this principle too far, or else you will have an unsightly instrument. The following is the sizes of the one that 1 made, which gives (with 1qt. Bunsen cell) a $\frac{1}{4}$in. spark with condenser. Core: Length, $2\frac{1}{2}$in.; diameter, $\frac{3}{8}$in., composed of a bundle of No. 18 iron wire. Primary, 4 layers of No. 20 silk (single) covered wire, about $\frac{1}{2}$oz. Secondary, $2\frac{1}{4}$oz. of No. 36 silk covered wire. Diameter, when all the wire is wound (with paper) $1\frac{1}{4}$in. The condenser consists of 24 pieces of tinfoil, 4in. by $1\frac{1}{2}$in. separated with paper. If "R. L. J." wants his coil for administering "shocks" to the human body, I should recommend him to use, as a regulator, a piece of brass tube made to slide over the core. The following sketch will show the arrangement in section. C is the core; BB, the ends of the wooden bobbin; F, is flange into which the core C is driven *very* tightly. A good way to keep the wires together at the other end is to tie them together and dip into melted shellac—glue will do—and, when this is hard, remove the string. The flange F is now fastened to one end of the bobbin by means of three screws. You will now find that the tube T will move over the core easily. This regulator is much greater than the ordinary regulator, if you do not want the trouble of bringing out the strengths by the wire. With mine, I can light up vacuum tubes and do everything that can be done with a small coil.—Electric Light.



[46207.]—**Weight of Cattle.**—The weight of cattle may be calculated by measurement in the following manner:—Measure the girth close behind the shoulder, and the length from the fore part of the shoulder-blade, along the back, to the bone at the tail, which is in a vertical line with the buttock, both measured in feet. Then multiply the square of the girth (in feet), by five times the length, and divide the product by 21, and the quotient is the weight (nearly) of the four quarters in imperial stones of 14lb. avoirdupois. For example: let us suppose that an animal is 5ft. in girth, and the length is $4\frac{1}{2}$ft.; ∴ 5ft. by 5ft. = 25, and $4\frac{1}{2}$ft. × 5 = $22\frac{1}{2}$; ∴ 25 × $22\frac{1}{2}$ ÷ 21 = 27 stones (nearly). In exceptionally fat cattle, however, the weight will be about 1-20th more, and those in a very lean state it will be about 1-20th less, than the weight obtained by the preceding rule.—A. J. D.

[46209.]— **Photographic.** — You can have flashed metal of any degree of colour in proportion to the thickness of the coloured metal on the surface of the glass used. Get the deep ruby as ordinarily sold, and you will be quite safe. You can buy flashed ruby from 1s. to 2s. per square foot; but I do not know the price of pot ruby, and I am not sure that I have seen any in sheets. It is rather too expensive to use for window-glass. I will give the instructions as to the dark-slide. Nobody seemed to require the instructions, or I would have given them. I am sorry to neglect anyone, but I endeavour to use the little time I can spare for the "E.M." for the benefit of the greatest number of querists or readers.—W. J. Lancaster.

[46211.]— **Wheatstone's Bridge.** — If the querist has got muddled with Ferguson's description (which he ought not to have done), I think he ought to clarify his perceptions by the directions, p. 168, of my book, which he appears to have at command. He may put his resistance to be measured in any one of the openings. As to the galvanometer, I can only say that if he alters the wires as to size and space fitted up, the readings I give will be utterly useless and incorrect. I cannot make the description more simple than that in my book, 90 turns of 20, 9 turns on each side of 18, connected as derived circuits to divide the current, 1 turn on each side in same way of copper strip. He can, if he likes, wind on as much 36 silk-covered as space admits outside of the strip, but its power will not bear much relation to the others, though it may be generally useful.—Sigma.

[46212.]—**Vegetable Black**—This substance, if packed in a leaky cask when freshly prepared, would condense the atmospheric gases on its surface, which, owing to the porous nature of the substance, is very large in proportion to its weight. In condensation the gases would give out a certain amount of heat, which, under favourable (or to you unfavourable) circumstances, might be sufficient to cause the ignition of some inflammable substance accidentally present, which by combining with the condensed oxygen, might liberate heat enough to cause the ignition of the vegetable black, which, when once started, would soon spread until the contents of the cask became red-hot. It is very unlikely that the heat liberated on condensation of the atmospheric oxygen would ever cause the ignition of the "black" directly, and even with a very inflammable impurity present that ignition would hardly ever occur.—J. M. Stocks.

[46212.] — **Vegetable Black.**—Fires occurring from the spontaneous ignition of vegetable black are very common, as the following paragraph, written by Superintendent Tozer, will show. Many porous substances, like fibres, when oily or greasy, are liable to self-ignition, especially during the summer after a continuance of dry warm weather. A sudden storm or a shower of rain appears to give life, as it were, to the parched-up matter, and a fire is the result. I have also noticed frequently the very reverse to occur after a continuance of wet weather. A few days sometimes are sufficient to set up active and rapid combustion, especially among sweepings in paint and oil-stores, consisting generally of wood-dust, dried vegetable and animal powder, colours more or less saturated with varnish, turpentine, oils, &c. This is one of the most common causes of fires in such stores. Several fires have occurred at which I have been present, when the damage done was confined within a cask of vegetable black. One occurred within our own workshop on a damp summer's night, through the carpenter on the previous afternoon dipping a wet paint can into the powder for the purpose of mixing some black paint. Ten hours afterwards the centre of the cask was found one mass of fire.—Thos. Marwood, Fireman, Chief Fire Office, Birmingham.

[46212.] — **Vegetable Black.** — Spontaneous ignition is not unfrequent in many large carriage factories, and builders' shops have been destroyed solely from this cause. So well is it known now, that various devices are adopted to obviate the chances of a disaster. The large firm of Wilkinson, Hayward, and Co., London, pack the lampblack in half-pound packets, done up in brown paper, and then packed in casks. To put it in printed paper would insure ignition, from the absorption of the oil in the printing-ink by the lampblack, generating gas which would soon ignite the soot or lampblack. One amongst many instances of well-attested cases of spontaneous ignition occurred at a large carriage-works at Grantham, in a shop far away from fire or the chance of a spark. The paint-shop was gradually illuminated on a mild summer's evening during daylight. It was noticed through the workshop-windows, and seen to be a tub of loose lampblack slowly consuming the cask. It was easily carried out on to the grass to finish its work. It was thought that, being near the grinding-paint-stone, some oil had been splashed into it, or an oily rag dropped into the lampblack. The secret was soon found out, by the pallet-knife being found amongst the ashes of the cask, having been carelessly dropped in with some wet paint on it; or even without any wet paint, the dry, oily paint which accumulates on the blade near the handle would be sufficient to cause ignition. It is not the large quantity of oil, but the small quantity, which is the cause of it. This is so well known, that some coachmakers, when they receive lampblack, put it into a sound cask and pour enough linseed-oil into it to saturate the whole. I caution workmen of the danger of oils near lampblack, and put the packets high up, out of the way of contact with oils. It would be well if lampblack casks had labels with a notice that minute particles of oil ignite lampblack in bulk.—J. Charles King.

[46213.]—**Measuring Steam.**—Why not find the amount of steam consumed in one stroke of "B.'s" engine or engines, and multiply that by the number of strokes made in a day or in one run. By fitting a counter to the engine a record of the number of revolutions could be kept, and an account taken daily or weekly, as might be found convenient. The pressure at which the steam is supplied would still have to be considered, and allowance made. This would, I believe, prove a better method than the one in use, and would tend to encourage economy. It would, nevertheless, be imperfect. Perhaps some of the other readers would kindly offer their opinion upon it. I am not aware of any form of meter for steam.—Ecosse.

[46213.]—**Measuring Steam.**—Seeing that the pressure of any given volume of steam indicates the energy or amount of work that B. can get out of it, it is fair that the price should be based on the pressure, and a fairer method of estimating its money-value cannot readily be conceived. To fix the price by volume would not be equitable. It would be a bad bargain for B. to have to pay for any stated volume of steam of 20lb. pressure the same price as if it had been of 40lb., and A. would have little inducement to supply the latter when he could get the same money for the former pressure with a less expenditure of fuel. If any encouragement to using the steam with economy is required, let an arrangement be come to, to pay only for the hours during which the engines have been actually at work.—Diamond.

[46214.]—**Stone-Lathe.**—No difficulty of any moment suggests itself. The way I would advise would be, if the mandril is provided with the usual three-speeded cone pulley, take it off, and get one cast from it, affixing to it core prints for the hole for shaft of overhead motion, said shaft's length being governed by the length of your bed (not given), so that you may be able to reach lever for throwing belt on to a fast or loose pulley, as required, and on which the belt from the fly-wheel works. I would have this overhead shaft, say, 1in. or $1\frac{1}{8}$in. diameter, according to its length, running in two standards bolted up to ceiling, about, say, 2ft. back from a perpendicular to the mandrel. You do not state the possible weight to be revolved in lathe. But I should advise a cast-iron wheel of about 5ft. diameter, belt pulley bolted to the spokes of this, with, say, two speeds, one of 2ft. diameter, the other, say, about 14in. or 16in., mounted upon suitable standards; wood upon end for bearings will answer well. Handle at each end of axle, "one up," when the other is "down."—J. J. A., Liverpool.

[46216.]—**Strength of Materials.**—I should be loth to rely upon calculations anent material and thickness of same in any man's model-made boiler, and have often given in these pages the best and easiest method of testing. Nevertheless, if "Barkis is willin" and "Eddy" is eulogistic, here we are again. Fill your boiler perfectly full of water, load your safety-valves with, say, double the pressure you ever mean to work it at, and place it on the fire, or, as I do, over a species of atmospheric gas-burner of my own design. The water soon expands and points out all (if any) leaks, and either bursts quietly or escapes at safety-valve.—J. J. A., Liverpool.

[46217.]—**Model Electric Engine.**—I should advise you to make one on the dynamo-electric principle, with the Siemens armature. You would get as much power from one weighing $3\frac{1}{2}$lb. as the one described some weeks back wound with 20lb. 14 wire. Will send photo. of one, and sketches, if editor is willing to insert with engravings.—George Tolman. [Please send.—Ed.]

[46217.]—**Model Electric Engine.**—You do not say about what size you would like to make engine. If you will say about what size you wish to make I will give you all instructions. I have lately made several simple motors that are capable of doing all sorts of light work, such as driving fret-saw or sewing-machine, and am now making one equally portable to probably drive a tricycle. If this succeeds, I shall have something to say about it shortly.—W. J. LANCASTER.

[46222.]—**Link-Motion.**—The length of link, from centre to centre of pins in eccentric rods, should be three times the travel of lever on rocking-shaft. This is not imperative; a little more would reduce the vibration, and consequently the wear and tear of the parts. A straight link will answer the purpose as well as a curved one.—ECOSSE.

[46223.]—**Electric Alarm.**—To MR. LANCASTER.—You can connect the bell to the clock very easily, and must get up to stop the bell ringing. Put bell in any convenient place, and couple bell to battery with one line, then carry another line from battery to clock and one from bell to clock. Now the contact maker shall be the simplest you can make, and the most successful. Go to the ironmonger's and purchase a hinge with long arms, say 1in. to 1½in. long, and about ⅜in. to ½in. wide, well work the knuckle until, when one half is upright, and the least move out of the perpendicular, it will fall down. Having done this, place it on a wooden base, one half of the hinge screwed down and attached to wire from battery; then put another piece of metal on same board, so that when the hinge falls down, it will drop on to this second piece of metal. Hinge ready for finger to move is shown thus—L; the upright leans against a pin just out of the perpendicular. Suppose, now, your finger just pushes it a little, then it falls on to opposite piece of metal thus, —⌐—, making contact the moment it touches. Of course, you must arrange hinge so that the minute-finger clears it. You will, I think, understand it in a moment, and will be able to apply it almost as quickly. Of course, the wire to bell is joined to the piece of metal on to which the hinge falls. You will have to get out of bed to stop bell ringing. The easiest way will be to keep a little wooden wedge to put under the hinge, then at night the hinge would be moved into position, piece of wood removed, and of course at 6 o'clock the bell would ring again.—W. J. LANCASTER.

[46224.]—**Silver Solution.**—Do not attempt the bright solution unless you are thoroughly master of the common one. It is always very troublesome, and requires to be kept in constant work to be of any good.—SIGMA.

[46224.]—**Silver Solution.**—The reason the articles are discoloured is through your putting carbon bisulph. direct into solution. Filter solution again, and if any carbon is at bottom remove it at once, and proceed as follows: Take a quart bottle, and into it pour 2oz. of carbon bisulph., and then fill up the bottle with a solution of cyanide (about 1lb. to gallon), after standing a day or two add a little each time you work solution.—ELECTRO.

[46224.]—**Silver Solution.**—I believe that Gore's "Electro-Metallurgy," 6s., first caused me to introduce a few drops of CS_2 into a plating solution. As I have not the book at present, I cannot say for what object the CS_2 was to be used, but I had an idea that it was to work wonders in some way. The result, however, was a dirty mess, which might be caused by the formation of Ag_2S as a black ppt. insoluble in everything the plating solution contained. Perhaps pure CS_2 would not give this ppt.; but I have never cared to try it, because I only keep a 4oz. bottleful of the solution, which was prepared three years since (by dissolving AgCy in KCy, and adding an excess of the latter) for illustrating electro-plating to students, and it works as well as ever—in fact, I have used it at three classes this week. For reliable information on this subject I should prefer the back-numbers of the ENGLISH MECHANIC before any books that I am acquainted with.—J. M. STOCKS.

[46226.]—**Gold Solution.**—For a small quantity of solution, like you say you use, you had better boil down to dryness, and then redissolve the residue in a weak solution of cyanide. After heating the solution, you do not get the desired colour, add a little more cyanide, and then if you fail, you have evidently some impurity in your solution, making it worthless; in that case, I shall feel great pleasure in giving you full instructions how to proceed to make a solution that will work satisfactorily; but try the remedy I have given first. You are not the first who has failed, and if you had read all the books published, you would still find that practice is better than reading. You had better continue reading "E. M." than any others.—ELECTRO.

[46229.]—**Transit of Venus and Earth's Distance from the Sun.**—It is intended with the coming Transit to arrive at some international agreement respecting the solar parallax, and, consequently the earth's distance from the sun. The present value of the parallax, 8·85″, is probably very nearly right; but astronomers generally favour the opinion of a smaller one, somewhere between 8·85″ and 8·80″. Taking 8·82″, which will correspond to a distance of 92,700,000 miles, Professor S. P. Langley is of opinion that astronomers in 1882 will not alter it by more than 0·01″, and as this angle is about equal to that filled by the apparent thickness of a hair seen at one mile distance, "E. J. B." can form some idea of the delicacy of the problem which has to be solved. Very little of the transit will be observed in this country. If we are favoured with a clear horizon at the time, we shall be able to observe the planet enter upon the sun's disc just before sunset, and then we shall lose both planet and sun together. Our American friends will be far more favourably placed; those in the United States and South America will not only be able to observe it directly after sunrise, but watch the whole phenomenon to its close.—A. MANOCK.

[46230.]—**Sensitised Paper.**—It will pay you much better to buy the paper ready prepared, than to attempt to make it. There are many things you can do, and some few that are much more expensive to manipulate than the finished article will cost you. This is the case with the gelatino-bromide paper, and I would certainly advise you not to attempt to make it. Still, if you have a desire to do so, let me know, and I will tell you what to do.—W. J. LANCASTER.

[46230.]—**Sensitised Paper.**—If "W. E. K." wishes to coat paper with gelatine bromide emulsion, he can do it by drawing paper rapidly over an emulsion kept warm in a flat dish. The emulsion should be kept nearly an inch in depth in the dish. Any good photographic paper can be used. The emulsion does not get weaker, the paper keeps well. "W. E. K." will find, however, that the paper he can buy ready coated is better than he can make on a small scale. It is more difficult to coat paper satisfactorily than glass plates.—H. G. M. CONYBEARE, Ingatestone.

[46231.]—**Cleaning Flower-Pots.**—There is no remedy for the efflorescence but cleaning; it is mainly lime and "salts" from the soil, dissolved by the water, which accounts for the fact that the pots receiving the least water have the least bloom. The remedy, if "G. H." objects to the efflorescence, is to use pots of glazed earthenware, which will not injure the plants, as is supposed in some quarters.—NUN. DOR.

[46235.]—**Reducing Balance-Spring with Acid.**—If "T." will follow my instructions, he will find it answer his purpose. Get a watch-glass nearly full of water, put four drops nitric acid in it, and put balance-spring in; let it stop in about ten seconds, take it out, put it in spirits of wine for about a minute to keep it from rusting; take it out, put it on balance, put roller on, put watch in beat, and you will find that the watch will lose instead of gain.—NICHOLLS.

[46238.]—**Turnstiles.**—You can easily make a registering apparatus to tell how many people have gone through the turnstile. If the stile allows four people to go through in one revolution, then it must have four depressions. The lever working into the depression will move a train of wheels up to 10,000, or more if you like, indications. You would get a good idea of the arrangement from a gas-meter: the train of wheels run along in tenths, the pinion revolving ten times for one revolution of next wheel. This would be the kind you would require. If the first wheel indicated 10 persons for one revolution, the next would be 100, then 1,000, 10,000, and so on up to any number.—W. J. LANCASTER.

[46240.]—**Legal.**—It is impossible to advise upon this question without having fuller details. But certainly the firm you employed could not be liable to their workman for an injury happening to him by the explosion of a steam-valve of your engine. As to whether you are responsible, everything would depend upon the evidence. The Employers' Liability Act is not concerned, because the man was not in your employ; but you would be liable at common law if the accident resulted through the defective or dangerous condition of your engine, or arose in any way by your fault, unless indeed the workman contributed to it by his own negligence.—FRED. WETHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall.

[46242.]—**Patent Law.**—Certainly. The patentee grants a license to use his patent, and so long as he does not "assign" it—which must be registered at the Patent Office,—it remains his property, and he grants as many licenses as he pleases, either in consideration of lump sums, or of the payment of royalties.—NUN. DOR.

[46242.]—**Patent Law.**—A patentee can enter into an arrangement to receive a lump sum from any company for the use of his invention by the said company, without such action necessarily implying that he parts with all right to the patent. The patentee may sell his invention outright, or grant licenses. In the case stated he would simply be paid a lump sum for a license.—DIAMOND.

[46242.]—**Patent Law.**—If by the arrangement with the Railway Company the patent only gives them the right to manufacture for their own use, then he can undoubtedly make similar arrangements with other companies to do likewise. But if the question means that the patentee transfers the exclusive right of manufacture for a lump sum, then to give others such a right, would be a breach of contract. Presuming that the former is the right reading of this query, then the mere sale of the right of manufacture would not amount to a sale or assignment of the patent itself.—FRED. WETHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall.

[46245.]—**G.E.R. No. 385.**—This was a four-coupled engine, and was formerly used for passenger traffic between Cambridge and London. It was designed by Mr. Sinclair, and rebuilt about 1876 or 1877 by Mr. Adams at Stratford. The bogie was added then.—G. C. M. HALL, Colchester.

[46246.]—**Sulphate of Copper.**—"Etcher" may readily convert his nitrate of copper into sulphate by adding excess of sulphuric acid, and evaporating in a porcelain basin until fumes of nitric acid cease to be evolved. The residue will be copper sulphate. It may be dissolved in hot water, and set to crystallise.—ANALYST.

[46247.]—**Photography.**—It is evident you are not working in the dark, and ought to know better. Now, then, tell me have you a dark ruby glass in the window of your dark room? If not, then light is the cause of fog. If you have time in developing to watch until the picture is seen through the back of plate, you have certainly not over-exposed them. I don't believe you have anything wrong besides too much light. Alter it, and you will soon succeed.—W. J. LANCASTER.

[46247.]—**Photography.**—If you are working with gelatine dry-plates, your trouble is probably fog. Are your dark slides perfectly light-tight, and what sort of light do you use to develop by? Are the edges of your plates, where protected from light by the plate carrier, clear and free from deposit? If the edges of the plates are clear glass, the fault may be due to over-exposure. One thickness of ruby and one of orange paper together over your window will give a perfectly safe light. I will try and help you further if you will send another query.—H. G. M. CONYBEARE.

[46248.]—**Amateur Dramatic Club.**—"A Fellow Workman" will find much useful information in a book written by an amateur performer of considerable experience. The title is "What shall we Act?" by M. E. James. Geo. Bell and Sons, London, 1882.—J. COLBY.

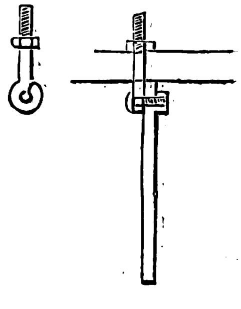
[46248.]—**Amateur Dramatic Club.**—Write to French, the theatrical publisher in the Strand, for his catalogue of acting plays. In it you will find a number of pieces suitable, with full particulars regarding scenes, number of characters, male and female, in each; also if past or present style of dress. He lends, for hire, the scenes, &c., required for many of them. Dresses, properties, and other requisites can be procured at any of the theatrical costumiers, who, on receipt of title of play, will supply you with every needful dress for acting same. Among the best costumiers may be named, May, Bow-street, Covent-garden; Nathan, Tichbourne-street, Haymarket; and Simmonds, King-street, Covent Garden. Wigs can be had from French or Clarkson, of Wellington-street. I might add that a most excellent manual, price 1s., is published by French on "Making-up," which by all means get, its hints being invaluable.—ARTHUR E. MORRIS.

[46250.]—**Fitting-up Battery.**—If you cannot go to the expense of clamps, better cast lead caps on the carbons, and solder them to small brass brackets, and screw them with wood-screws where you want them. You cannot solder to amalgamated zinc, as the solder amalgamates with the mercury. Should certainly use clamps in both cases.—GEORGE TOLMAN.

[46250.]—**Fitting-up Battery.**—Bend a piece of brass into this shape ⊓, then screw the carbon plate on to one side and the zinc plate on to the other side. You can tap the brass two holes on each side, and then drill holes in the zinc and carbon plates to correspond; then, with large-headed screws, fasten all together, and paint over with shellac varnish; screw the brass plate up against wooden carrier.—W. J. LANCASTER.

[46250.]—**Fitting-up Battery.**—Bend a piece of thick wire like Fig. 1, screw end, and fit nut, screw copper rivet, and fit nut, bore hole in C plate ½in. from centre of width and ¾in. from top edge, fix bent wire to C plate by screwed rivet. If zinc plates are thin, treat them in the same way; if thick, drill hole in end ½in. from centre of width, tap, and screw wire to fit. Bore holes in lifting-bar, which may be 2in. wide by 1in. thick, pass wires on plates through, and fix by nut, Fig. 2. All the wires from zinc plates must go through holes ½in. on one side of centre of width of bar, and all wires from C plates through holes ½in. on opposite side, so that the centre of width of plates is in centre of width of bar. You can connect the

FIG. 1, FIG. 2.



plates for various effects by wires between the lifting-bar and nut, terminal wires being fixed to the terminal plates in the same way.—J. M. STOCKS.

[46251.]—**Inhalation—Compound Oxygen.**—The article in question is probably an aqueous solution of hydrogen peroxide—a very unstable compound, readily decomposed into water and free oxygen on gently heating. It may be purchased at a moderate rate from any operative chemist. It is prepared by passing carbon dioxide through water holding finely-powdered barium dioxide in suspension, and filtering off the insoluble barium carbonate, or by adding barium dioxide to dilute hydrochloric acid, as long as it is dissolved. The solution in this case would contain barium chloride as a complementary product; but this would not interfere with its use as a source of free oxygen.—ANALYST.

[46251.]—**Inhalation—Compound Oxygen.**—Will "Tom" warm some of this substance in a test-tube, and insert a splinter of wood (which is just red-hot at the end) into the liberated gas. If the splinter bursts into flame, then moisten a piece of blotting-paper (white) with acetate of lead, expose paper to sulphuretted hydrogen (which turns it black), then put a drop of the American article on the paper. If the latter is turned white, buy a small quantity of hydrogen peroxide at 4s. 6d. per lb. in any large town, and see if that will produce the same curative effects as the substance you mention. You can prepare hydrogen peroxide by passing CO_2 through a mixture of BaO_2 and water for some time; then filter, when solution contains the hydrogen peroxide. Report results.—J. M. STOCKS.

[46251.]—**Inhalation—Compound Oxygen.**—The liquid is only a solution of hydroxyl or hydrogen dioxide (H_2O_2), often called oxygenated water. It contains just twice as much oxygen as ordinary water, hence it is sometimes called peroxide of hydrogen. It may be prepared by dissolving baric dioxide in dilute hydrochloric acid; precipitating the barium as sulphate, by means of sulphuric acid. The extra atom from the dioxide combines with the water, instead of being given off in the gaseous form. Fresh baric dioxide is again added and precipitated as above, until the solution is strong enough. These operations require performing carefully. Another manner by which it may be prepared is to pass a current of carbonic dioxide gas through water holding baric dioxide in suspension. The solution which is made by either of the foregoing methods, can be further concentrated under an air-pump, until it becomes a thick syrupy liquid, totally distinct from water. Very little rise of temperature causes the oxygen to be evolved with effervescence. A solution, containing ten volumes of the gas, can be obtained from the chemical dealer's, at about 4s. 6d. per lb. Without you are used to chemical manipulation, I should advise you to buy, instead of endeavouring to make it yourself.—ARTHUR E. MORRIS.

[46252.]—**Electric Bells.**—The following will, perhaps, suit; for although the resistances are not quite the same in each coil, you will find them most suitable for electric bells for ordinary purposes. Each bobbin must be filled level with size wire given.

	Bobbins.		Silk	Core.	Armature.
Bells.	Long.	Diam.	Wire.	Diam.	Square.
in.	in.	in.		in.	in.
2	1¼	⅝	30	¼	¼
2½	1½	¾	28	5-16	5-16
3	1¾	⅞	26	⅜	⅜
3½	2	1	24	7-16	7-16
4	2¼	1¼	22	½	½

—GEORGE TOLMAN.

[46252.]—**Electric Bells.**—A simple rule to remember will give you all the information you require as to size of electro-magnet for each size belt. Let the cores be one-half the length of diameter of bell, and their diameters one-fourth their length. Thus, for 2in. belt the cores would be 1in. long and ¼in. diameter; then the bobbins must contain a depth of wire equal to diameter of core. You can use 26-wire for small bells, and up to 18 for large bells.—W. J. LANCASTER.

[46253.] — **Spin - Wheels.**—Soak well with paraffin oil, and they will drive off easily.—J. J. A., Liverpool.

[46255.]—**Steel Stencil-Plates.** — Any ironmonger or tinman should be able to get you such sheets of the dimensions named, in steel, from the tin-plate manufacturers.—DIAMOND.

[46255.]—**Steel Stencil-Plates.**—I would go to a tenon-saw maker where the steel could be procured. Make it red hot (being careful not to burn in any part); when red, cover up in sawdust. This will leave it soft as the finest quality of iron, with no nasty pins in its texture; cut desired letters, &c., and then heat over a "charcoal fire." Hold it out in the open to cool, then stand at ease.—J. J. A., Liverpool.

[46256.]—**Poor-Rates.**—The rent of a house or premises has nothing to do with its rating, except as some evidence of value. Business premises are assessed according to the class to which they belong, as shops, warehouses, or mills, and if there be machinery upon them, that is considered in the valuation. It is obvious that the rent paid under a lease would often be no indication of the true annual value. If "H. H." thinks the rating too high, he can appeal within the time allowed from the date of the assessment.—FRED. WETHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall.

[46257.]—**Astronomical.**—Of course, a finder of almost the lowest power will enable you to pick up Uranus. It can be seen with the naked eye by many people, but is very difficult to the majority of observers as a naked-eye object. His angular diameter is, as you know, 4″, and never differs to any appreciable extent. This gives him about the same brilliancy as a sixth to seventh magnitude star.—W. J. LANCASTER.

[46258.]—**Discolouration of Bricks.**—Though in the business myself, I have never heard of any remedy for the white efflorescence which occasionally appears in red bricks. It is due to the presence of some salt, usually potash or soda, in the material, which works to the surface of the brick, and shows as a white scale. The only cure I know of is time. When the salt, whatever it may be, has all worked out and been washed away, the discolouration will cease. In the case of a house, it might be washed off with a hose, repeated till no more appears. My chimney "whitened" in places for months after it was built, but it wore off by degrees. Bricks that have been burnt in a Hofman kiln occasionally show a whitish colour in the ends where they have received the steam from the adjoining bricks; but that, too, wears off with time and weather. The same remarks apply to flower-pot (query 46231). It is a peculiarity of the material, which, as far as I know, nothing but time will get rid of. In flower-pots, perhaps the supply of salt is kept up from the earth used in them.—TREADLE.

[46259.]—**Piston Speed.**—To obtain piston speed multiply the stroke in inches by the speed in miles per hour, and by 56. Finally, divide this product by the diameter of driving-wheel in inches. The result will be the speed of piston in feet per minute. Applying this to your example, 26 × 60 × 56 / 84 = 1040ft. per minute.—ED. GOBERT, B.Sc. (Nottingham).

[46259.]—**Piston Speed of Locomotives.**—A 7ft. wheel is as near as possible 22ft. in circumference (7 by 3·14159); a mile is 5,280ft.; therefore, a 7ft. wheel makes 5280 / 22 = 240 revolutions per mile, or per minute, when speed is sixty miles per hour. With a stroke of 26in. the piston must travel 52in., that is 4·33ft. at each revolution; therefore, piston speed will be 240 × 4⅓ = 1040ft. per minute, a very high piston speed. The engine should, I think, have a larger driving-wheel or a shorter stroke. I have made for myself a small table, by which piston speed can always be calculated in a few moments.—L. G. B.

[46259.]—**Piston Speed of Locomotives.**—Rule: Multiply the number of revolutions of the driving-wheels per minute by twice the length of stroke in feet and fractions of a foot. The result is the piston speed in feet per minute. Thus, in the instance given, train is going 60 miles per hour—that is, 60 × 5280 / 60 feet per minute. Wheels, in one revolution, go 7 × 3·1416ft. Therefore, the wheels revolve 60 × 5280 / 60 × 7 × 3·1416 = 240 times in a minute. At each revolution, piston travels 26 × 2 = 52in. = 4⅓ft. ∴ piston speed is 240 × 4⅓ = 1040ft. per minute. The diameter of the cylinder has nothing to do with the piston speed.—GUIDE-YOKE.

[46259.]—**Piston Speed of Locomotives.**—The following is a simple rule for finding the piston speed. Speed of train in feet per minute × stroke in feet × 2 / circumference of driving-wheel = piston speed. For example: 60 miles per hour = 1 mile per minute = 5,280ft. per minute; stroke = 26in. or 2 1-6ft., circumference of driving-wheel = say, 22ft. Then, 5,280 × 2 1-6 × 2 / 22 = 1,040ft. per minute. The multiplier 2 is used, because each revolution of the driving-wheel equals two strokes of the piston. In this case the piston travels through 52in. or 4ft. 4in. for every revolution of the driving-wheel.—ECOSSE.

[46261.]—**Brakes.**—Holbech's new self-acting continuous brake acts by the momentum of each carriage, each one being independent of the other, and, under present circumstances, when the driver pulls over his lever all automatic arms are in position to act on brakes being applied on engine or front carriage, as if that brake is sufficiently powerful to put the required pressure on the next carriage those brakes are applied, and so on to the end of the train, be there one or a hundred. The brakes are applicable to all carriages that run on metals, either railways, tramways, or mines, as 20 to 50lb. springs per ton will effectually apply the automatic arms, and also the brakes, whenever the momentum exceeds the pressure at which the brakes are set to act, and each carriage will relieve its brakes when the momentum falls below that pressure, and can so be set by a pin by the superintendent of the carriage department. The arms can be thrown out of action by the guard; but, should the train be divided by any means—as failure of draw-bars, breaking of coupling-chains, or any other cause—a breakaway apparatus is provided, which locks the wheels of parted carriages in a moment, and applies continuous brake to left portion of train that also forms an efficient hand-brake for station or sidings. The great utility of this brake is first no steam, air, or vacuum cylinders, tubes, taps, or couplings are required; no thought of applying brakes is required when wanted to stop, as that is done before trains leave a station; also, should one or more carriages have their brakes deranged, they do not affect the remainder; each carriage will actuate its own brakes in any train, and almost any brakes may be used by my apparatus without interfering with their usual working; be they Westinghouse, steam, or vacuum; no extra fitting required on engine, so that many accidents might have been prevented had this invention been placed under the others to act where the scientific brakes are not understood, or not in working order. My hand-brake will lock engine-tender or guard's van in two or three turns of their wheels, when lever is pulled hard over. Models can be inspected in Leicester by appointment or application to patentee.—W. B. HOLBECH, Enderby, Leicester.

[46262.]—**Battery.**—You cannot beat the Fuller cell for fair constancy, but you cannot have power and constancy. Let me know the purpose for which you require the cells, and I will do my best to advise you.—W. J. LANCASTER.

[46262.]—**Battery.**—You cannot have a better one than the Bunsen; but you must charge the porous cell with nitric acid, or dipping aquafortis. It is tomfoolery to use the bichromate solution, unless you are working through a great resistance.—GEORGE TOLMAN.

[46262.]—**Storage Batteries.**—The force of Sutton's is considerably below the Planté; and I must say I have never yet seen one of these with a force of 2·5 volts. I am afraid Mr. Hezmalhalch will not get his questions answered. They would involve a complete treatise on electric lighting.—SIGMA.

[46267.]—**Piano Pins.**—These pins are not tapped with any thread, being simply filed slightly taper at points, and depending for their hold (like the violin pegs) upon the friction induced by driving them into a smaller hole than their own diameter, in hard beech. When from carelessness in not pressing home, or bad stringing, the pin protrudes from its normal nucleus, simply drive it in again with the hammer head, to be found upon any proper tuning key; but slack up the strain on wire before you hit.—J. J. A., Liverpool.

[46268.]—**Electro-Gilding.**—If your solution is one of double cyanide of gold, you have only to add a little free cyanide; have a stronger current from battery, and use solution at nearly boiling-point.—ELECTRO.

[46271.]—**Secondary Current in one Direction.**—The current produced in an induction coil is so feeble in quantity, that it could not be made to do any mechanical work, unless it was a very powerful coil, with large battery power, and specially constructed bells of high resistance. It would be just possible to charge a small secondary battery for very occasional use, but would simply cost about a dozen or two times as much as a common battery.—SIGMA.

[46272.]—**Legal.**—This is a very complex question which I cannot answer conclusively without knowing more. If the occupier has been in adverse possession of the office and buildings for over twenty years, then he has acquired a legal right to them; but if that occupation has been by the license or permission of the owner, that right would not accrue. If the statute of limitation applies, and the occupier has had over 20 years' adverse possession, then he cannot be disturbed or made to pay any rent. But should this not be so, and of this I cannot be certain without knowing more clearly all the facts, then the occupier, if no rent has been fixed, would be liable to pay a reasonable sum for the use and occupation (though not for more than six years past) while being a tenant at will. He could be served with a notice to quit at any moment.—FRED. WETHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall, E.C.

[46288.]—**Oval Lathe.**—Does "Oval" want to turn holes which are "oval," or which are elliptic? An "oval" is smaller at one end than the other, like the long section of an egg, from which, indeed ("ovum," an egg), the word is derived. Many people vulgarly call an ellipse chuck an oval chuck, whereas the ellipse chuck does not produce an oval but only an ellipse. A contrivance by Goyen, modifying the action of the ellipse chuck, is said by its author to turn ovals; but one gentleman, who had bought it, could not succeed, and when I tried it I saw no way in which it could be made to turn ovals. This was in the absence of instructions as to its use by Mr. Goyen. Other people call the ellipse chuck an "elliptic chuck," as if the chuck were itself elliptic, which, of course, it is not. Does "Oval" want to make holes which are oval, *i.e.*, egg-shaped and smaller at one end than at the other, or elliptic, *i.e.*, dish-shaped and alike at both ends?—J. E.

[46290.]—**Brass Casting.**—To insure against honeycomb, use new materials in the composition of the metal for your brasses. I have noticed that when old scrap is used, honeycomb almost invariably appears in the castings.—ECOSSE.

[46290.]—**Brass Casting.**—This may arise from pouring the brass when too hot, the mould not being dried enough, or not being sufficiently pricked to vent it. Brass-casting (like most occupations) requires experience, and a rational use of the reasoning powers of the pussons so situated.—J. J. A., Liverpool.

[46290.]—**Brass Casting.**—Your sand should be mixed well and often. Be careful when ramming, use the bellows freely, and if the brasses are large, vent them; but in all cases where sound castings are required, use a riser to your mould. This will bring off all the air, together with all the grit, and save you a deal of inconvenience when fitting them up.—PATTERN-MAKER.

[46292.]—**Dutertre's Gilding Solution.**—I am not acquainted with the formula for this solution; but perhaps the following, taken from a back number of the *Chemical News*, will answer the purpose. Dissolve 1 gram of fine gold in aqua regia, concentrate the solution by evaporation until it is the colour of ox-blood. Add half-litre of hot distilled water, in which four grams of potassium cyanide have been dissolved. Stir with a glass rod and filter. To gild with this solution, it is heated a little above lukewarmness, and the articles to be gilt are immersed in it and supported upon a piece of clean zinc.—ANALYST.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

45626. Micro. Objects, p. 411.
45631. Guardianship of Children by Marriage Settlement, 411.
45639. Eyepieces, 411.
45643. Stop Watches, 412.
45649. Wave, 412.

45860. Viola, p. 505.
45861. Trigonometry, 505.
45869. To Mr. Dresser, 506.
45873. Cotton Spinning, 506.
45878. Mr. Goyen's Lathe, 506.
45887. Polaristrobometer, 506.
45889. Cheese, 506.
45892. Gases, 506.
45904. Coloured Glass, 506.
45906. Umbrella Making, 507.
45908. Electro-Deposition of Iridium, 507.

The coal-tar or aniline dyes differ but in their molecules, and the quantities of hydrogen and oxygen. Water furnishes these gases by electrolysis, and M. Goppelsruder, of Bale, has submitted water holding certain colouring material in solution to an electric current, and has obtained various dyes.

QUERIES.

[46293.]—**Electro-Motor.**—My thanks are due to Mr. Lancaster for the very clear instructions along with drawings which he has so kindly given in answer to my query addressed to him, "Re Electro-Motor for Revolving Vacuum Tubes." I have made one exactly in accordance with the instructions given, but I do not get the required speed. It revolves very quickly indeed; but I should have liked it to have run at a very high speed, sufficiently so that when a tube is revolving it would produce the appearance of a catherine wheel, that is, it should produce the appearance of an unbroken circle of light. Would Mr. Lancaster kindly assist me? I made the electro-magnet exactly in accordance with his instructions given in No. 872, p. 336—and this works well. It has a very powerful attraction; the brass wheel is tinned, and will probably weigh ½lb.; the six armatures are as described, and ⅛in. thick; the commutator I have arranged to make contact when the cores are midway between the iron armatures, and contact broken just before the armature is over the centre of the magnet cores. Have I wound the magnet properly? I have wound both cores in the same direction—i.e., as if it were a straight bar, and then bent, having the same lengths of wire silk-covered on both limbs. I shall be very thankful to Mr. Lancaster for any information he will kindly give. I notice with pleasure that Mr. L. has the first part of his paper on the Rhumkorff induction coil finished. Would Mr. Lancaster kindly supplement his paper by stating the various quantities, sizes, and weights of materials for making coils of various sizes? Myself, I should very much like to make a 3in. coil, and shall certainly attempt to follow Mr. Lancaster's instructions, being so pleased with the success I have met so far, as others might only wish to make a 1in., and so on.—A. A.

[46294.]—**To "Sigma."**—The article on electricity in the *Encyclopædia Britannica* suggests the use of metallic sulphides in the construction of thermo-electric batteries, and refers to the works of Wiedeman for details. I have no opportunity of consulting the work. No doubt "Sigma" will have some notes on the subject, and would kindly suggest the best sulphides for use, and any incidental information that would assist me in the construction of a thermo-electric battery.—T. S.

[46295.]—**Paralysis.**—Will Dr. Edmunds and others kindly give their opinions on this case?—A friend of mine who is suffering from paralysis of the legs, and has been under treatment of several medical men, and tried almost every known remedy to regain his locomotive powers, now thinks that if a stationary machine were constructed, having cranks and pedals to fix to the boots, and worked by levers with the hands so as to give an action to the legs similar to walking, and take an hour's exercise daily in his room on this machine, it would tend to the recovery of his natural powers. My friend now rides a 50in. invalid's tricycle, Bayliss, Thomas, and Co.'s, worked by hand-levers, from which the idea is taken. No doubt there are many others suffering in the same way, who would be glad to know of something for their relief.—C. R. B.

[46296.]—**Harmonium or Organ.**—Through the kind help given in your paper by "Saul Rymea" and "Elève," I was enabled to build a two-row American organ about three years ago, with which I was much pleased. Now as past success makes bold for future endeavour, I wish to enlarge to a four row, one manual, using the same case, reeds, stops, and briefly all that is possible to be used, to save expense. Good-hearted "Saul."—Shall I make it pressure harmonium or suction American? Would the effect of American boards turned upside down with pressure-bellows and pallets, harmonium fashion outside, be satisfactory? In either case I am not clear as to how to make the pallet action for four rows. How is it done on the harmonium? In this four row I want variety and pure, pipe-like quality of tone. Advice will not be lost on one who feels grateful for past help.—BETA.

[46297.]—**To Mr. Lancaster.**—Can you tell me any rule by which I may ascertain the different thicknesses of wire on an electro-magnet, and an armature to revolve within it? I have two Siemens armatures wrapped with No. 18, and wish to construct two electro-motors, one on Grisćom's principle, and the other on Trouvé's; but hitherto have been unable to find out the thickness of wire for the magnets. If it depends on resistance, is there no way of measuring that without a resistance box; and finally, how is the amount of wire found, supposing the space it has to occupy, when wound, be known? It seems a very inaccurate way to treat it as solid copper weighing ·3225lb. per cubic inch. An answer will greatly oblige—CLÔTURE.

[46298.]—**Glycerine.**—Lately this valuable article has advanced so enormously in price that I am told soapmakers are now extracting it from their waste products. Will Mr. Allen or some other kind reader inform me the best means to adopt to try it on a large scale, and also state what the chief impurities are in commercial glycerine, with the best analytical method of detecting them?—INQUISITIVE.

[46299.]—**Precession of the Equinox.**—Will some of your numerous correspondents kindly inform me when the Sun first entered the constellation Pisces at the Vernal Equinox? In all the books on Astronomy I have yet seen, this fact is stated: that the Sun is no longer in Aries on the 25th of March; but none of them say when the change from Aries to Pisces took place.—ASTROLOGOS.

[46300.]—**Broken Drills.**—How can drills be got out of a brass plate 1¼in. thick? They are broken off about half-way through. The drills are "Morse twist" size 30, and the holes in which they are broken are drilled 6 to the inch (that is 36 to the square inch), so that they are quite close together. Can they be dissolved out by an acid that will attack the steel without touching the brass?—C. T.

[46301.]—**To "Sunlight."**—Thanks very much for answering my last query; but it is as I expected. If not troubling you, will you be kind enough to give description of boiler to suit engine ¾in. bore, one that will stand, say, 50 to 70lb. per sq. in.? and form of boiler. Would the cylinder stand, say, about 45lb. pressure? The covers are fastened with six screws at each end.—C. HORACE PHILLIPS.

[46302.]—**L. and S. W. R. Engines.**—Can "Clyde," or any other correspondent, kindly give me principal dimensions of this company's engine, Wildfire, No. 77, where built, and date?—F. G.

[46303.]—**Medical Coil.**—To MR. LANCASTER.—Kindly explain the manner in which a coil should be joined up, made with No. 18 wire for primary, and No. 36 for secondary with contact-breaker at end of coil? The reply you asked me to refer to in "E. M." of 17th ult., is in reference to a coil on a different principle from the above. Sorry for again troubling you.—JAS. MAIN, Aberdeen.

[46304.]—**Hardening Brass Wire.**—Will someone kindly inform me of a way to harden brass wire which has been made red-hot? I find it bends far more easily after being heated; but it is of no use as a spring without being elastic.—NORTHUMBRIA.

[46305.]—**Blowing Engines.**—Can any correspondent give me the following information regarding blowing engines?—Are they suitable for getting blast to a large number of smiths' fires? If they are, what size would be necessary for working, say, 50 heavy work fires? If anyone can give this information, along with particulars of construction and method of calculating the power of blast engines, it will be greatly esteemed.—CLARE.

[46306.]—**Telephone v. Bell.**—I am anxious for information with regard to the relative advatages obtained by using for telephone calls magneto-electric bells as compared with those obtained by the use of the ordinary electro-magnetic bells and Leclanché battery. I am at present arranging telephonic communication between some 24 different parts of a large building, and am anxious, if possible, to do away with the necessity of attending to 25 separate batteries. The points upon which I more especially wish to be informed are as follows:—1. Does the magneto-electric bell easily get out of order? 2. If I use a magneto-electric bell, is it necessary for me to have a battery of one or more cells at both ends of the line, Crossley's transmitters being used? 3. Is any special form of indicator required with the magneto-electric bell or will any of the ordinary forms do? 4. Should I be able to ring two bells at the same time in different places with the same facility as in the case of the ordinary electric bell? 5. Would the sound produced by a magneto-electric bell, such as ordinarily manufactured, be sufficient to call attention in a noisy workshop? 6. What is the average time during which the ordinary Leclanché cell will remain effective if not used more than 10 or 12 times a day for periods of, say, 5 or 10 minutes at a time, supposing it to be duly attended to? In short, for the use of servants and workmen little accustomed to use delicate instruments, would the magneto-electric system be as economical and serviceable as the ordinary electric bell for calling attention to the telephone; and would it be as easily made serviceable to meet the requirements of a large institution?—YEKNAS.

[46307.]—**Barrow.**—Will any of our kind readers help me with a few suggestions for making a light and inexpensive truck or barrow for carrying, say, pianos, &c.? I have a pair of wheels, axle, and springs. The wheels are 3ft. 6in. high; axle 3ft. 3in. between boxes; now I want the body. Any suggestions.—AMATEUR WHEELWRIGHT.

[46308.]—**Telescope.**—To MR. LANCASTER.—I have a first rate opera-glass, the lenses of which I should like to make an astronomical telescope. The lenses are achromatic plano-convex of 2in. dia., and, as near as I can measure them, of 3½in. radius. If you would tell me what additional lenses I should require, and how to find their distances apart, &c., you would greatly oblige me.—CROTCHET.

[46309.]—**Filterer.**—I have a water-tank sunk in the ground, and supplied with the rain-water from the roof of the house. There is a filter in connection with it, through which the water has to flow previous to entering the tank. The said filter contains about two tons of ordinary river-sand. Could anyone tell me if rain-water filtered in this way is fit for domestic purposes, or of any better material with which to charge the filter to make the water fit for such purposes?—GEORGE HUTCHINSON.

[46310.]—**Water Supply.**—Would it be practical to get a siphon to work with 1ft. of fall through a ½in. pipe half a mile long, the said pipe having to pass over a hill about 20ft. high? Or would it be better to cut through the hill to get the fall?—G. HUTCHINSON.

[46311.]—**Horizontal Engine.**—What should be bore of cylinder for engine to drive a 4in. centre lathe; also boiler and slide-rest?—SCRIB.

[46312.]—**Repairing Cylinder Face.**—Having a traction engine with cylinder and valve-faces roughly cut and worn, I wish to be informed the best way to get cylinder face up, it being boxed in.—HIGH PEAK RANGER.

[46313.]—**Roof for a Lean-to Hot-house.**—I wish to put a new glass roof and glass ends on an old hot-house of the following dimensions:—Height at back 9ft.; breadth at base, 12½ft.; slope of roof (back to front), 15½ft.; length, 21ft. I am informed that the cheapest plan is to put up rafters and glaze them when in position, leaving the ventilation to be managed by openings in the front and back walls. This I can easily do, as my walls are of brick. What size rafters should I use to carry 21oz. horticultural glass? How should the ends be constructed—should they be stronger than the sloping portion (my old one was blown down in a very heavy gale)? What size of glass, and what kind of timber is best? How should the latter be prepared for glazing and painting; what allowance should be made for expansion of glass and wood by weather? Wishing to do the carpentry and glazing myself, I should feel much obliged to anyone who will kindly give me any information on the subject.—MUSCATEL.

[46314.]—**Closet Cistern.**—Will some of "ours" explain the cause of the water coming down supply-pipe when cistern is three-parts full to water-closet when wind is rough? Is it necessary to have an air-pipe in the ᑌ-trap? It has worked some years without. Also, how can I put a new leather on valve in cistern?—does the brass pivot unscrew?—CLOSET.

[46315.] —**Ethoxo Limelight.**— Would "Sunlight" kindly tell me what alteration I would need to make on my mixed gas-jets to use them with the above light? Also, what is the size of the hydrogen generator, and is it in the form of a wash-bottle? My lanterns are a pair of Sciopticons, by Wood, London; but I seldom use the lamps. Any information on the above light would be greatly valued by—EXHIBITOR.

[46316.]—**Continuous Brakes on L. & S.W.R.** —Could any correspondent tell me if it is true that the L. & S.W.R. are going to adopt Smith's vacuum brake? I have noticed lately on one or two four-coupled tank engines belonging to that company, two brake-handles close together, one being for a steam brake, which is on the right hand side of the engine; what is the other handle for above the regulator? Is it for Smith's vacuum? If so, why is there a steam brake for the engine-wheels? There was a hose connecting-pipe at either end of the engine. Many thanks to "Centaur" and "Driver" for their answers to query 45712.—BRAKE-BLOCK.

[46317.]—**Ferns.**—Will someone be kind enough to inform me how to deposit copper on ferns? I have tried, by coating with plumbago, but the frond has swollen in the water, and thrown off the plumbago, and no deposit has taken place.—SINGLE CELL.

[46318.]—**Protecting Steam-Pipes.**—I am going to run a steam pipe 1in. dia. under ground for 500ft. for steam-heating; pressure of steam, 50lb. Would someone who has had some experience, please say how I can protect it so as to have as little condensation as possible? The ground here is frozen from 2 to 3ft. in the winter.—CANADIAN SUBSCRIBER.

[46319.]—**Engineering.**—Having a large quantity of stone to bring from a line to my work, a distance of 400 yards, I should like to fix a drum and tramway to make the loaded waggon draw the empty one back. Will some of your correspondents kindly inform me if this is practicable with a fall of 1 in 10, and where I could see a similar apparatus at work?—ENQUIRER.

[46320.]—**Motor.**—I have a machine that requires 28lb. weight attached to a handle to move it. What I should like to do is to obtain a motor to work it, which must be of small size. Therefore, I could reduce the power by spur gearing 5 to 1 or 4 to 1, which would, in the former case (if I am correct), reduce the power required to move the machine to about 5½lb. weight, but would necessitate a speed of 170 revolutions per minute. In the latter case the weight would be reduced to 7lb., and speed 136 revolutions. The machine is not a fixture, and will be required to work in various places. Could "Sunlight," or any kind reader, suggest something likely to suit? and oblige—POOR PETER.

[46321.]—**Tipping Clay Tobacco-Pipes.**—Can anyone inform me how tobacco-pipes are enamelled or glazed at the tips to prevent them sticking to the lips? Some are mounted with sealing-wax, which comes off when smoking.—TOBAC.

[46322.]—**Electric Sign.**—Will some reader of the "E. M." be kind enough to supply the necessary information to enable me to make a small electric sign? The letters of which would be composed of circular discs, bright. Or cost of one of one of seven 5in. letters?—GIBSON.

[46323.]—**Pumping by Steam.**—Will "Sunlight" inform me the best way to pump water by steam to supply a boiler? The well is 200 yards from engine—8 h.p. We have to pump the water at present by manual labour, which is a lot of trouble. I do not want to go to a lot of expense.—AMATEUR.

[46324.]—**Shuttle Tongue for Paper Tubes.**—Can any reader give me any information of the best sort of shuttle tongue for paper tubes? The ordinary shuttle tongues pull them out of shape, and cause the weft to break when the cop is half woven off.—BEDA.

[46325.]—**Intensity Coil.**—1. What is the relation between the coil and the cell-power that may be applied to it, so that one may know how to get maximum effects without risk to the coil? 2. In purchasing a coil for ordinary experiments, such as illuminating full-sized vacuum tubes; raising platinum wire to white heat; exploding gunpowder, &c., what qualities ought one to look out for? 3. Why is the ordinary sulphide of calcium not phosphorescent?—VOLVOX.

[46326.]—**Helical Epicycloids.**—In Vol. III. of the Amateur Mechanical Society, Mr. Burnaby gives a description of an instrument for helical epicycloids, and gives drawings and curves produced by it. It is very interesting. I should much like to construct such a machine. I have essayed making full-sized working drawings, but am not satisfied with them. To make all plain, I should like good elevations of the complete machine from three points of view. Photographs would probably answer if lettered, and a sectional drawing added. A friend, who was a member of the Society, lent me the first three volumes, but has no more of them. Nobody I know, knows whether a fourth volume has been published. If anything further has been written regarding this machine by Mr. Burnaby, I am sure many, besides myself, would be gratified by seeing in your pages what I ask for.—RAMADEEN.

[46327.] —**Steam Launch.**— In constructing a launch of iron 30ft. long, what beam and depth from deck to keelson would be requisite; and in what manner are the ribs set out? Or would any reader of your valuable paper supply me with working drawings?—DOX.

[46328.] —**Lodger.**—If a distraint is made for rent in a house where apartments by the week or month are let to temporary lodgers, are the belongings of such lodgers liable to seizure?—O.

[46329.] —**Chromate of Calcium.**— Will any chemical reader tell me how to make chromate of calcium?—W. T.

[46330.]—**Cream Separators.**—Could any reader give a description of Paterson's cream separator, as used in the Aylesbury Co.'s premises; also the Dairy Supply Co.?—A. B. D.

[46331.]—**Flageolet.**—I have a flageolet which, when I got it, would not play the C unless I hardly blew at all; but played, instead, the upper B. This, I thought, was because the wind did not strike fair on the edge of the whistle; so I took a little bit off the piece inside to make the wind strike lower down—but that made matters worse. It now plays the B only when I do not want it, and the C not at all. Will someone tell me the cause of this, and what I must do to set it right?—A MUSICAL CHIP.

[46332.]—**Electrical Resistance.**—Will some subscriber tell me the name of some liquids which offer a high resistance to the electric current? Also the method and instruments that are used to find the resistance of a circuit?—INQUIRER.

[46333.]—**Gregorian or Cassegrain.**—I have an old-fashioned Gregorian telescope by Dollond, on excellent stand. The mirrors are broken, and I wish to replace them by silvered glass ones, ground to spherical curves. I shall be very glad if one of our optical friends will tell me whether Cassegrain's or Gregory's construction gives least distortion? Also the best ratio for the focal lengths? The diameters must be 4in. and 1in. respectively. Is the distortion in these telescopes greater than in a Newtonian of equivalent focal length? Of course, I mean in a Newtonian with a spherical mirror.—G. L. E.

[46334.]—**Gas Purifying.**—I have a small gas-works (gasometer having a capacity of 6,000 c. ft.), recently erected by a first-rate maker, but am not successful in purifying the gas. I wish to know the proper modes of purification, and also the tests required—both for quality of light and purity of gas. I should also be glad to know the best kind of coal to use. The works are in Devonshire.—ROSICRUCIAN.

[46335.]—**To Mr. Lancaster.**—Some time since, you kindly replied to a question concerning the method of using permanganate of potash, put by me. If if be not asking too much, I would request an answer to the following:—I know that cottons and linens can be disinfected by permanganate, by steeping them in it overnight; but how should flannels (which are not usually steeped in cold water) be treated? Would not hot water hasten the action too much?—HOUSEKEEPER.

[46336.] — **Telephone Circuits and Call.** — Given a line and a return wire between two stations, and that each station is provided with a bell, a push, and a battery: a description, with diagram, is asked for, of proper arrangement of wires, so as to use the bell as a call, and then telephones at either station. Return wire is not insulated. Also, how, in foregoing query, to add a microphone to either or both stations?—MEME.

[46337.]—**Steam Launch.**—To "SUNLIGHT."—I intend putting a 5in. bore by 6in. stroke engine into a ship cutter 25ft. long and 6ft. beam. I have a propeller 2ft. 3in. diameter by 3ft. 6in. pitch. I wish to get in a cross-tube boiler or a vertical boiler with vertical tubes. The launch is for salt water. Will "Sunlight" say what size I will require, how much heating surface? Would a vertical boiler do, 2ft. 6in. diameter by 3ft. high, heating surface of firebox 12ft. 6in., and two 4in. cross-tubes, heating surface 4ft.; total, 16ft. 6in. Regarding the exhaust, I hope to condense same by series of pipes along the keel. Any further information will oblige—STEAMER.

[46338.]—**Sulphide of Calcium.**—Would some of our readers kindly inform me how to make this? I have tried heating sulphur and lime, but cannot succeed. Must the crucible be made airtight, or are there any particular proportions?—F. R.

[46339.]—**Dynamo Machines.**—Is it possible to make a small one, say for two 20-candle lamps? If so, any information as to construction would greatly oblige—F. B.

[46340.]—**Painting on Silk and Satin.**—I have painted on both these fabrics with oils and water-colours, but in both cases have found the paint to crack very shortly after completion. I should be much obliged to any correspondent who would tell me how this may be prevented.—LENT LILY.

[46341.]—**Nickel-Plating.**—During the last three years we have had a number of formula for solutions given; but at the present time nickel-plating appears to be done much better than heretofore. Will any practical subscriber of "ours" kindly inform me—1. The best working solution? 2. Power of battery. 3. Surface of anode (pure nickel) to be exposed to the surface to be plated. 4. Any preparation for steel. Following several formulæ in "ours," I get either a rough deposit or one that strips off steel in small pieces.—W. S.

[46342.]—**Estimation of $S'H_2$ and CO_2.**—Will "Analyst" or W. Duff kindly give a description of process for estimating the quantities of SH_2 and CO_2 that are driven off gas-liquor by boiling with lime?—L. D

[46343.]—**Smith's Fan.**—Will J. Perry kindly give me the size and all information concerning same as offered, as I want to make one to blow my fire instead of bellows? I have some chains taken from a Green's mowing machine—could I use them to work up the speed on same?—ALBERT HALL, Smith.

[46344.]—**Locomotive Matters.**—Will Mr. Gobert, "Flying Dutchman," or any other correspondent, kindly explain what the Belpaire system of firebox consists in, and what its advantages are? Also, what is the Bourbonnais type of goods-engine? Is this latter a peculiar type? If so, kindly give a few particulars, &c.—GUIDE YOKE.

[46345.]—**Continuous Brakes.**—Can any correspondent give any information concerning the Creamer, Ward, Loughbridge, and Henderson systems of brakes? What is the medium by which they are worked? I believe they are in use in the United States of America. —GUIDE YOKE.

[46346.]—**M.S. & L.R. Engines.**—Would some correspondent kindly give the dimensions of the new M.S. & L. single engine, and state where it is stationed? —LORD OF THE ISLES.

[46347.]—**Indigo.**—I have a considerable quantity of a solution of indigo, known in the dyehouse as "vat liquor." It has been employed for dyeing woollen; but through having no use for it for some time, it was left in the vat in which it was prepared. On dyeing some woollen last week, I found that the colour given was of a dirty description. On examining the liquor, I found it to contain large quantitites of dyestuff along with dirt. Thinking that if the liquor was freed from the soluble impurities which had got in through the negligence of a man who had the care of the vat, a small portion of the liquor was passed through a filter, and its dyeing power tried again, giving about the same result. What must be done with this; is it to be turned into the river as useless? It contains a large quantity of indigo, which, I think, might be utilised. Any suggestions will oblige—PRO BONO PUBLICO.

[46348.]—**Strophometer.**—Can any of our readers give information as to the construction of Hearson's strophometer or revolution indicator, for which the Society of Arts awarded their gold medal some years ago? —T. AND D.

[46349.]—**Model Steamboat.**—I have a boat about 3ft. 9in long, 9in. beam, and 8in. deep. A slide-valve engine to drive it, ⅜in. bore, 1¼in. stroke. Would "Sunlight" or some brother-reader kindly tell me the best sort and size of boiler that would suit it? A rough sketch would greatly oblige—S'IL VOUS PLAIT.

[46350.]—**Lantern Optics.**—If two slides of equal thickness and similar tone of colouring be placed in the same position in the lantern successively, both slides will be seen equally well without alteration of focus for the second slide; but if a third slide be introduced of similar thickness, but dissimilar colouring, will readjustment of the focus of the objective be necessary, and if so, why?—B. B.

[46351.]—**Leclanche Battery.**—Will Mr. Lancaster or some other gentleman kindly tell me how to prevent oxide forming between the carbon and lead?—J. ELLIS.

[46352.]—**White Fungus on Fish.**—I should be much obliged for a little information respecting the character, cause, and cure of the above? If too voluminous, a reference to a source of information would be very acceptable.—C. O.

[46353.]—**Chemical or Other Action in Aquarium Fittings.** — Would the following materials, composing the supply and waste to, and bottom of tank, in contact with which the water comes during some portion or other of its journey after passing through the ordinary lead service and zinc cistern of the house, be detrimental to the fish—viz., compo gas-pipe, brass, indiarubber tube (white, a portion having turned black during use), zinc, galvanised iron, soft solder, red and white lead, litharge putty, and Portland cement. If so, would the action decrease or cease entirely in course of time, with ample change of water?—C. O.

[46354.] —**Telephone Transmitter.**— In Vol. XXXII., No. 809, p. 56, was given sketch and description of De Locht's pantelephone, and stated that the movable plate may be of metal, cork, or mica. I made a pair with brass plates, but could not get any satisfactory result. It seemed, on listening at telephone (Bell's pattern), that a pair of cymbals were being clashed in the circuit; and on screwing contact-piece more firmly against the carbon disc, I could not get any sound; so after trying several times, I threw them on one side in despair. I now see by a recent article in the "E. M." that they are a great success at the Crystal Palace; also that an induction coil is needed. Would any of "ours," having seen it, kindly give particulars as to thickness of diaphragm, and in what part of transmitter the coil is inserted; also gauge, and amount of primary and secondary wires? I am not able to see for myself, being too far away.—ON GUARD.

[46355.—**Photo. Enlargement.**—To MR. LANCASTER.—Would you inform me how to make an enlargment on sensitised paper, or recommend a cheap book describing it? I want full particulars. I have a quarter-plate lens and camera, and a friend has a magic lantern, if that is required in the work, and oblige—H. C. F.

[46356.]—**Analysis of Alloys.**—Would any of your chemical readers kindly explain the *modus operandi* for determining, separating, and estimating weight of the respective elements contained in an alloy supposed to consist of copper, zinc, tin, antimony, and a trace of iron, giving the reaction in each case?—A LANCASHIRE ARTISAN.

[46357.] —**Clock and Watch Making.**— To "ALFOJOE" AND OTHERS OF THE TRADE.—Encouraged by the example of C. R. Beaumont, I beg to ask if it would be possible for a man 30 years of age to learn the trade? I may say that I have received a fair education, and take great interest in mechanics, &c. I should like to learn the trade if possible. Could I get anyone to teach me if I went for some time for nothing? Would I have any premium to pay? Any advice would be most thankfully received by—NO TRADE.

[46358.]—**Galvanometer.**—Would someone kindly give full particulars of the instrument used by the inspectors in the postal telegraph department of the Royal Engineers? Is it a sine, or a sine and tangent combined? It is carried in a leather pouch, like field-glasses, and is used with the resistance coils. The instrument I refer to is in a brass case, about 5in. dia. Is it graduated with degrees? The one I saw (over five years ago) was very delicate, and served its purpose well. Fullest details will oblige—M.M.I.So.S.

[46359.]—**Gilding Watch-Plates.**—Can any of your readers inform me how the frosted appearance on watch-plates is produced? I have tried to do it, but cannot do it to satisfaction.—H. COHEN.

[46360.]—**Roofing.**—A small villa, much exposed to all winds, is to be covered with felt and slates. What kind and size of slate would be best?—should they be hung on one or two nails? Could anything else be put on felt without damaging appearance? State difference in price per 100 square yards, and oblige—INGLE.

[46361.]—**Bicycle.**—I propose to have the extremities of the fork a little turned back, like the letter J. It would give it elasticity, and a tendency to run in a straight line. The strain upon the arms would be relieved, and the saddle could be moved further back. Has it ever been tried?—INGLE.

[46362.]—**Cast Steel.**—I shall be glad if some of our practical correspondents will tell me how to erect a furnace for casting about 10 cwt. of steel suitable for pit-box wheels and pedestals; also, what kind of metal is used for mixing and making steel?—WIGAN.

[46363.]—**Turning up Cart-Wheel Axles.**—Would someone kindly give a sketch of a simple self-centring tool to hold brass caps for cart-wheel axles in a lathe while they are turned up?—L. W.

[46364.]—**Preservation of Teeth.**—Would Dr. Edmunds kindly inform of a remedy for small black specks on the teeth? I think a few hints on the preservation of the teeth would be thankfully received by many.—G.

[46365.]—**Income-Tax.**—I shall feel grateful for advice. My income from all sources is, say, £210 per annum (£40 pension, £40 parish officer, £80 on business, and £50 improved ground rents). I have always understood that in paying Income-tax on such an amount a claim of £120 is allowed off, which, in my case, would leave £90 to pay on. This I have hitherto done, but this year the order of things is altered; the Assessor of Taxes demands 5d. in the £ on the £40 as parish officer, but I argue that I have already paid on £90 (£40 pension, and on £50 ground rents), and if I pay on the £40 demanded it will be paying on £130, and a claim of only £90 off. The Assessor states that all pensions and appointments must pay on the full amount, no matter how small—even if the whole of the income should be but £50 a year derived from either a pension or appointment, that sum must pay Income-tax. If this is law, surely it is a robbery, and shall be glad to know if I am not entitled to a claim of £120 off under the circumstance stated.—J. W.

[46366.]—**Leather for Bellows.**—I am making a pair of double bellows for blowpipe and other use—will some reader kindly inform me what is the right kind of leather to use? Hints in making will also oblige—NEMO.

[46367.]—**Furnace.**—Will some obliging reader explain to me what should be the difference in construction of a reverberatory furnace for reheating iron, using anthracite coal, and the same kind of furnace using bituminous coal? Also, what is the best method of distinguishing the one kind of coal from the other?—ADRIAN.

[46368.]—**Clock.**—I have a Yankee lever watch I want to take to pieces and cannot. Will any kind reader help me out of the difficulty? The rim at the back seems fast at each side. I have undone all screws visible. Does the winder and hand-setter come off before the back?—ANXIOUS AMATEUR.

[45369.]—**Vacuum Tubes, and What Can be Done with Coils.**—TO MR. W. J. LANCASTER, "A. W. S.," "J. B.," AND "H. B. T. S."—Many thanks to the above gentlemen for their information relating to V. T.'s and Coils. To Mr. W. J. Lancaster and Mr. A. W. Soward, I beg to say that I will be most thankful for any information they will kindly give as to what can be done with a small coil about ⅜in. spark. I have the ENGLISH MECHANIC for the last fifteen years, and, on looking through them, I see very little about working the coil, though a good deal about making it. I acknowledge that the use I make of the coil is principally for amusement; but, still, I do not lose sight of the "hidden mysteries" altogether. I have made several devices or designs with the 6in. tubes on black-boards, with connecting wires carried along at the back, the ends merely coming through the board in the form of hooks on which to hang the tubes, and succeed perfectly in the illumination of five or six tubes thus arranged—that is, with one end of them—and from what the aforesaid gentlemen say, I suppose I must not expect more—that is, that both ends will show with equal brilliancy.—W. R. C.

[46370.]—**Lathe.**—In Volume XXXIV., No. 876, p. 420, I see drawings of an amateur's lathe; I think it is a very handy one. Will Mr. Evans or some kind friend help me in the matter? I want it to be self-acting, and about 3ft. between centres, and 4in. from top of bar to centre. How am I to bore holes in standards true, for bars to go through, as for rest to slide on, as the bars want to be perfectly true? Ought the bars to shoulder at the standard face-plate end of spindle? Must the bars be tapped, or will hole drilled and pins hold them tight? Will it be best to have the screw in centre of bars, or to run by the side through stud? Can it be driven by the screw? I mean a pulley keyed on live spindle, and a square bar run along the lathe-bed turned at ends. A strap off pulley on live spindle on pulley on square bar, strap off another pulley at other end of square bar on to pulley on end of screw, the screw to run in bearings with two collars and nut, or hole in rest tapped for screw to thread in. Must the screw be turned and chased in the lathe, or can it be made to work freely tapped in the ordinary way with stocks and dies? Would it not work better in centre? As regards the spindle, I have taps and dies from ⅜ up to ¾. Will any of these do to tap live spindle to screw face-plate in? How am I to proceed to make the rest? Must there be a nut fitted in the middle of that for screw-thread to work through? If so, how is it done? Can it be fitted in two, so when loosened to slide up the bars faster (the rest I mean) instead of screwing both ways? Are the crossed legs halved together strong enough? Will the lathe vibrate at all? Would angle-iron be better? If screw has to be turned and chased, what will be probable cost? Likewise bars turned true 1in. round—is 1in. round sufficiently strong? The slide-rest looks the most difficult. Any information will be thankfully received by—A CAMBRIDGESHIRE BOY.

THE longest railway in India is the East Indian with 1,504 miles; next comes the great Indian Peninsular with 1,275 miles. The Madras follows with 858 miles; the Sind, Punjaub, and Delhi with 663 miles; the South Indian with 645 miles; the Rajputana with 489 miles; and the Bombay, Baroda, and Central India with 444 miles.

ANSWERS TO CORRESPONDENTS.

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*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

***** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.**

The following are the initials, &c., of letters to hand up to Wednesday evening, March 8, and unacknowledged elsewhere:—

H. HOLT.—W. Grove.—J. L. Stothert.—Rev. J. Lamont.—J. Terras.—A. Pigott.—D. H. Littlejohn.—F. York.—J. Mather.—C. S. Stock.—Jas. Wilson.—R. W. Armstrong.—J. B. Stephen.—Prof. Patrix.—Rev. J. B. Annesley.—D. Browne.—W. L. O.—Tindal.—Joiner.—Ladle.—Guyot.—Sam Weller.—Summit of England.—X. Y. Z.—N. W.—Conoid.—H.—Les Dents.—Progress.—H. A. Wassell.—North Briton.—Constant Reader.—Subscriber.—Orderic Vital.—Bevel Wheel.—H. L. Dunkin.—Isomeric.—R. E. B.—J. E. Ford.—Chepstow.—Novice.—Dome Joint.—Bramwell.—Enquirer.—Hot Iron.—A. S. T. E.—Pollockshaws.—Diamond.—J. C. King.—H. S. P.—R. W.—Jack of All Trades.—T. G. Elger.—Rough Diamond.—E. Gobert.—E. C. S. E.

A NEW VOLUME.

THIS number is the first of Volume XXXV. Readers willing to oblige us by recommending "ours" to new subscribers should do so now, when a new volume is commencing. The index to Vol. XXXIV. will be published in the number dated March 24, and cases and bound volumes will be on sale shortly after. Readers desirous of making up their sets for binding the last volume are recommended to do so at once, as the back numbers soon run out of print.

D. P., York. (There is no special law affecting apprentices to electricians. If their parents and guardians imagine that their masters are neglecting them—nine parents out of ten blame the master when they should wake up their lazy sons,—they have their legal remedy, which any solicitor will point out. Hours of working vary, but average nine hours a day.)—CHIMNEY POT. (It smokes when the wind is S.W., because some taller building or similar obstruction hinders the draught. No universal remedy can be named; but, speaking generally, we believe Boyle's chimney cowl is the best thing you can use. See advertisement pages of the *Building News* for illustration and description.)—FIDDLESTRING, PAGANINI, AND OTHERS. (We cannot spare any more space for queries as to the value, age, &c., of real or fancied old violins. Nine out of ten are rubbish, and the merits of the tenth can only be appraised by a connoisseur who has *seen* the instrument.)—JOHN LANE. (What you ask would take a volume to give in outline only. There is a book published by Churchill and Co., by Dr. Geo. Wilson, which would give a great deal of the information asked for, but we forget the title. Get the last "Public Health" Act, and read that and the statutes it superseded and consolidated, and then wish, as all sensible men are wishing, that one of these days Parliament may have the time and inclination to pass a really comprehensive and reasonably perfect code of sanitary laws, instead of wasting its time as at present.)—ONE AND ALL. (It is a question for a valuer or surveyor. We cannot deal with matters relating to cost and value of houses in "queries.")—GLENESK. (See a surgeon, It may be dangerous; but no one can possibly say without seeing you.)—A SUFFERER FOR FOUR YEARS. (Such ailments frequently last for years, and then disappear. Temperate but good living, and abstinence from beer and spirits—except when ordered by medical men—are the most likely means of assisting Nature to a cure. It is more than probable that you are suffering from inherited disease.)—GEREBE ADMI. (We believe not; but you had better address the Secretary. The Society and its publications seem alike in a backward condition.)—IN TROUBLE. (You must employ a solicitor, and let him state your case to counsel. On production of counsel's opinion that you have good grounds for proceedings, the Judge of the Divorce Court will allow you to sue *in formâ pauperis*. You had better consult your solicitor on the question of damages.)—H. HOLT. (Many thanks; but we fear we could not spare the space.)—JOHN TYLER. (You had better communicate direct with the correspondent you mention. Long before his reply can appear the ten days will have elapsed.)—A SUFFERER. (Most probably indigestion. See back numbers.)—W. P. (By passing steam through incandescent anthracite or coke. See reply 46155, last week.)—ENGINEER. (See articles on the subject in No. 551, p. 110, and No. 552, p. 135; also pp. 192, 195, 318, 240, Vol. XXV.) C. L. (It is clear that something is the matter with a dog whose coat has been coming out during six years. You would probably find that a change of diet, with abundance of exercise, will effect a cure.)—CITRUS. (If you will look through the last three numbers you will find some remarks about the audiphone and instructions for making it.)—J. D. F. (See recent back numbers. Perhaps it is not damp in the wall, but vapour of the air condensed on the interior surface. If the wall is damp from driving rain, paint it with tar thinned with turps, or coat with Portland cement. 2. See p. 176. The best angle for general purposes is 37°; but for special purposes it may be modified to suit other conditions. For vines only the angle would be much greater in order to secure greater length of rafter, say, 60°. The guiding rule for general purposes is that the angle should be equal to the latitude of the place, modified, however, at lat. 1° and 70°, for instance. 3. Certainly not. One much more serious than the other. As to their curability, much depends on the constitution of the patient. That being good, the answer is, Yes.)—WYKEHAMIST. (The terrestrial has more lenses, in order to present the objects in their natural positions. Dents of no moment.)—P. A. T. (Butter analysis is not an easy task. See p. 14, No. 495, and the indices to Vols. XX., XXI., XXIII., and XXIV. 2. Get Mr. Fletcher's list, and look through the indices of last five vols.)—NOVICE. (You do not say whether brick or plaster wall; but the answer is the same—good paint. Use the cheapest colours until you obtain a good surface for the finishing coat.)—MAGGIE LAUDER. (A simple test for butterine is said to be examination of a knife which has been passed through the same, the blade being held up to the light so that the appearance of the little strings at the edge can be seen. The difference in appearance between butter and butterine is said to be remarkable; but the comparison must be made to be understood.)—DECIMAL. (The rules are given in Molesworth's Pocketbook and similar works—probably in one of Calvert's Mechanics' Almanacks; but if you want something more than a mere rule for calculating the strength, get Wilson's "Treatise on Steam Boilers," Lockwood and Co.)—MILLWRIGHT. (Your best plan is to apply to the Agent-General for the Colony, Sir F. D. Bell, 7, Westminster-chambers, S.W., and it is advisable for a man with a wife and family to secure a situation before emigrating, unless he has sufficient money to keep his family while looking about for work.)—W. FANN. (See that your "iron" is well tinned and sufficiently hot; the solder will then follow wherever you lead it.)—W. J. WARNE. (In the same, preferably.)—SUFFERER. (There is some constitutional disorder which personal examination by a medical man may discover; but, meantime, you may obtain much relief, and can do no harm, by bathing the feet in water as hot as it can be borne.)—R. J. W. (Special signals, probably for goods trains; but impossible to say without knowing the "rules of the road.")—WOULD-BE AMATEUR TURNER. ("The Lathe and its Uses," Trübner, Ludgate-hill, E.C., 16s.)—C. HORACE PHILLIPS. (By means of a dynamo-machine. See a series of articles on the principles involved on pp. 567, 591, 615, Vol. XXXIII., and pp. 8, 33, 58, 85, and 106, Vol. XXXIV. There are also many practical directions in recent back numbers.)—MERCURY TUBE. (Can you not put some more in, if part has been lost? As put, the query is a puzzle.)—A. W. G. (Move the regulator to the side marked "fast," or get a watchmaker to do it.)—E. C. S. E., L'pool. (If you look through back numbers you will find an answer to your queries. You will want a battery of about 30 quart Bunsens to do any good with an incandescent lamp. 2. Directions for constructing aquaria have been given many times. See p. 537, No. 541, and p. 153, No. 552; also the indices of back volumes.)—MOSSVALE. (Any good glue; but perhaps Russian is best for the purpose. 2. No; see many of the papers on the subject in recent numbers. 3. Dip twice in boiling logwood solution, drying between each dip; then go over with solution of sulphate of iron. All the questions answered many times.)—PHŒNIX. (Where "grammes" is the term, it is always understood as a weight.)—ONE WHO WISHES TO ENTER. (By apprenticeship. You might obtain particulars of the Government service by applying to E. Greaves, Esq., Engineer to the Postal Telegraph Department, St. Martin's-le-Grand, E.C.)—VERITAS. (Full particulars can be obtained on application to the Registrar of the Pharmaceutical Society, 17, Bloomsbury-square, W.C.)—G. H. MATTHEWS. (Better try a speculum, for it is clear you have little idea of the nature of the work. You will, however, find full particulars in back volumes. See recent indices, including that to be published on March 24.)—RODRIGO. (If you have the hundred cells made you must procure a "regulator," or so arrange two pieces of carbon-rod that the current will pass from one to the other. Good examples are illustrated on p. 230, No. 764, and p. 573, No. 778; but a simple form may be made with two pieces of carbon and the regulation effected by hand.)—ZEALAND and H. LEES. (Advice to emigrants is always given with extreme caution, unless they are personally known, and their characters understood. "Zealand" has friends in New Zealand who could surely advise him better than strangers; and H. Lees has left the matter so long that he wants direct answers. We advise them to read some of the handbooks and to consult some of the agents of the colonies to which they propose to emigrate.)—AMATEUR ELECTRICIAN, Cork. (We answered you on p. 603, No. 883. Instructions for making coils have been given over and over again, and we cannot spare the space to repeat mere elementary information. See reply 46186, No. 884.)—BAND SAW. (You will find two methods of brazing band-saws illustrated in No. 628. See also Nos. 523, 524, and the indices of back volumes.)—CAMERA. (Look up what has been written in recent numbers. and the last three or four volumes.)—JOHN KERSHAW. (Probably the recipe given on p. 520, No. 749, is what you require.)—JEWELLER. (Answered fully within the last five months. See pp. 145, 168, 189, 193, 216, 260, &c., last volume.)—J. SHAW. (Your query would open the door to a gratuitous advertisement. A private inquiry in the district where such machines are used—say, Leicester—would, no doubt, elicit trustworthy information.)—AN OLD READER. (See p. 575, No. 830, and p. 376, No. 848. If for an existing pad, dissolve aniline with acetic acid and water into a paste, and add a little glycerine.)—JUMBO. (The cordial is made by dissolving oil of peppermint in rectified spirit which makes the essence: that is diluted with white, tasteless, proof spirit, and is reduced with water, sugar being added to sweeten and alum to "fine." The oil is obtained by distilling the fresh shoots of the flowering plant, and in commerce contains, as a rule, about one-third of rectified spirit. 2. You will find plenty of devices in back volumes. All that is needed is to provide the hand with a sufficiently long contact, or cause it to let off a trigger which will make contact and keep it until broken.)—FRANK. (Perhaps your manganese is in too fine a powder, and perhaps you had not given sufficient time for the solution to soak through. At any rate, "try again." 2. Look through recent numbers, and watch those to come for medical coil.)—F. R. (Books descriptive of the machines, but none giving dimensions and details. You have seen, we presume, what has appeared in recent volumes.)—E. E. R. Tratman. (Our space would not admit of it, for the subject is of limited interest. You can obtain photos of Mr. Bleasdale, 136, Park-road, Aston, Birmingham. 2. We do not think you will find anything better than pins, using large and thick ones, cut short near the head.)—W. M. (It is worked to a putty-like mass in a masticator, and forced into iron moulds.)—Rustic. (See p. 212, No. 867. A simple "cure" is to coat with hot limewash, and brush off when dry; but the only thorough remedy is to have the pot regalvanised.)—G. A. H. (See preceding answer.) —Sefton. (You can do nothing. If, when all the assets are realised, there is a balance, it will be divided among the shareholders; if there is a deficit, you will have to make it good amongst you to the amount of your shares, or, if the liability is not limited, to the full amount. The matter is very young yet, and liquidators are not in a hurry as a rule. We have, within the last few days, received the last instalment paid in the liquidation of a company which has taken seventeen years to arrange.)—An Amateur Painter. (Yes, of course it *is* the drying ingredient. What you mean by "doing harm amongst varnishes" we cannot imagine.) —P. W. (The query was fully replied to, and we do not think the querist wanted any new theory expounded to him. We have no space to discuss your measurement theory – hundreds of things of more practical importance are standing over in the present crowded state of our columns.)—Shoe Black. (Dozens of recipes for blacking have been given in back vols. One, a very good one, is given in letter 16233, p. 69, No. 757.)—Eclectic. (1. No. 2. We cannot, in this column, decide who are the "best" makers of any articles. 3. The construction of the glycerine barometer was described on p. 532, No. 829. 4. We do not know what you mean by the "effects of magnetism." 5. Longmans' "Textbooks of Science." See advertisement on p. vi. in No. 882.)—Electron. (See answer to "One who Wishes to Enter.")—Tubal Kain, Alfojoe, An Old Photographer, Jack of All Trades. (In type.)

THE LATE "SECONDS' PRACTICAL WATCH-MAKER."

We have received the following additional contributions since our last issue, and hope our readers will help us to close the list as quickly as possible. Mrs. Coates has also received five shillings direct from Mr. George Bourn, of London, which she wishes us to acknowledge.

	£	s.	d.
Amount previously acknowledged...	£11	0	6
Sir Edmund Beckett..................	5	0	0
C. S. Stock		1	0
F. Rhodes.............................		3	0
A. Manock		15	0
W. S. Franks		2	6
J. Rawlinson		2	6
"Revel"		2	6
E. W. F. Browning		5	0
E. Hoblyn.............................		1	0
A Cambridgeshire Boy..................		1	0
James Broxup..........................		10	0
	£18	4	0

Tricycles and Bicycles for the Season.—The Excelsior bicycles and tricycles manufactured by Messrs. Bayliss, Thomas, and Co., of Coventry, are too well known to need any praise; but for the present season the firm is introducing some new designs which may appropriately receive a word or two. One of these—the Victa Excelsior Tricycle—is a double-driver, the lightest and most compact machine of its kind—the Victa D.E.H.F. bicycle is its counterpart; another is the folding Excelsior tricycle made on Fletcher's patent, which, by taking out a taper pin, unhooking brake-chain, and unslotting guide-rod, can be folded up so as to occupy little, if any, more space than a bicycle. Perhaps the most taking novelty is the Duplex Excelsior Tricycle, which is so built that both riders drive, sitting one behind the other, while by removing the additional seat and cranks, the machine is reduced to the appearance of an ordinary tricycle, and weighs only a few pounds more. Messrs. W. Gorse and Son, of Birmingham, are introducing "The American," a bicycle which, for lightness and rapidity, compared with price and quality of material, is claimed to be the cheapest first-class machine in the market.

Throat Irritation.—Soreness and dryness, tickling and irritation, inducing cough and affecting the voice. For these symptoms use Epps's Glycerine Jujubes. Glycerine, in these agreeable confections, being in proximity to the glands at the moment they are excited by the act of sucking, becomes actively healing. Sold only in boxes, 7½d. and 1s. 1½d., labelled "James Epps and Co., Homœopathic Chemists, London." A letter received:—"Gentlemen,—It may, perhaps, interest you to know that, after an extended trial, I have found your Glycerine Jujubes of considerable benefit (with or without medical treatment) in almost all forms of throat disease. They soften and clear the voice.—Yours faithfully, Gordon Holmes, L.R.C.P.E., Senior Physician to the Municipal Throat and Ear Infirmary."

Holloway's Ointment and Pills are never at fault in successfully disposing of skin diseases, scrofulous sores, and scorbutic affections. In all hereditary diseases these excellent remedies may be relied upon, and by their means the most delicate may become strong, and the foulest blood may be gradually changed into the purest fluid.

TERMS OF SUBSCRIPTION.

PAYABLE IN ADVANCE.

6s. 6d. for Six Months and 11s. for Twelve Months, Post-free to any part of the United Kingdom. For the United States, 13s., or 3 dols. 25c. gold; to France or Belgium, 13s., or 16f. 50c.; to India (via Brindisi), 15s. 2d.; to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post-office order. Back numbers cannot be sent out of the United Kingdom by the ordinary newspaper post, but must be remitted for at the rate of 3d. each to cover extra postage.

Messrs. James W. Queen and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post-free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes they must be paid for at the rate of 4d. each copy, to cover extra postage.

Vols. XXIV., XXVI., XXVII., XXVIII., XXIX., XXX., XXXI., XXXII., and XXXIII., bound in cloth, 7s. each.

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in March and September, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d each, through any bookseller or newsagent, or 2½d. each, post-free from the office (except index numbers, which are 3d. each, or post-free, 3½d.)

Indexes for each half-yearly volume up to Vol. X. (except Vols. II., III., IV., V., and X.) inclusive, 2d. each. Post free 2½d. each. Indexes to subsequent vols., 3d. each or post-free, 3½d. Cases for binding, 1s. 6d. each.

*** Subscribers are requested to order Cases and Vols. through their booksellers, and not to send direct. The regulations of the post-office prevent their transmission through the Post.

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Every additional eight words..	0	6

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*** It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions; and in cases where the amount sent exceeds One Shilling the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement and charged for.

Advertisements *must* reach the office by 3 p.m. on Wednesday to insure insertion in the following Friday's number.

OUR EXCHANGE COLUMN.

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The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

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All sorts of **Instruments** and Apparatus exchanged for others. Good value allowed.—Dr. Caplatzi, Science Depot, Chenies-street, Tottenham Court-road. Established 1862.

For Sale, 4ft. planed iron and steel, mechanic's **Lathe,** 3in. centre. Offers in Bicycles or Tricycles.—G. J. Bragg, 10, Queen-street, Colchester.

Exchange **Stereo Camera** and Lens for pair of 5in. Lantern Condensers, or offers.—O. Lange, 23, Newstead-road, Liverpool.

Strong **Horizontal Engine,** 2in. bore, 4in. stroke, brass cylinder, and feed pump, nearly new, in perfect order, in exchange for microscope to value £3.—R. Webb, 2, Hope-street, Hackney-road.

Three-vol. **Novels,** in good condition, for exchange. What offers? Shocking coil or high music-stool wanted.—Mr. Salter, Cromer, Norfolk.

Lathe Parts.—4ft. planed Iron Lathe Bed, pair of standards, and 3-speed driving-wheel; exchange silver watch, drill chuck, &c.—Mitchell, Park-street, Keighley.

Wanted, **"The Universal Measurer and Mechanic,"** by Abraham Fletcher, 1781, for scientific Books, or value.—W. H. G., 19, Albert-road, Braintree, Essex.

"Cassell's Popular Educator," six volumes bound in three, perfectly new and unsoiled, cost £2 5s. Will exchange for long-distance Telescope or offers.—F. J. Cunningham, Young Men's Society, Cork.

"Cassell's Popular Educator," bound in three vols., almost new. Will exchange for ½ Objective for Microscope, or offers.—C., 15, Marmion-road, Liverpool.

Choice rapid Carte-de-visite **Lens.** Exchange for small Doublet Lens, or good Single Lens or offers.—E. B. Fennessy, Pallas Green, Limerick.

Excellent **Camera and Lens** (Chevalier), really useful apparatus, cost 50s. Exchange good Apparatus for copying circulars, &c., in black; or sell.—Platt, Normacott, Longton.

Books.—"Keble's Occasional Papers and Reviews," "Woodcroft's Origin and Progress Steam Navigation," "Clegg's Architecture Machinery," "Arago's Life Watt." What offers? —W. Ambrose Taylor, Penzance.

Concertina (the Paragon). Powerful tone 30-keyed baritone, Anglo, steel vibrators, new, in lock case; splendid instrument, cost £5. Offers?—James Southey, Wellington, Somerset.

I have two **Bicycles,** 48in. and 50in. Will exchange anything useful.—apply to E. Childs, Sherborne, Dorset.

"English Mechanic," from May 3rd, 1878, to present time. Two numbers missing. Exchange Mathematical Instruments, or books on Building Construction.—W. T. Johnson, 147, Portland-road, Notting Hill.

"English Mechanic." Will exchange the last 24 vols. up to date, X. to XXXIV. inclusive, unbound, clean, and complete, with indices. For Photographic Apparatus or Bicycle. Offers.—W. James, 6, Percy Circus, Islington, W.C.

Parcel of **Artificial Sapphires** (five dozen) in exchange for small Galvanised Iron Garden Barrow. (Sample Stone sent for six stamps).—K., 1, Rose Villas, Sudbury, Middlesex.

Wanted, Dallmeyer's **Stereographic Patent** Lens. Will give in exchange a Stop of Principal Metal Pipes, new, voiced and tuned.—S. Arlidge, Organ Builder, Kingsley Park, Northampton.

Wanted, a good **Cloth Background,** medium tint. Will give in exchange a 10 by 12 German Glass Bath; in mahogany case, complete.—J. Arlidge, Photographer, Kingsley Park, Northampton.

Strong back-geared foot **Lathe,** 9in. centre, wood bed, 7ft. 6in. long; cost £20. For Iron Saw Bench.—Jas. Baigh, Burton-in-Lonsdale.

"History of England," quite new, splendidly bound, gilt rims and clasps; cost 45s. Exchange for good Dulcimer.—M. C., Duleek, Meath, Ireland.

Excellent new **Horizontal Engine,** 3¼in. cylinder, 5½in. stroke, with flywheel and pulley, turned and polished; any reasonable offer.—J. Coatman, 381, Bolton-road, Darwen.

Lathe Heads, pair 8in. centres, back-geared, 5 steel centres, face-plate, rest, and socket, all in perfect condition; any reasonable offer.—381, Bolton-road, Darwen.

Sweet-toned **Organ Accordion** on stand, and foot-blower, cost £6, in perfect order. Wanted.—Bicycle, Harmonium, English Concertina, or Shuttle Treadle Sewing-Machine.—Wm. Shackleton, Market Hall, Accrington.

2½ H.-P. Horizontal Boiler, guaranteed sound. Exchange for chest of tools, or anything really useful.—H. Bibby, St. John's-road, Longsight, Manchester.

Wanted, first-class **Landscape Lens,** ¼ or ½-plate. Will give Photo, or other apparatus.—J. Rutherford, Jardington, Dumfries.

Good **Dagger,** best steel, with pearl and German silver handle, in sheath, exchange for small revolver.—J. Gidley, 44, Dean-street, Soho.

Bicycle, 52in. (bright), roller bearings, and cash exchanged for screw-cutting lathe, 4 or 4½in. centre, gap-bed preferred.—38, Victoria-street, Sheffield.

Splendid white cane **Roach Rod,** double winched and line, folding ring and net.—E. Baker, 6, Prince's-terrace, Maldon-road, Kentish Town, N.W.; for Bicycle Lamp and Alarm.

Table Engine and Vertical Copper Boiler, ½ H.-P., in working order, for 5in. screw-cutting lathe.—Address as above after 6 p.m.

Lathe, 4in. back-geared, compound slide-rest and Tee, for 54in. bicycle.—Address as above, after 6 p.m.

Model Locomotive Copper **Boiler,** 6in. cylinders and steam tap complete, for model electrical engine.—Malvern, 25, Shirlock-road, Haverstock-park, N.W.

£5 Day and Night **Telescope,** £2 Wire Dulcimer, hand-sewing machine, all perfect, for Harmonium out of order, or what offers?—31, Central-buildings, Kendal.

Small **Blast Forge,** suitable Locksmith, Gasfitter, also boiler, 5in. by 16in., and tricycle, works hands and feet; offers.—A. W., 16, West-street, Maryland-point, Stratford, Essex.

Two good toned **Violins** and Bow, for Bicycle, or offers.—G. Hughes, 55, St. Arnaud-street, Edge-hill, Liverpool.

THE SIXPENNY SALE COLUMN.

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Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

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For Sale.

"The Night-light Clock." Illustrated and described on page 370, No. 848. Price, carriage free, 5s. 6d.—F. Robertson, 13, Greek-street, Soho, W.

Band Primo.—A Tutor for all Band Instruments. "A Book which every Bandsman should have." Price 5s., P.O.O. T. Rawson, 114, Heaton-lane, Stockport.

Harmonium, £5; 7 stops, walnut case, full compass, ivory keyboard; bargain.—55, Collier-street, King's-cross.

Lantern Photographs, 10,000, with readings, from 6d. plain, 1s. coloured.—A. Pumphrey, Emily-street, Birmingham.

Lantern Photographs for Hire. List and sample picture for 8d. in stamps.—A. Pumphrey, Emily-street, Birmingham.

Triplex Lantern, **Achromatic Lenses,** full size, best light, limelight excepted, 42s.—Pumphrey, Emily-street Birmingham.

Complete **Limelight Apparatus,** equal to 200 candles, 90s. List of Apparatus 3d.—A. Pumphrey, Birmingham.

Chromatrope, with 5 designs and Eidotrope, complete from the manufacturer, 10s.—A. Pumphrey, Emily-street, Birmingham.

Harmoniums, second-hand; returned from hire. All prices.—Venables and Co., 187 and 189, Essex-road, Islington.

Pianos, second-hand; returned from hire. Extensive showrooms.—Venables and Co., 187 and 189, Essex-road, Islington.

Working Drawings by Practical Draughtsman at moderate charges. send particulars or rough sketches of requirements to H. Burch, 111, West High-street, Salford, Manchester.

Magnesium Ribbon, burns like the electric light, 3d. per foot, post free.—L. Rowland, South John-street, Liverpool.

Prof. Kennedy, Dublin, will send his Infallible Corn or Bunion Cure (state which) for 14 stamps

"The Feet, and How to Treat Them," by Professor Kennedy, Dublin. Pamphlet sent for 2 stamps.

Notice.—If Prof. Kennedy's Corn or Bunion Lotion fails to cure, the money will be returned.

Mitre Machine for picture-frame makers (registered). Send for Illustrated Circular, post free.—Booth Brothers, Dublin.

The English Mechanic
AND
WORLD OF SCIENCE AND ART.

◆

FRIDAY, MARCH 17, 1882.

RAILWAY SIGNALLING APPLIANCES AT THE CRYSTAL PALACE ELECTRIC EXHIBITION.

RECENT railway accidents which have exposed the defects of some of the existing methods of signalling have naturally made the appliances exhibited at the Palace Exhibition objects of much attention, and as nearly every really useful system is shown in working order (that is, when not disarranged by the carelessness of experimenters), the public have an opportunity, not often afforded, of becoming acquainted with the signalling arrangements commonly adopted on railways. Besides the standard systems, as they may be called, there are, however, several novelties which are more or less adapted to remedy defects which are inherent in or appertain to the well-known devices, and these we shall endeavour to describe as minutely as possible. The London, Brighton, and South Coast Railway Company exhibit the methods adopted on their line at various periods, including Saxby and Farmer's union of "lock" and "block," while the London and South-Western show Preece's system in working order for a block section, with three signal-repeaters to indicate to the signalman in the boxes the position of the semaphore arms. Mr. Spagnoletti's arrangements as employed on the Great Western are also shown, and as we have previously mentioned, Mr. C. V. Walker, the electrical engineer of the South Eastern, exhibits a unique and chronologically arranged collection of instruments used for signalling purposes. All of these are tolerably familiar to those interested in the subject, as they are fully described in the text-books; but in the exhibit of W. R. Sykes, shown in very large scale model, we have perhaps the most advanced and most perfect combination of the electric lock and block. This system has been in use for some years on the London, Chatham, and Dover, and the Metropolitan District, and is probably as near perfection as it is possible to go. It is shown as working between three signalling points, and those who are sceptical can try for themselves how far it is possible to break it down, and set signals so as to cause an "accident." The system is based on the mechanical union between the lock and block, and every signal given requires the attention of at least two signalmen. Thus, suppose we designate two signal-boxes as A and B, A cannot lower his semaphore until B releases his lever, and per contra, B cannot lower his semaphore for a train in the opposite direction until A has released the lever by electrically removing a pin from the stop in the lever. Suppose a train to be approaching A's box, and travelling towards B's, A sends the call to B, and receiving "line clear," sends another signal which releases the lever in B's box, and enables the latter to pull off his signal, which he can put on again, but not "off" until he gives "line clear" a second time. Thus two trains cannot be in one block-section at the same time, except by consent of two signalmen. Similarly, by combinations of electrical and mechanical arrangements, it is impossible to pass trains by signal while a siding is open for shunting, as the fact that the points are open for the siding effectually locks the main-line signals. On the other hand, points for sidings cannot be opened if a "line clear" signal has been given to a main-line train, until that train has passed out of the section. Thus, unless two signalmen at different boxes make the same blunder, it is impossible for an accident to occur, provided the drivers of the trains pay attention to the signals. It will be readily understood that such a system would have prevented the Canonbury "accident," which may be taken as an extreme case of railway blundering that would have been simply impossible if the signalling arrangements had been on the plan just described. All the systems we have mentioned are, however, thrown out of use by dense fogs, and by occasional defects, and attempts have been made by enthusiastic inventors to persuade the railway companies to employ what may be termed automatic systems, not that they are really automatic, dispensing with the services of signalmen, but as complementary signals appealing more directly to the driver than the semaphores, for which it may be said he has to look out. Even in the case of fog, however, the Sykes' system has been found to answer remarkably well, for the simple reason that a signalman cannot allow a train to leave until the signalman in advance has released the lever. Still, fogs are not unknown in London so dense that the driver cannot see even the post, let alone the semaphore, and in such cases fog-men are employed—introducing yet another element of human fallibility. To provide for such conditions as these several devices in the shape of electric gongs working in connection with the signals have been invented, and one of the simplest of these is Sullivan's electric fog and night signal, shown in a working model in the Eastern Gallery at the Palace. This arrangement is simple, not likely to get out of order, and certainly more trustworthy than the average fogman. It consists simply of a small bar placed parallel with the rail, and projecting slightly above its surface when the signal-arm is "on," or at danger. The wheel of a passing engine depresses this bar, and rings a powerful gong in a box near the post; while, should the signal be "off," the bar is drawn below the level of the rail, and the gong is not sounded. The signal is entirely under the control of the signalman, and can be worked either electrically or mechanically in connection with or separate from the semaphore. It is, in fact, a type of a useful class of signals, which can be so arranged as to supplement the ordinary semaphores in clear weather, and to act as substitutes in the event of fog or derangement of the apparatus.

The British and Irish Telephone Co. exhibit a working model of Redcliffe's fog-signal, which differs so far from that just mentioned, that the "signal" itself is given on the engine. In this arrangement we have the usual magnet and armature, the latter carrying a projection, which rubs against a long lever carried alongside the engine, in about a line with the centres of the driving-wheels. This lever actuates a small semaphore placed on a level with the driver's eyes, and also sounds the whistle,—a crude idea, which does not commend itself by the finish of the model. Several better devices have been described in our back volumes, and so long ago as Feb. 5, 1875, we gave an account of Sir D. Salomons' system, which was so far complete in details as not only to call the driver's attention, but actually to shut off steam and apply the brake for him. That system (see p. 516, Vol. XX.) necessitated a central insulated rail, which was so connected to the engine that on the latter entering a block section already occupied a bell would be rung, or, as before explained, the steam might be automatically shut off. A practically identical system was patented last year by a Mr. Putnam, of New York, and in the Concert-room Gallery, Messrs. Apps exhibit a nicely-finished working model of the system invented by Mr. T. T. Powell, of Harrogate. In this we have the insulated centre rail or wire in contact with the train by means of light wheels and rods, a couple of signal-boxes, and bells, &c. Levers at the side of the rails are depressed by the passage of the train and give notice in the signal-boxes, while tapper-keys on the engine and guard's-van enable either driver or guard to communicate with the signalmen, and the latter can, of course, communicate with them. The model is sufficient to show that a railway worked on this system would form an electric circuit, or combination of circuits, by which not only would signalmen be able to communicate with trains approaching their boxes, but the manager could, by means of an indicator, locate the position of any train at any given time; further, platelayers could inform signalmen promptly of any defect in the road, and passengers could communicate with the driver or guard. The difficulty is the centre insulated rail, which would cost something, and the insulation, we are afraid, would be a source of trouble. In some respects, Mr. Powell's system is more complete than that of Sir D. Salomon's, for the latter breaks his centre-insulated rail into "block sections"; but we do not think that either plan is likely to be adopted for some time. A really useful invention is shown in the Eastern Gallery in the shape of King's patent electric railway signal, which is specially adapted for use on single lines in sparsely-populated countries, or where the amount of traffic will not allow of a competent and ample staff of signalmen. In the model we have a single line with a branch to a siding and three posts, one of which contains a clock capable of indicating time up to 15 minutes, and a semaphore put "on" by mechanical means as the train passes over a lever treadle level with the rails. This semaphore is put to "off" by means of electricity when the train reaches the next post, where, at the same time, it puts the second signal at danger. The use of the clock is not quite apparent, for the inventor can scarcely expect his system to be adopted in crowded districts, but for certain purposes it will be employed in the following way:—The clock, say, is at post A: a driver approaching and finding the signal "off" will see by the clock how many minutes have elapsed since the previous train passed into that block section, and as his engine passes the post it will, as explained above, put the semaphore at danger and the clock-hand back to zero. When the engine passes post B, it again runs over a treadle, which puts the semaphore at B to danger and clears the block section in the rear by lowering the semaphore at A, where the clock-hand again indicates the number of minutes since the engine passed. Suppose post B guards the entrance to a siding, the engine which passes A and enters the block between A and B puts a special semaphore at danger at B by means of electricity, and thus gives warning that a train is approaching, and that the pointsman must be ready to clear or to pass into the siding, as the case may be,—a lever at B working a signal at C to indicate whether the branch or siding is clear. The arrangements are all under cover, and the treadles and other accessories are so arranged that the signals work at the same speed whether a fast or slow train passes; in fact, the details have been carefully worked out, and the system will no doubt find employment in America, Australia, and other places, as well as in large goods stations with long lengths of sidings. Another device worth notice is found in the Southern Gallery, where Dr.

Garau shows a model of his method of communicating with the guard by making the electric connection through the buffers. On pulling the signal cord in any compartment, an arm is thrown out from the side of the carriage, and a bell rung in the guard's van. It is obvious, however, that this method is not to be compared with others, as it depends for its efficiency on the fact of the buffers being in contact, and that is not always the case except, perhaps, on some of the metropolitan lines. Altogether it may be said that although some useful novelties are shown at the Exhibition, so far as railway signalling is concerned, the established methods are the best.

WATCH-CLEANING AND REPAIRING.

By "A Fellow-Workman."

The Verge Watch.

BEFORE I begin I should like to say that it is not my intention to write this for the benefit of general jobbers or improvers. My intentions are to put before the amateur, and those who wish to learn the trade and have not the needy to buy it, the easiest and cheapest way that I know of; so that if I can give any poor novice a start, or any amateurs a few evenings' amusement, without touching their pockets, I shall be satisfied.

First remove the movement from the case. Poise the movement in your left hand so that your thumb comes on the contrate-wheel F. Now the watch should stop. Remove cockplate (D) screw; then, with your tweezers (9d.) take off cockplate, now put your tweezers in front of the pin that secures the hairspring and lever it out, and turn back the balance B until the hairspring is free. After you have removed the balance you can let watch run down; now remove the hands, next the dial (or face); you will be able to remove pins best with the small blade of a knife. Now take off hour-wheel, next, motion wheel, then with your pliers (2s.), remove canon-pinion which carries the minute-hand; then remove regulator (put the screws in a piece of paper, and put R on it), next barrel bridge, if it has one; now the pins in pillars, and take off plate; the barrel-lid or cover is removed by striking the arbor on the opposite side.

Now take upper or top plate, Fig. 2, poise it in left hand with follower stud (B) towards you, and with your long-nosed pliers (1s. 1d.), remove follower, then escape wheel (A), then potence J. Before removing the escape it is necessary to see that the holes are all right, and that it is in order; but I will give that further on. We will presume now that the watch only wants cleaning.

Begin with the pillar or bottom plate (Fig. 2). Brush round and round against the sun (if you brush straight across, it will show scratchy), dapping out the chamfers and hollow places, using the best white chalk (which you should keep in a little box under your bench) until you have removed all traces of dirt and oil, especially round the holes and in the chamfer; if the chalk or dry brush (8d.) does not do it satisfactory you must use another brush, which has been damped with oil and rubbed on a piece of wood, which we will call the *wet brush;* but always finish with the dry brush, and be sparing with your chalk. You must hold the article in a piece of thin unglazed paper while cleaning. Clean the holes with pegwood (2d. per bundle) or dogwood, and sharp at one end, bringing it off to a fine point, cutting off the other end with three sides for cleaning the chamfers. We will call this a *skewer*. Now with your skewer clean out the holes F, E, G, I, first one side and then the other until, by holding it up to the light, the hole looks bright and clean, and the skewer comes out clean. Put this in a saucer under a glass, and take the top plate (Fig. 2): clean this in the same way; be careful of the stop spring (K), also clean hole in follower stud (B, or counter potence). Put this under the glass and take potence (J). Clean escape-hole front and back. In cleaning the bottom hole, be careful not to press too hard. Cut the skewer flat at the point the size of the hole, and keep cleaning until you can see the bottom of the hole. If you should break the point in the hole you must be careful to remove it. It is done by carefully working in the point of a bottoming tool, which should be *smaller* than the hole; as soon as it has reached the bottom it will not throw out any more wood; then go on cleaning again. Next take the cockplate (D, Fig. 3), *dap* out the fretwork. Next regulator H, now barrel, clean out holes, and harbor (C), oil pivots of arbor and put on lid. The cut in the lid should come directly over the hole made for chain-hook; clean follower by holding it in your pliers; clean fusee (K). In cleaning cogs or *teeth*, you must use wet brush first: the teeth should be bright both sides, next centre-wheel, dap out pinion-leaves (*i.e.*, the steel teeth); third wheel, E; contrate, F; escape, A. Now the balance or verge (B). This should be cleaned with the pith of elder, which should be collected in the winter or spring. Select white dead pieces, lay it in a dry place; when you want to use it remove the bark and the pith will be firm, soft, and beautifully clean. Take the balance in your left hand, and press the pith on the verge until it touches the collet (L). Push it on and off until the pallets are clean; if you cannot remove all dirt with your pith, use the point of your skewer, be careful if you use your brush—always lay the balance down with the verge resting on the saucer or pad, and then it will not get broken. Now clean the wheels under the face; hands are cleaned by laying them, face downwards, on a piece of wash-leather, and rubbing them to and fro with your finger; now we will put it together; before you drive a screw, you turn it backwards until you feel it drop; then screw up—never force it.

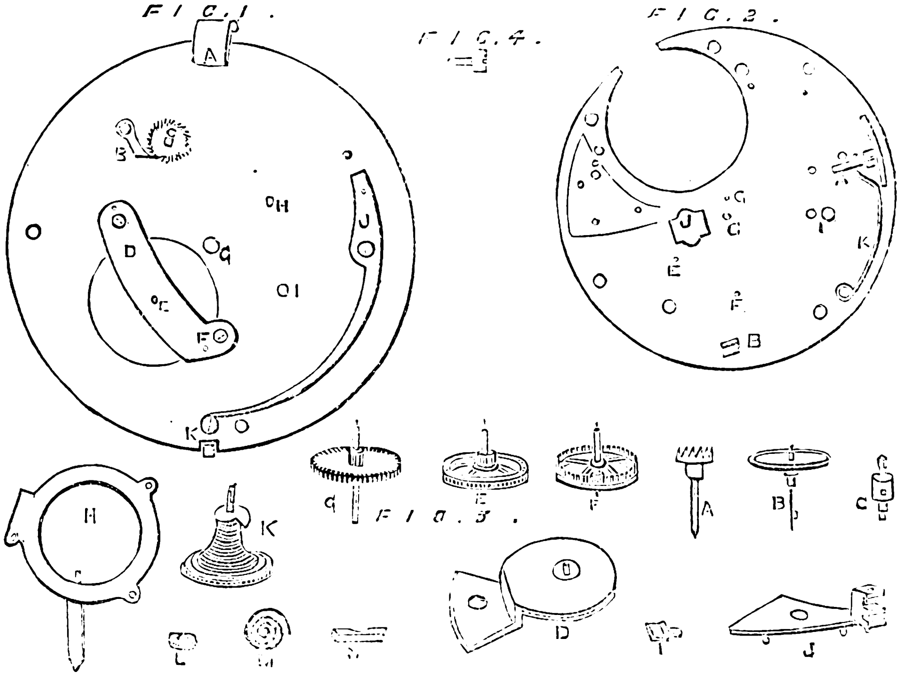


FIG. 1. FIG. 4. FIG. 2. FIG. 3.

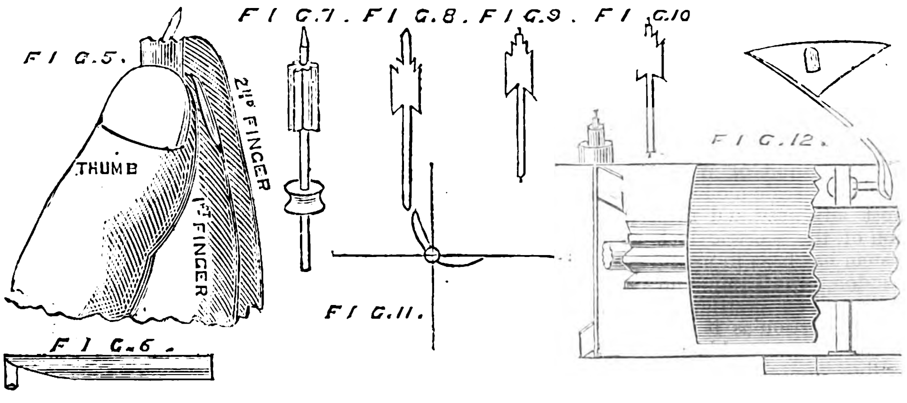


FIG. 7. FIG. 8. FIG. 9. FIG. 10. FIG. 5. FIG. 12. FIG. 11. FIG. 6.

First put on the potence, then put the escape-wheel in its place; if there should be more than one hole, it is generally the hole nearest the screw, but you will see which way the dovetail (N) has been moved; hold the escape-wheel with the forefinger of your left hand until you have fitted the follower; allow a little shake; now take pillar-plate, put in third wheel first, centre next, fusee next, contrate next (barrel next, if there is not a bridge); put on upper plate, place the thumb and third finger under the pillar-plate, and the first and second finger on the upper plate, and with your tweezers put the pivots in their respective holes, while you gently press with your fingers; a short pin comes under the cock-plate, and barrel-bridge and regulator.

(I forgot to say that, before you put in escape-wheel you must oil the holes in potence and follower; a small drill is best; for oiling one dip is sufficient).

Now oil the holes you have cleaned; put in barrel; make sure, when you drive in any screw over the potence, that it does not prise the potence away from the plate; put on chain, set up half-round, put on regulator, &c.; to put the watch in beat, you must try it by means of your thumb on the contrate wheel, whichever way it goes furthest ease it—in this way you will get it true; allow a little end shake. Now put on canon-pinion; if it fits loose, put a small hair out of your brush in to make hole smaller; put on dial (clean it first) then the hands, and your movements are ready for the case, which should be cleaned with wet whiting and a stick, then left to dry, and brushed off with a brush kept on purpose—not your dry brush.

SCREWS.—The cockplate screw is the first which comes under our notice. In fitting this screw, above all others, great care should be taken. Take a piece of steel wire, the size of countersink in cockplate, centre it and turn for thread; it is not necessary to make the thread up close to the head. Take your saw and cut nearly off, return it to the screw-plate, break off; now file the head level, take your saw and make a slot for driver, file off all burrs, put it on a piece of charcoal, and blow to a glowing red-heat, and drop it into cold water, polish the head, and put it on the blue-pan. Fig. 4 is a sketch of a screw as it *should* be made; take care that when it is screwed on that the end does not go beyond the plate; it should go nearly through. You should always take particular care, when fitting a screw to either plate, that the end does not go beyond the inner surface. You can buy screws in the rough, but making them is a good practice for the graver; a screw-plate and taps will cost about 3s.

Escapement.—Now, the escapement is the principal thing. It is composed of the escape-wheel, potence, follower, balance, and cock-plate, which should always be examined before you clean a watch.

Escape-Wheel.—The front of the teeth should never be touched, as that is your only guide; if the teeth have lost their points, you must file at the back with a "balance-wheel file (4d.); hold it in your hand as shown, Fig. 5, you place it between your forefinger and thumb, and place your second finger behind your fore, to act as a support and guide; if you send it to London you can get it properly cut for 6d.; but before you cut it you must find out if the teeth are all of the same length. You cannot do this in the turns; you must place it on the face of a piece of *true flat* Turkey or oil-stone, and work it round and round until all the teeth touch the stone. You can remove the burr from the inside with a piece of slate-pencil, shaped as shown, Fig. 6.

To Put in a Pinion.—Get one in the rough (4d.); send the old one as pattern, which must be removed as follows:— Place the wheel on a stake and drive out with a punch; Figs. 7 to 10 show the progress of the pinion.

Verge.—The pallets of the verge should not stand at right angles, nor should it be too proud (Fig. 11 is about the proper angle). measure from the bottom of the potence to the top of escape-wheel, as shown by the horizontal lines, Fig. 12. Now fit it in your carriage. There are several sorts of carriage, but they are all more or less dangerous; the best I know of for beginners are Figs. 13 and 14. Fig. 13 is a rose made of bone, A and B are two plugs made of peg-wood. Sharp up a piece of peg-wood and press through the rose, cut the bottom end off close to the rose from A to the shoulder of bottom pivot (B); cut off and split in two halves; cut a little crease up the centre of inside, and cut one a little shorter than the other (see Fig. 14). Turn for collet, then balance next bottom pivot, then top pivot. Now place verge on "verge riveting stake" (4d), and, with a spring punch, rivet on balance. If banking-pins are in the potence, you can rivet on balance, but if it (the banking) is on the outside of the balance you must adjust the verge, as per Fig. 15. A is bottom pallet, B is top pallet; when the pin on the rim of balance is exact between the two bankings, the pallets should stand as shown in Fig. 15. Now, having riveted your verge, next see to the holes; if they are jewelled, you will have made the pivot to fit the holes; but if brass, *vice versâ*.

FIG. 13.

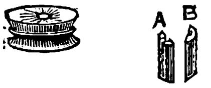


FIG. 14.

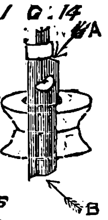


FIG. 19.

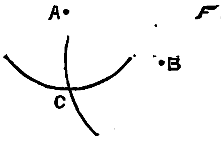


FIG. 15.

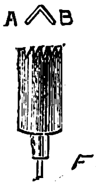


FIG. 16.

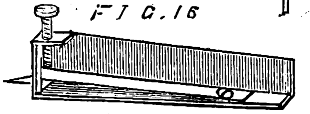


FIG. 17.

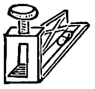
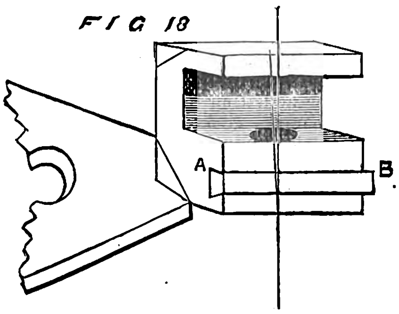


FIG. 18.



To Put a New Hole in Cockplate (or Bar).—If there is sufficient of the bush left, you may knock it through a little way; file away nearly to the bottom of the old hole; then, with a drill same size as pivot, drill the hole; finish with a bottoming-tool, which should be chisel-pointed, the chamfer a little; if there is not enough bush left, you must fit a fresh one; fit a piece of brass wire, which should be cut off close from the inside; make the hole a little out of the centre, so that by turning the bush round you can bring the verge upright; the bottom hole is done in the same way, only cut off close on the outside, or else it may rub on centre-wheel.

To put a hole in potence slip, you can fit a bush (or bouchong) 1s. per 100. Make the old hole large enough to hold bush firm with a small broach. If your escape is not deep enough on verge, or, as I should say, got too much drop, it is then necessary to file away the face of the potence. This should be done with great care. A good fine file that will cut without any pressing. Fancy you are trying to file the hole, and in this way you will get a flat surface. Some would chamfer the hole, but I do not agree with that, as the potence will have eventually to be cut. In some cases a new slip is necessary, and in such cases I should advise my readers to put one. They will find that it is easier to put a new one than "*make* the old one do"; in fact, makeshifts in any part of a watch will not do—it is sure to take a long time, and is only a makeshift when it is done. Therefore, throw away the old slip, and fit a new one; but before you throw it away you must get position of the hole, which is done with a simple tool, 16 and 17. The screw B raises or lowers point A. You lay your tool on plate, to which you have fixed potence and follower, and take heights of hole; thus you secure the height. The hole should be in a line with the top and bottom hole. Now try your drop, which, if it is not right, you must adjust with the potence slip. If there is too much drop at *top*, you must move the slip from A to B; if at bottom, *vice versâ*. By making a mark across the face of the potence, you will be able to see how much you move it. There should be a little more drop at bottom than top, just enough to discern. This may not seem right in theory, but you will find it right in practice. I can explain if required.

Hairspring.—Practice only can manage a hairspring; so I should advise you to get an old one and practice upon it. There are tweezers made for the purpose. If you want to shift the collet after it is on the verge, you must insert the head of a small drill in the slot of the collet, then by gradually turning the drill you will open the collet, and then you can move it which way you like. If you have got a hairspring that lies uneven, you must put it on a blue-pan and blue it. When you take it from the pan it should be flat; but the less you mess hairsprings about the better. A hairspring is not much use after it has been crippled.

Now I think we have done with the escapement, and will go on with the other parts.

Pillar Plate, Fig. 1.—Always try the pillars; and if you find one loose, place one end on a piece of lead and rivet tighter. No screw should protrude through the inside of the plate or steady pins, or anything that is likely to interfere with the wheels between the plates.

Making a New Hole.—First get the position of the old hole, as follows. Fig. 19, C (where the lines cross), is the old hole; first make two dots, A and B, with your centre-punch, and draw the lines indicated with your compass. Now drive out the old bush, fit in a fresh one—that is, file up a piece of good brass wire, press it firmly into the hole, and cut off close to the *inside*, and about ¼in. from the outside. Now take your compass again, and make the diagram perfect, which have been partly destroyed by the removal of old bush. Now drill a small hole at C, exactly where the lines cross one another, put in the wheel with the other wheels, and try the depth, when, by taking hold of the ¼in. left for this purpose, you can put the wheel deeper or fleeter, as you require it. Now break off the ¼in., which has been previously nearly cut off, with an old knife.

(*To be continued.*)

IRIS-DIAPHRAGM FOR VARYING THE APERTURE OF MICROSCOPE OBJECTIVES.

SOME years since, Dr. Royston-Pigott applied an Iris-diaphragm behind the objective for reducing the aperture of objectives, in support of the view which he was then advocating that wide-aperture objectives produced confused images.

The editor of the *Northern Microscopist* has recently suggested the use of such a diaphragm to enable penetration to be obtained with wide-angled objectives of different apertures. Fig. 1 is a side view of the apparatus, as made by Mr. C. Collins, of Great Portland-street, and Fig. 2 a front view. The upper end in the former Fig. screws into the microscope tube, while the lower receives the objective. The diaphragm is opened or shut by sliding the lever projecting at the side. The partial closing of the diaphragm does not, of course, contract the *field*, but diminishes its brightness by obstructing the passage of a greater or less part of the cone of rays.

Fig. 1.

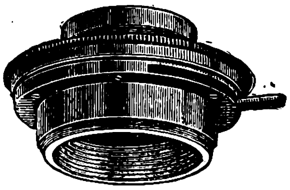
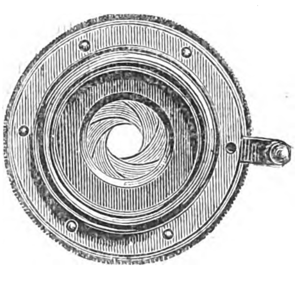


Fig. 2.



In some remarks on the use of the apparatus it is pointed out* that it shows the value of wide apertures for good definition, for if a preparation of the proboscis of the blow-fly be observed with an inch objective having an air angle of 30°, the view is superb, the pseudo-tracheal markings come out well-defined and sharp; but close the shutter until an angle of 14° or less is obtained, and examine again, when it will be found that the definition is not nearly so good, while there is more penetration, the whole of the pseudo-tracheal tube being observed under one focussing. While in this condition, the eye being still applied to the tube, open the shutter to its full extent, and the effect of wide aperture will demonstrate itself.

"Perhaps the best object to show the amount of penetration possessed by objectives of low angle, may be found in the micro-fungus, *Myxotrichum deflexum*, or *M. chartarum*, observed under the 1in. objective. The former object consists of little patches of grey downy balls, from which arise a number of radiating threads, furnished with a few opposite and deflexed branches. Under an inch objective of 30° air angle, but few of these branches can be seen under one focussing, the remainder being enveloped in a haze of light; but if a central layer be focussed, the simple closing of the shutter will suffice to bring the superior and inferior layers into view, though, of course, the image is not so bright and well defined as before."

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* *North. Micro.* II. (1882), pp. 13, 14 (2 Figs.).

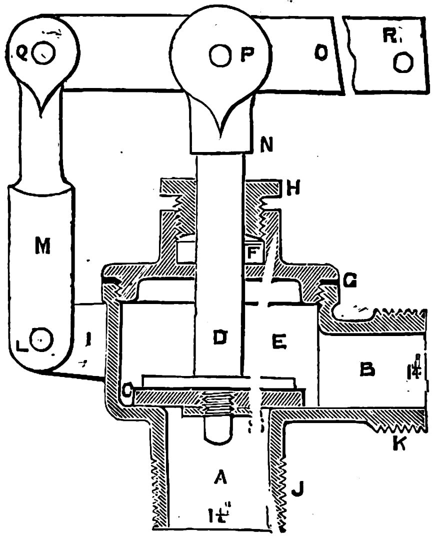
PRACTICAL NOTES ON PLUMBING.—XXIX.*

By P. J. Davies, H.M.A.S.P., &c.

Stool-Valves.

Fig. 148 shows the stool-valve with stuffing-box, for fixing under the seat of a w.c., attached to the spreader. I gave a full description of it last week.

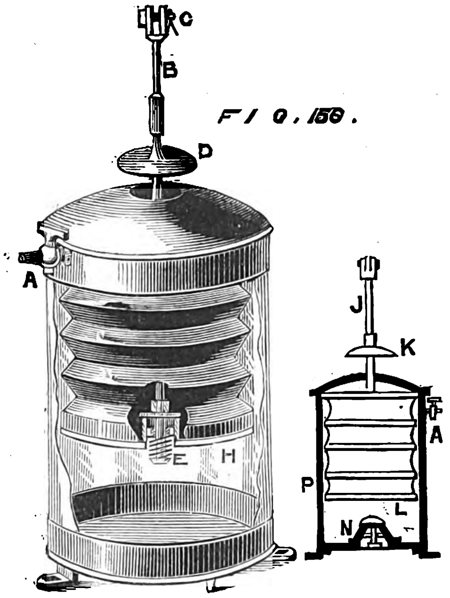
FIG. 148.



The Bellows Regulator.

So far as reliance is concerned, this closet-valve regulator is unquestionably the best yet introduced; it is simply a lantern bellows, with copper, or other metal casing, as shown at Fig. 156. P is the casing, L the bellows fixed round the top of the casing; the action is, that the raising of the handle N, Fig. 84 (whereon is fixed a spur), brings up the valve-lever N, Fig. 142, and, with it, the rod of the bellows J, or B, Fig. 156. When the handle is dropped, the apparatus is prevented from falling back quickly by reason of the bellows expanding and displacing the air from within the casing, in proportion to the opening of the regulating-tap, AA. It is not unusual to make these bellows to take in the air through the regulating-cock, instead of expelling it; but, under any circumstances, the same end is attained, that is to say, the lever with valve is allowed to close slowly.

FIG. 156.



Oil Brass Closet-Regulators.

Thoroughly practical men, I am sure, will agree with me when I say that I cannot recommend the regulators, inasmuch as where oil is used as a lubricant, it very soon becomes cloggy, and even glycerine will not be found a good lubricant for any length of time, though it is far better than common oil, more especially in the winter season. A, Fig. 157, is the cylinder, within which the piston, D, works. On raising this, air gets below J, and, when the lever or rod is depressed, the bucket J of the piston expands, and so keeps the valve-lever from suddenly falling; but, by opening the regulating-screw C, the inclosed air is released, and, in proportion to the opening, so the piston, with the closet-valve, is allowed to fall and close the seating. This kind of regulator is shown at Fig. 157A, as generally fitted to a stool-valve on an iron frame, MN, in damp places, where the bellows are likely to decay. J is the regulator. In such situations glycerine (or quicksilver) should be used, instead of sweet oil.

FIG. 157.

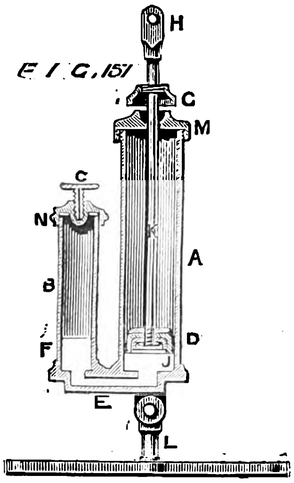
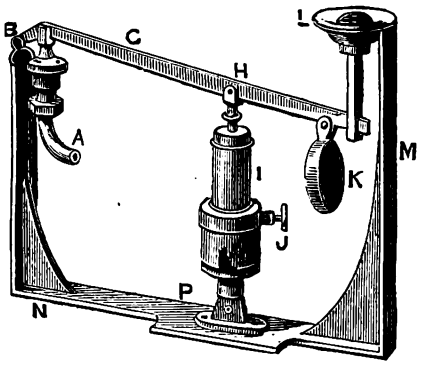


FIG. 157A



Cottage Closet-Valves with Diaphragms.

These valves will be shown at Figs. 158 and 159, which we are compelled to hold over till next week. Fig. 158 is the supply-pipe to come from below and be connected at I, which, in many instances, will save a bend, as also some lead piping. Fig. 159 shows the valve, having the inlet on top at I; this will be found very suitable in cases when the pipe has to be run down the left-hand side of a w.c., and will also save a double bend. These closet-valves, however, as generally made, are very objectionable, for exemplification of which see Fig. 160; this is the cottage closet-valve, with diaphragm in section. I is the inlet, F the outlet, and M the brass part of the valve, to which is fixed the indiarubber X. This valve, in order to keep it perpendicular to the seating, has a guide-nut, T, having spurs or feathers, see P Q R S, also N T. This blocks the water-passage, and often to the extent of three-fourths of the water-way, so that it is simply absurd to use an inch valve in connection with an inch pipe. Such a valve as the one illustrated should, therefore, never be used. These valves though, be it understood, are capable of improvement; for instance, instead of using the feathered nut, as shown in the diagram, and commonly made for these valves, let the top-plate V, just where the spindle enters at W, be made, as shown, longer than those at Figs. 158 and 159, and so let this guide and steady the valve. There is no reason why this should not be done.

Single Diaphragm Waste-Preventing Valves.

Fig. 160A represents one of the first single diaphragm waste-preventing valves made by my late firm at Hornsey and King's Cross; the same have been made to a very great extent, on account of their extreme simplicity. They are suitable for a servant's closet, or may be fixed over a service-box for either valve or pan-closets. G is the seating to be soldered to the bottom of the cistern, and over the down-pipe I, or this may be connected by nut and screw to the cistern. M is the pull-up spindle for attaching the copper wire to D (which may be made to work through a stuffing-box at P), the spindle for actuating the flexible diaphragm L. This diaphragm is fixed at H to the ring P, which is also connected to the valve-plate B. At B is a small regulating-hole, for the purpose of allowing the descent of the valve when the spindle is being held up.

FIG. 160.

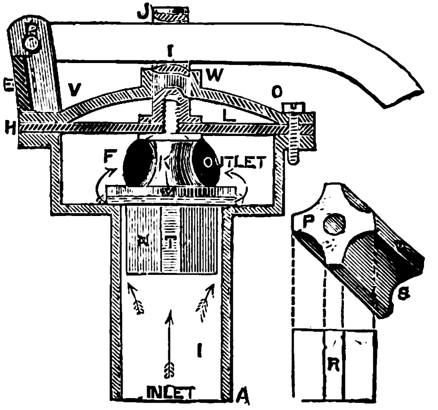
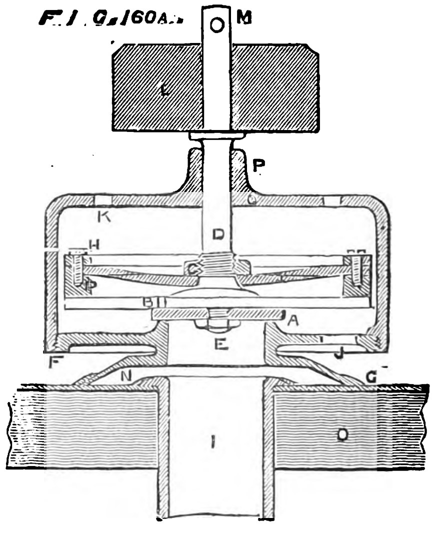


FIG. 160A.



The action is that, on pulling up the spindle D, it brings up the flexible diaphragm, and, with it, the outlet-valve A; but, as the top, Q, limits the amount of lift to both diaphragm and valve, the flexibility of the diaphragm allows the valve to descend slowly, and so cuts off the water from above and below the valve seating. This valve has been made to work under the closet seat, and is done by making the casing Q watertight with a stuffing-box, and by cutting a thread either at J or any other part of the valve-casing. Of course, in this latter case the spindle M is best worked with a lever.

Diaphragm Waste-Preventing Closet Cottage Valves.

Fig. 161 illustrates a double diaphragm waste-preventer valve. It has an improvement over that shown in Fig. 160, inasmuch as the feathered nut is here dispensed with, and the spindle made to work through a guide in the top. To understand the action note the following particulars: Suppose all to be full of water, i.e., between D, H, A, V, &c., V to be the inlet, and A the outlet; then pull up the spindle P of the top diaphragm B; this, by reason that the water is between the two diaphragms will, so to speak, suck up the other diaphragm D, thereby opening the valve attached, when, of course, water will run to the w.c.; but by reason that there is a small hole F in the bottom diaphragm, and that this diaphragm has weight, the water will run up through the hole F, and allow the diaphragm D with the valve S to descend slowly, and again cover the seating; this happens notwithstanding that the lever and top diaphragm are being held up.

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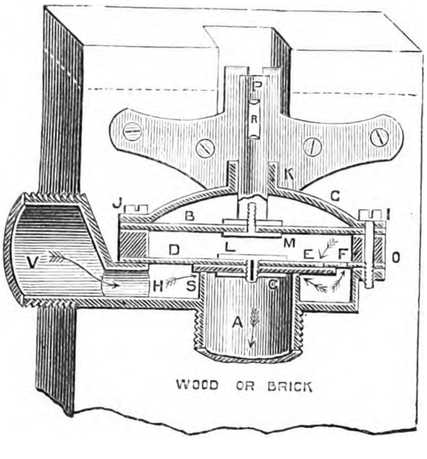
FIG. 161.



Suppose such an action to have taken place, and drop the lever, the top diaphragm will fall and send out water from between the diaphragms through the small and simple relief-valve E, which opens downward; the arrows indicate the direction in which the water rushes during the time the valve is in action—*i.e.*, during the upward or downward motion.

Double-Action Waste-Preventer Valves.

The Metropolitan and other water company's Acts, especially that dated 1871, has created much agitation and not a little enterprise and inventive talent in the manufacture of water-closet valves, which may very easily be accounted for by reference to the following items in the Act. It will be seen by Clause 21, which I here insert, that the supply of water to closets is limited. It says:—

"Every water-closet cistern or water-closet service-box hereafter fitted, in which water supplied by the company is to be used, shall have an efficient waste-preventing apparatus so constructed as not to be capable of discharging more than two gallons of water at each flush." But it does not make any stipulation as to the number of times you may repeat the flushes. Here is the result: by referring once more to Fig. 147 you will observe the valve-closet, and above it the cistern with the double-action waste-preventing valve, capable of discharging the two gallons twice over, but at different intervals. These after-flush valves should be thoroughly understood by every plumber, for the reason that, like most other water fittings, their good or bad working will, to a great extent, depend upon the treatment they receive from him. Every builder or master plumber should bear this well in mind, as my experience has taught me that half the best sanitary fittings (more especially valves) are spoilt by the clumsiness or carelessness of unskilled workmen.

Fig. 162 is a section of one of the Double-action Water-waste Preventers (for the method of fixing and elevation see Fig. 147) for fixing in a cistern under water. B is the tinned seating, to be wiped over the mouth of the down-pipe leading to the w.c., as at 49, Fig. 147. W L, Fig. 162, are the valve-seatings; I and X are the suckers, and JJ the sucker-plates; RR the regulating-holes, G T the casing.

Next refer to Fig. 163, which illustrates a valve similar to Fig 162, the difference being that Fig. 163 is for fixing under the seat of a w.c., and consequently the body, shell, or casing must be varied from that shown at Fig. 162, but Fig. 163 may be fixed and used either in or out of a cistern; that is to say, the outlet A of the valve may be screwed to the bottom of the cistern with an ordinary fly or back-nut, or it may be screwed into a pipe; this, though, only under exceptional circumstances, as the cost of the valve at Fig. 163 is nearly double that of 162, in consequence of the extra strength required for the body-shell or casing, and the extra work for stuffing nuts, boxes, &c.

FIG. 162.

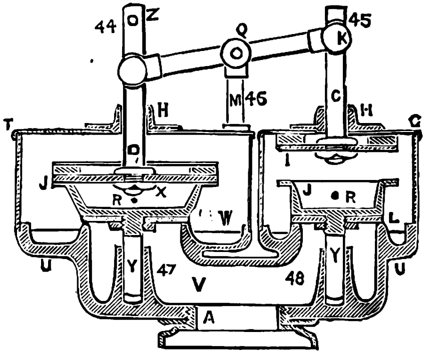
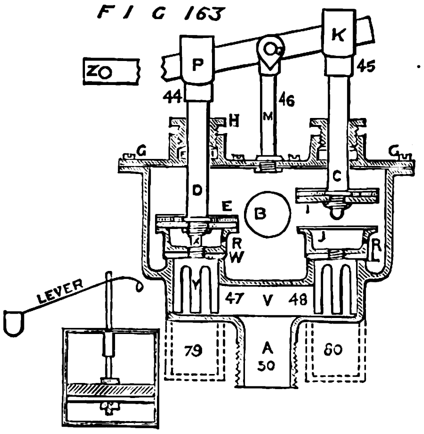


FIG 163



The valve W L, when fixed to work under heavy pressure, is made with loose, retarding pistons, and chambers, as shown by the dotted lines at 79 and 80; this is nothing more than a water-cushion or cataract, as shown at K, Fig. 153. The real use of the water-cushion in Fig. 163 is to prevent the slamming of the valves; whilst the use of the same in Fig. 153 is to keep the valve open for a particular period. It also acts as a preventative to slamming. If a flexible diaphragm is used, as illustrated at L, 160 A, or a ball connected to the valve-dish, the valve cannot drop off, and the valve consequently falls slowly, accordingly as the ball or diaphragm may expand, open, or fall.

(*To be continued.*)

ON COMETS.*

By William Huggins, D.C.L., LL.D., F.R.S.

At the present moment there is no consensus of opinion as to the nature of comets. But within the last few years, from two opposite directions—from the use of the spectroscope and from mathematical investigation applied to the periodical displays of shooting stars—much knowledge has been gained of their nature, though there are still many points on which we can only speculate. It is my purpose this evening to give chief prominence to the new knowledge which these two methods of research have placed within our reach, and to distinguish as clearly as may be possible between what we know about comets and what is not more than speculation.

To carry out this purpose we must first study carefully the phenomena which have to be explained, namely, the essential appearances and changes which comets present during their approach to the sun, at the time that they are visible to us.

It is not necessary here to describe in detail the more purely astronomical side of the subject. It will be sufficient to say, in two words, that some comets have become permanent members of our system, while others probably visit us once only, never to return. It depends upon a comet's velocity whether its course should be a hyperbola, a parabola, or an ellipse. In the latter case only can it become a permanently attached member of our system. If the velocity of the comet when at the earth's distance from the sun exceeds 26 miles a second, the comet must go off into space, never to come back to us. If the comet is going less swiftly, its path will return into itself, and it will visit us periodically after longer or shorter wanderings. In the case of many comets, including the brightest comet of last year, their velocity is so near the parabolic limit that it is scarcely possible, from observations made in the small part of their orbit near the sun, to be quite sure whether they will return to us or not. A number of comets, chiefly small ones, are certainly periodic, and of some comets several returns, true to the calculated time, have been observed.

The small portion of the comet's life during which we are able to study it is quite unlike its ordinary humdrum existence. It consists of the short period of extreme excitement into which it is thrown by a more or less near approach to the sun—a state of things which is accompanied by rapid and marvellous changes, often on a stupendous scale.

1. *The nucleus.* With the aid of a telescope, in the heads of most comets a minute bright point may be found. This apparently insignificent speck is truly the heart and kernel of the whole thing—potentially it is the comet. It is this small part alone which conforms rigorously to the laws of gravitation, and moves strictly in its orbit. If we could see a great comet during its distant wanderings, when it has put off the gala trappings of perihelion, it would be a very sober object, and consist of little more than nucleus alone. It is only this part of the comet which can have any claim to solidity, or even appreciable weight. Though many of the telescopic comets are of extremely small mass, nucleus included—so small, indeed, that they are unable to perturb such small bodies as Jupiter's satellites—yet in some large comets the nucleus may be a few hundred miles in diameter, and may consist of solid matter. I need not say that the collision of a cometary nucleus of this order with the earth would be fraught with danger on a very wide scale.

2. *The coma.* This appears usually as a luminous fog surrounding the nucleus, and gradually shading off from it. The nucleus and the coma form together the head of the comet.

3. *The tail.* The tail may be considered as a continuation, in a direction opposite to that of the sun, of the luminous fog of the coma. This appendage may be scarcely distinguishable as a slight elongation of the coma, or it may extend half across the heavens, and be many millions of miles in length. The tail may be single, or composed of several branches.

We must now study more closely the cometary appearances as they may be seen when a large telescope is directed to a brilliant comet. I have selected for this purpose the Great Comet for 1858, and I shall exhibit on the screen a series of views of this comet, taken at intervals of a few days. The first set shows the growth, position, and form of the tail, as a whole. The second group represents the more detailed structure and changes of form of the head of the comet, as viewed in a large telescope. These views are, of course, from sketches made at the telescope. Last year several attempts were made to photograph the comet which appeared in June. M. Janssen has kindly sent me a positive taken from the original negative. M. Janssen purposely sacrificed detail in the head of the comet, for the sake of obtaining the structure and form of the tail, exposing the plate for thirty minutes. From a careful examination of several similar negatives, Janssen made a drawing of the comet. Mr. Common, at Ealing, with a fine three-foot reflector of his own construction, also photographed the comet, but his object, different from that of Janssen, was to get the form of the nucleus. For this purpose he gave an exposure of only ten minutes—far too short to obtain an impression of the tail. The comet was also photographed by Dr. Draper, of New York. My own work was confined to the comet's spectrum, of which I shall speak presently.

We may now advance to the consideration of two primary questions:—

1. Does a comet shine wholly by reflected solar light, or has it also light of its own?

2. Of what material is a comet composed?

The spectroscope has furnished us with information on both these points. The first successful application of the spectroscope to a comet was in 1864, when Donati discovered in its light three bright bands. In 1866 I was able to distinguish two kinds of light from a telescopic comet—the one kind giving a continuous spectrum and presumably solar light, and the other a spectrum of three bright bands, similar to those which had been seen by Donati. But in 1868 a great advance was made. The close agreement of measures I took of the bands of the comet *b* of that year with those I had previously taken of the spectrum of certain compounds of carbon led me to compare, directly, in conjunction with my friend Dr. W. Allen Miller, the spectrum of the induction spark in olefiant gas, with the comet's spectrum, in the manner shown upon the screen.

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* The substance of a lecture delivered before the Royal Institution.

There could be no longer any doubt of the oneness of chemical nature of the cometary stuff with the gas we were using—in fact, that carbon, in some form or in some state of combination, existed in the cometary matter. From that time some twenty comets have been examined by different observers. The general close agreement, notwithstanding some; small divergences, of the positions of the three bands with those seen in the flame spectrum of hydrocarbons, leaves no doubt whatever that the original light of comets is really due to matter containing carbon in combination with hydrogen.

At first, indeed, for certain reasons, I was led to consider this spectrum to be that of carbon itself in the form of gas: a view still held by some physicists; but subsequent researches by several experimentalists on this point appear to me to be strongly in favour of carbon combined with hydrogen.

Last year another advance was made. For the first time since the spectroscope has been in the hands of the astronomer, the coming of a bright comet made it possible to extend this mode of research into the more refrangible region of the spectrum. Making use of the apparatus and arrangements which I employed for photographing the spectra of stars, I succeeded in obtaining a photograph of the spectrum of the head of comet *b*.

A copy of this spectrum is now upon the screen. There is a continuous spectrum which can be traced from about G to beyond K, in which are seen distinctly several of the Fraunhofer lines, G, *h* H, K, and many others. The presence of these lines was crucial, and made it certain that this continuous spectrum was really due to reflected solar light. But there was also present a second spectrum consisting chiefly of two groups of *bright* lines. These evidently were due to the same light which is resolved, in the visible region, into the three bright groups. I regarded them with intense interest, for there was certainly hidden within these hieroglyphics some new information for us. Measures of their position in the spectrum, taken under the microscope, brought out that these groups were undoubtedly the same which appear in certain compounds of carbon. Professors Liveing and Dewar had recently shown that these groups indicate a *nitrogen* compound of carbon, namely, cyanogen. On this view there must be in the cometary matter, besides carbon and hydrogen, the element *nitrogen*.

A few days after my photograph was taken, Dr. Draper succeeded in obtaining a photograph of the comet's spectrum, which appears to confirm mine so far as the bright lines, but does not give the Fraunhofer lines. About the same time that the observations were made on the comet, Professor Dewar succeeded in confirming his results, by the reversal of the groups, employing either titanic cyanide or boron nitride.

The positions and characters of these bands, together with those in the visible spectrum, leave no doubt that the substances, carbon, hydrogen, and nitrogen, and probably oxygen, are present in the cometary matter, and that this light-emitting stuff appears to be essentially of the same chemical nature for all the comets, some twenty, which have been observed up to the present time. Certain minor modifications of the common type of spectrum are often present, and show, as was to be expected, that the conditions prevailing in different comets, and indeed in any one comet from day to day, are not rigidly uniform.

The temperature, the state of tenuity, the more or less copious supply from the nucleus of the gaseous matter, must be subject to continual variation. At times it is probable that the hydrocarbon spectrum is complicated by traces of the spectrum of the oxygen compounds of carbon. These and other possible variations betray themselves to us in the spectrum, by the length of range of refrangibility through which each group can be traced, by an alteration in the position of maximum brightness in the groups, by the relative brightness of the groups, by a more or less breaking up of the shaded light of the bands and the visibility or otherwise of bright lines, by a more or less distinctness of the violet group, and, lastly, by the visibility in the brightest comet of last year of a less refrangible band of the hydrocarbon spectrum which occurs between C and D of the spectrum.*

We must now consider the information about the nature of comets which has come to us from a wholly different source. On almost any fine night, after a short watch of the heavens, we shall see the well-known appearances of "shooting stars." At ordinary times these are small, and appear indifferently in all parts of the heavens; but on certain nights they show themselves in great numbers, and of such brilliancy, as to present a spectacle of much magnificence. On such occasions one remarkable feature presents itself, which is well marked in the diagram on the screen. The meteors all shoot forth from one spot, which is called the radiant point. A little consideration will show that this appearance is really due to perspective, and represents the vanishing point of the parallel courses in which the meteors are moving. Hence we learn that they all belong to an enormous swarm of these bodies which the earth is meeting, and further, we may find the direction in which the swarm is moving relatively to the earth. Now the researches of Olbers, H. A. Newton, and Adams showed that the November shower is really a planetary swarm, revolving round the sun in about 33¼ years. Further investigations of Schiaparelli, Leverrier, and Oppolzer brought out the astonishing result that the path of the November meteors is really identical with that of a comet discovered by Tempel in 1865. Schiaparelli showed further, that another independent group of meteors which appears in August, has an orbit identical with the third comet of 1862. We are thus led to see the close physical connection, and oneness of origin, if not indeed identity of nature, of comets and of these meteors. Now the meteors on these occasions are too minute to pass through the ordeal of ignition by our atmosphere, they are burnt up before they reach the earth, but at other times small celestial masses come down to us, which, there can be little doubt, are of the same order of bodies, and similar in chemical nature. The meteorites we have in our hands contain matter of the same kind probably as that which gives rise to cometary phenomena. These two small meteorites, which fell at Estherville, were kindly sent to me by Professor Newton, as probably good examples of the sort of stuff of which the nuclei of comets are composed. The question arises, Are the revelations of the spectroscope about comets in harmony with what we know of the chemical nature of these celestial waifs and strays?

Meteorites may be arranged in a long series, passing from metallic iron alloyed with nickel at one extremity, to those of a stony nature, chiefly silicates, at the other. In meteorites more than twenty of the elementary bodies have been found, including hydrogen, carbon, and nitrogen, which the spectroscope has shown to be in comets. It may be, however, that in the sun's action on comets, we have to do not with the decomposition of the cometary matter, but with the setting free of gases occluded within the meteoric matter, forming the comet's nucleus. If the meteoric matter were decomposed, we should expect a more complicated spectrum.

Some years ago, in conjunction with my friend, Professor Maskelyne, I examined the spectra of certain meteorites, and obtained in several cases a spectrum similar to that of comets. Some meteorites, like that of Bokkveldt, contain a large percentage of hydrocarbons. Professor Vogel has recently experimented in the same direction, and finds that the gas which comes off from the meteorite he used gives a hydrocarbon spectrum mixed with that of carbonic oxide, and under certain conditions the spectrum of hydrocarbon predominates and becomes almost exactly similar to that of comet *b* 1881. We are at a disadvantage in one particular, for we cannot get at meteorites as they exist in celestial space, but only after superficial ignition in passing through the air.

The experiments hitherto made throw but little light on the question, whether cyanogen ready formed is present in combination or otherwise in the comet, or whether it is formed at the time by the interaction of carbonaceous and nitrogenous matter. In the latter case we should have to admit a high temperature, which would be in favour of the view of an electric origin of the comet's light. Professor A. Herschel and Dr. Von Konkoly have pointed out that the spectra of the periodic meteors are different for different groups. I may also mention that Captain Abney considers that he has evidence of hydrocarbons in the outer portion of the sun's atmosphere.

We have now advanced to the extreme boundary of the solid ground of our knowledge of comets. Before us lies the enchanted region of speculation. Without being too venturesome, we may well consider a few points which may explain more in detail some of the phenomena of comets. Of whatever nature we may regard the tremendous changes which take place in them to be, we must certainly look for the primary disturbing cause to the sun. Is the solar heat sufficient to account directly for the self-light of comets, or does it act the part of a trigger, setting free chemical or electrical forces? On this point of the sufficiency of the solar radiation we must not look to the few cases of exceptionally close approach to the sun, but to the more average distance of comets at perihelion. Professor Stokes has suggested that some results obtained by Mr. Crookes may throw light upon this question. He concluded from his experiments that in such vacua as exist in planetary space the loss of heat, which in such cases would take place only by radiation, would be exceedingly small. In this way the heat received from the sun by the comet would accumulate, and we should get a much higher temperature than would otherwise be possible. In this connection may be mentioned the remarkable persistence of the bright trains of meteors in the cold upper air, which sometimes remain visible for three-quarters of an hour before the light fades out by the gradual dissipation of the energy.

I need hardly say that the enormous tails of bright comets, many millions of miles in length, cannot be considered as one and the same material object, brandished round like a great flaming sword, as the comet moves about the sun. It is but little less difficult to suppose that the cometary mass is of so large an extent as to include all the space successively occupied by the sweep of the tail at perihelion. On the material theory we seem to be shut up to the view that the tail is constantly renewed and reformed, either by matter streaming from the nucleus or in some other way. But this view involves velocities far greater than the force of gravitation can account for. Let us consider the order of the phenomena. Under the sun's influence, luminous jets issue from the matter of the nucleus on the side exposed to the sun's heat. These are almost immediately arrested in their motion sunwards, and form a luminous cap; the matter of this cap then appears to stream out into the tail, as if by a violent wind setting against it. Now, one hypothesis supposes these appearances to correspond to the real state of things in the comet, and that there exists a repulsive force of some kind acting between the sun and the gaseous matter, after it has been emitted by the nucleus. On this hypothesis the forms of the tails of comets, which are usually curved, and denser on the convex side, admit of explanation. Each particle of matter of the tail must be moving in a curved course, under the influence of the motion it originally possessed, combined with that of this hypothetical repulsive force. But in the form which the tail assumes for us we have not only to consider the effect of perspective, but also that the comet itself is advancing, so that the visible tail is due to the portion of space which at the time contains all the repelled matter, each particle describing its own independent orbit, and reflecting to the eye the solar light or giving out its own light, as the case may be. The value of the repulsive force which would be necessary on this theory has been investigated by Bessel, Peirce, and others. Recently Bredichin has investigated the curvatures of the tails of a number of comets. According to him, they fall into three classes, each type of curve depending upon a different assumed value of the repulsive force. This leads to another point, namely, the secondary tails which are often present. Some of these appear to be darted off with an energy of repulsion so enormously great that the original motion of the nucleus tells for very little, and hence the secondary tail is but slightly curved, or even is sensibly straight. Again, if we take the hypothesis that this repulsive force, of whatever character it may be, varies as the surface, and not, like gravity, as the mass, substances of different specific gravity would be differently affected and separated from each other, and these secondary straight, or nearly straight, tails would, on this view, consist of the lightest matter.

On this hypothesis a comet would suffer of course a large waste of material at each return to perihelion, as the nucleus would be unable to gather up again to itself the scattered matter of the tail; and this view is in accordance with the fact that no comet of short period has a tail of any considerable magnitude.

A theory, based on chemical decomposition, has been proposed by Professor Tyndall; but as this view has been illustrated here by the eloquent author himself, I will not now enter upon it.

A different view of the whole matter has been suggested by Professor Tait. He supposes, not the nucleus only, but the whole comet, to consist of a swarm, of enormous dimensions, of minute meteoroids, which become self-luminous at and about the nucleus, in consequence of the impacts of the various meteoric masses against each other, giving rise to incandescence, melting, the development of glowing gas, and the crushing and breaking up of the bodies into fragments of different sizes, and endowed with a great variety of velocities. She tail he conceives to be a portion of the less dense part of the train illuminated by sunlight, and visible or invisible to us, according not only to circumstances of density, illumination, and nearness, but also of tactic arrangement, as of a flock of birds under different conditions of perspective, or the edge of a cloud of tobacco-smoke.

On this hypothesis we should expect to find a more complicated spectrum, and the spectra of comets to differ greatly from each other.

There seems to be a rapidly-growing feeling among physicists that both the self-light of comets and the phenomena of their tails belong to the order of electrical phenomena. One of the most distinguished of the American astronomers wrote to me recently: "As to the American views of the self-light of comets I cannot speak with authority for anyone but myself, still I think the prevailing impression amongst us is that the light is due to an electric, or, if I may coin the word, electric-oid action of some kind." Here I confess I tread most cautiously, for we have no longer any stepping-stones of fact on which to place our feet. I am ready to admit that the spectroscopic evidence, especially that furnished by the photographs of last year, favours, though it does not necessarily demand, the view that the self-light of comets is due to electric discharges. I do not attach much importance to the fact that the bright groups in the visible spectrum of comet *b* agreed with those of the so-called "flame spectrum," for the reason that the same spectrum may be obtained from the induction-spark, when suitable arrangements are used to make the discharge one of comparatively low temperature.

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* For these reasons measures of these bands should be considered as strictly applicable to the particular comet at the time of observation only, and not necessarily as applicable to other comets.

As we are now fairly on the wide ocean of speculation, I need not say that the precise modes of application of the principle of electricity which have been suggested are many. Broadly, they group themselves about the common idea that great electrical disturbances are set up by the sun's action in connection with the vaporisation of some of the matter of the nucleus, and that the tail is matter carried away, possibly in connection with electric discharges, in consequence of the repulsive influence of the sun, which is supposed to be in a state of constant high electrical potential of the same name. Further, it is supposed that the luminous jets and streams and caps and envelopes belong to the same order of phenomena as the aurora, the electrical brush, and the stratified discharges of exhausted tubes. Views resting more or less on this basis have been suggested by several physicists, and, in particular, have been elaborated at great length by Zöllner, who endeavours to show that on certain assumed data, which appear to him to be highly probable, the known laws of electricity are fully adequate to the explanation of the phenomena of comets.

All the theories we have considered assume that the bright lines seen in the spectra of comets indicate heated luminous gas. An alternative hypothesis has been suggested by Professor Wright, and especially by Mr. Johnstone Stoney, who considers that the compound of carbon vapour is opaque in reference to the particular rays which appear as bright lines in consequence of sending back to us the sun's rays falling upon the vapour. Further, he considers the phenomenon to be of the order of phosphorescent bodies, and he states that the conditions existing in the cometary gas are such as will eminently promote phosphorescence, and therefore visibility, in presence of a luminary.

ELECTRIC LIGHTING BY INCANDESCENCE.

ON Friday last Mr. Swan lectured at the Royal Institution on the incandescent system of electric lighting, and, in the course of his remarks, gave the following interesting details:—He thought he could fairly say that the difficulties encountered in the construction of incandescent electric lamps had been conquered, and that their use was economically practicable. They knew, by actual experiments, that continuous heating to a fairly high degree of incandescence during 1,200 hours did not destroy a well-made lamp. What the utmost limit of a lamp's life might be they did not know. Probably it would be an ever-increasing span; as, with increasing experience, processes of manufacture were sure to become more and more perfect. Taking it, therefore, as fully established that a cheap and durable lamp could now be made, the further question was as to the cost of the means of its illumination. The cost of producing light by means of electric incandescence might be compared with the cost of producing gas-light in this way: 2cwt. of coal produced 1,000 cubic feet of gas, and this quantity of gas, of the quality called fifteen-candle gas, would produce 3,000 candle-light for one hour. But besides the product of gas, the coal yielded certain by-products of almost equal value. He would, therefore, take it that they had in effect 1,000 feet of gas from one cwt. of coal, instead of from two, as was actually the case. The one cwt. of coal would give fifty horse-power for one hour. Repeated and reliable experiments showed that they could obtain through the medium of incandescent lamps at least 200 candle-light per horse-power per hour. But as there was waste in the conversion of motive-power into electricity, and also in the conducting-wires, he made a liberal deduction of 25 per cent., and took only 150 candle-light as the net available product of one horse-power. For fifty horse-power, the produce of one cwt. of coal, they had then 7,500 candle-light, as against 3,000 candle-light from 1,000 feet of gas. That was to say, two-and-a-half times the amount of light which the gas from the same quantity of coal was capable of producing. There remained, however, an allowance to be made to cover the cost of the renewal of lamps. Whether by the method of multiple arc, which necessitated the multiplication of electrical stations, or by means of the simple series or of secondary batteries connected with each other from house to house in single series, the lamps being fed from these in multiple arc, he was quite satisfied that comparatively with the distribution of gas, the distribution of electricity was sufficiently economical to permit of its practical application on a large scale. As to the cost of laying wires in a house, he had it on the authority of Sir William Thomson, who had just had his house completely fitted with incandescent lamps, that the cost of internal wires was less than the cost of plumbing in connection with gas-pipes. Referring to the use of carbon as the wick of an electric lamp, Mr. Swan pointed out that excellent carbon filaments could be produced from the bamboo, and also from cotton thread treated with sulphuric acid. The sulphuric acid treatment effected a change in the cotton thread similar to that which was effected in paper in the process of making parchment paper. He exhibited an example of a carbon filament produced from parchmentised cotton thread. The filament, he said, was not more than the ·01 of an inch in diameter, yet a length of three inches, having therefore a surface of nearly the one-tenth of an inch, would give a light of twenty candles when made incandescent to a moderate degree.

GLYCERINE FROM SOAP LYES.

THE following method of extracting glycerine from soap-lyes has been patented by Dr. F. Versman of New Charlton. So many uses have been found for glycerine of late years, that it has been gradually rising in price, and as a querist points out on p. 19, it is now obtained from what are known as the waste products of the soapworks. The following notes will partly answer the query No. 46298. The object of Dr. Versman's invention is the recovery of glycerine from soap-lyes, and its more or less complete separation from the accompanying salts, chiefly chloride of sodium, carbonate of soda, and caustic soda. He separates a large percentage of these salts by simply boiling down the soap-lye and raking out the salts as they become insoluble; he then allows the concentrated solution to cool, after which carbonic acid gas is passed through it until the whole of the carbonate and caustic soda is converted into bicarbonate of soda, which is much less soluble in glycerine than either the carbonate of soda or the caustic soda, and may readily be removed by filtration or other convenient means. The liquid from which the bicarbonate of soda has been removed is rich in glycerine, but it still retains sensible quantities of chloride of sodium and other salts, the presence of which may act injuriously in the subsequent application of the glycerine to certain purposes. These salts the patentee separates by submitting the liquid either hot or cold to the process of osmose in an apparatus known as the "osmogene," such as is used in the separation of saline compounds from solutions of beet-root sugar; by this process nearly all the salts are separated from the glycerine; but as the latter becomes diluted with water it is concentrated by evaporation, when it will be ready for the market as crude glycerine. Instead of commencing the treatment by boiling down the lye, carbonic acid gas may be passed through the original soap-lye, or, if preferred, the use of carbonic acid gas may be dispensed with, but the patentee finds the most convenient and economical way is to first reduce the bulk of the liquid by boiling down so as to separate large quantities of the salts, and then to treat the liquid with carbonic acid; the subsequent treatment in the osmogene is essential in all cases.

This osmogene is a modification of Graham's dialyser and consists of 40 or more cells formed by sheets of parchment paper laid flat and connected at the edges all round, the space between each pair of sheets being fully half an inch. Each sheet is supported by a cross piece of wood and a network of string, and the whole affair is about 4ft. long by 3ft. high. Water is sent through alternate spaces, and the substance from which the salts are to be extracted through the others, the water by osmose carrying off the salts and leaving a small quantity of itself in the syrup or other substance.

SHOP WRINKLES.*

Making Chasers with odd Threads-Grooving Taps—Tempering Taps, Reamers, &c.

A FEW years ago I broke a screw on one of my instruments. This necessitated sending the instrument, or part of it, to get a new one fitted—which would involve the loss of at least six or eight weeks' time and heavy expense.

I had hunted in all of the jewelry, gun and blacksmith shops for a screw plate with the right number of threads, but, of course, I failed to find one. There was no screw-cutting lathe in the vicinity on which I could cut a screw, or make a hob with which to cut a chaser. Under these circumstances, it became necessary to originate a screw; and for the benefit of others, who may some time be similarly situated, I will tell how I managed.

I found a jeweller who offered me the use of a small hand lathe with a slide rest, the feed screw of which was, I believe, 14 threads to 1in. The screw I desired to cut was an odd number—47, I think. The problem I had to solve was how to produce a screw of 47 pitch from one of 14 pitch, without gears, and this is how I did it: I first turned and filed up a milling cutter about ⅓in. diameter, the edge of which I made of the same shape as the thread on the broken screw. I then took a strip of thin brass, drew a straight line through the centre, took a pair of sharp-pointed dividers, setting the points about ⅓in. apart, and marked off 47 points along the line on the brass strip, prick-punching small holes at each point. I cut off each end of the strip a little over 1-6in. beyond the end holes, bent the strip in the form of a hoop, and fitted the ends squarely together until the two end holes were brought the same distance apart as the others. I then wired the ends together and soldered them with silver solder. I next fitted a wooden wheel on a flange in place of the feed handle of the slide-rest, placed this wheel in the lathe, and turned it down until the hoop fitted snugly. I now had an index divided by 47 true enough for the purpose. I then forged a blank chaser, fastened it in the tool post of the slide-rest, placed my cutter in the lathe, and commenced by milling a groove in the end of the blank chaser to the depth of one thread, screwing the cross-feed up to the cutter, and marking the position of the handle. I then backed up the cross-feed, and advanced the feed-screw 14 holes on the index, and milled another groove by screwing up the cross-feed to the same point as in the first cut, bringing the handle to the position marked when milling the first groove, and so on till I grooved the end of the blank across its whole face. I then filed up the chaser, so as to give the proper rake or slant to the teeth, hardened it and did the job, making the required screws with my improvised chaser, a perfect fit.

Any required chaser can be easily made in this manner, the rule being to make an index, having same number of holes as the required screw has threads to one inch, and advance it the same number of holes as the lead screw has threads to one inch; or, when both numbers are divisible by same number, make a fraction, the numerator being the number of threads in the lead screw, and the demoninator the number of threads in the required screw; then reduce to its smallest demoninator. For instance, the lead screw has 12 threads, and it is required to cut 48; then as 12/48 = ¼, you can make an index of four holes, and advance the screw one hole on the index.

I believe the way to groove taps is to make spiral-flutes like a twist drill, only giving less twist, making the flutes with circular section. Small taps up to say ½in. diameter, I file up in the vice with 3 flutes. I use for this purpose a drill file, or a round file. By this method of fluting you can give full stroke to the file, and finish quicker than you can rig up to plane or mill them with the ordinary straight flutes. Any one using this form of tap for the first time will be surprised at the ease with which it cuts, if otherwise properly made.

I have found by experience that there are only a few machinists who can harden and temper such tools as taps, fluted-reamers, &c., and do it properly. They sometimes burn the steel, spring the tool, or crack it in hardening, or temper it so unevenly that it will come out with all the colours of Jacob's coat. I will tell how I do it, and if any think it better than their method they are welcome. There is no patent on it, neither do I claim it as original. I expect a great many mechanics will say, "Who don't know all that," &c. Some may have even a better method. If I have many tools to temper at one time, I use a lead bath. I heat the tools only sufficient to harden, and if heated in an open fire, I use hard soap to prevent oxidation. With some steels which require a high heat to harden, I have found the use of a paste made of prussiate of potash and salt, dissolved in stale beer and thickened with flower, of advantage. The tool should be heated perfectly even, not too quickly, and still it should not soak in heat too long. Experience must be the only guide on this point. After it is properly heated I quench it in a bath of salt brine containing prussiate of potash and corrosive sublimate, acidulated with sulphuric acid. This solution should have the chill taken off so that the temperature is about 50° to 60° F. I don't say that I know this solution is better than pure water, but I have always had better luck (if that is the right word) with it than with pure water. I keep the tool perfectly straight, without motion side ways, and after dipping quickly to a

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[*] By G. B. FOOTE, in *American Machinist*.

point above where I desire to harden it, then dip very slowly, and raise and lower it slowly for a distance of an inch or two. After the shank has cooled down below a red heat, I cool off by dipping its whole length. After this I polish so as to give a bright clean surface, then wipe it all over with an oily rag or waste, to give a very thin film of oil all over the surface (lard or sperm oil—not mineral). I then heat to a red heat an iron ring or tube of sufficient weight to retain heat, and of sufficient length to take in about half or two-thirds of the length of the hardened portion of the tool. The hole should be of a size so that the tool when placed in the centre will be an inch or so from the hot ring or tube. Insert the tool in the hole, moving it slowly back and forth and turning it around until it takes on the desired colour.

For a ½ in tap or reamer, a piece of 2in. or 2½in. gas pipe, about 3in. long, answers a good purpose. Other tempering sleeves can be made of old pulley hubs, or other pieces that can be found in the scrap heap. Draw the temper slowly, and let the tool cool off without quenching in water, and I believe you will have a satisfactory job. These tempering sleeves are excellent for drawing the temper on many other tools when an even temper is desired.

ELEMENTARY LESSONS IN DRY PLATE PHOTOGRAPHY.—II.*

Chemicals.

We ought to have enumerated in our last lesson, amongst the necessary apparatus, a small balance such as apothecaries use for weighing out medicines. This should be provided with the usual set of "apothecaries' weights." The chemicals required are as follows:—

Pyrogallic acid 1oz.; ammonia of specific gravity ·880, 3 or 4oz.; bromide of ammonia 1oz.; sulphite of soda 4oz.; neutral oxalate of potash ½lb.; sulphate of iron ¼lb.; citric acid 1oz.; hyposulphite of soda 1lb.; alum ¼lb.; methylated spirit ½ pint; negative varnish a few ounces; bi-chloride of mercury ¼oz.; a couple of books of test papers, one of blue-litmus and one of red-litmus.

The ammonia used in photography is the strongest solution of ammonia which it is possible to make in water at atmospheric pressure. When the stock has been purchased, it is advisable to pour it at once into a bottle holding exactly double the amount of ammonia, and to fill up the bottle with water. If this is not done, the stopper of the smaller bottle may be blown out by the pressure of the liberated ammonia gas when the weather is warm.

Neutral oxalate of potash ought to have neither an acid nor an alkaline reaction; but often that sold as neutral is somewhat alkaline.

Sulphate of iron or "copperas" should be kept—after it is dissolved in water—in a closely stopped bottle.

The alum used may be the ordinary alum sold by grocers, and may be either a potash or a soda alum. As it is intended to be dissolved in water, it should be bought in the form of a powder.

Bi-chloride of mercury is a whitish crystalline substance, and is strongly poisonous. It is commonly known as corrosive sublimate.

The test papers are for discovering whether a liquid such as a solution of any salt is neutral, acid, or alkaline. To use them, proceed as follows. Suppose you have a solution of whose condition as regards acidity or alkalinity you are ignorant. Dip a small piece of the blue-litmus paper into the solution. If the paper changes its colour to red at once, or after a short time, the solution is acid; if no change in its colour takes place, the solution is either neutral or alkaline. In this latter case, dip a piece of the red-litimus paper into it; you will now know its exact condition. If the red-litmus becomes blue, the solution is alkaline; if no change takes place, it is acid.

We give instructions for mixing one or two of what are called "stock solution." These are solutions which may be kept for some time, and which the photographer should always have by him. These we now describe are to be used in the first lesson in development.

No. 1 bottle to be labelled "Solution of Oxalate of Potash" in large letters, so that it may be read in a very dull light. Place the whole half pound of neutral oxalate of potash in a bottle capable of holding from ten to twelve ounces. Fill up the bottle with warm water, place in the cork, and shake. A part, but not the whole, of the white crystals, will dissolve. The liquid will be what is called a "saturated solution"—that is, the water will have taken up as much of the salt as it is capable of doing. When any of the solution is used, the bottle should be again filled up with water, and this may be done repeatedly till all the crystals are dissolved, when more oxalate of potash must be purchased. This solution must be tested in the manner described above to discover whether or not it is alkaline. If it is, enough citric acid must be added to make it neutral or very slightly acid.

No. 2 to be labelled "Sulphate of Iron Solution." Place about a half of the sulphate of iron in a half-pint bottle, and proceed exactly as with the last stock solution. It is very necessary in this case to keep the bottle always full of solution, and well corked, as the oxygen of the air, if it come in contact with the liquid, very rapidly spoils it. The solution should be of a bright green colour. If it becomes red, it is useless.

No. 3 *Ammonia-Bromide Solution. One per cent.*—Weigh out twenty grains of ammonia bromide. Place in a four-ounce bottle, and make up to four ounces with water. The percentage is not exactly correct, but is quite near enough for the purpose.

No. 4. *Alum Solution.*—Place three or four ounces of the alum in a pint bottle. Fill up with warm water. The whole of the alum will probably dissolve, but some of it will be thrown down again as crystals when the solution becomes cold. As long as these last, more water may be added from time to time, as the solution is used. When they are all dissolved, alum must be added.

No. 5. *Fixing Solution.*—Place five ounces of hyposulphite of soda or "hypo" in a pint bottle, fill up with warm water, and shake till all is dissolved.

Common tap water may be used for all these solutions.

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* Condensed from the *Photographic News.*

SCIENTIFIC SOCIETIES.

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ROYAL ASTRONOMICAL SOCIETY.

The March meeting of the Society was held on the 10th inst., at Burlington House. Mr. E. J. Stone, President of the Society, and Director of the Radcliffe Observatory, Oxford, occupied the chair.

Mr. Samuel Jefferson, of 17, Virginia-road, Leeds, and Mr. James Leigh, of Watford House, King's Norton, Worcestershire, were balloted for, and duly elected Fellows of the Society.

Prof. Pritchard read a paper entitled "Notes on M. Loewy's Remarks Relative to the Wedge-Extinction Method of Stellar Photometry." He said M. Loewy urges the inequality of the absorptive power of such specimens of neutral-tinted glass as he has hitherto procured. With respect to the wedge used by me, I have examined its action upon spectra obtained from the sun and from a gas-flame, though I have not yet been able to try it upon a spectrum obtained from the electric light. I find that its absorptive power is very uniform, except in the extreme red, where the light is very faint, so that it is not likely to affect the measures of any stars visible to the naked eye; moreover, relative photometry of coloured light does not lie within the reach of any instrument known to me. That disposes of M. Loewy's first objection. I should not have troubled myself to make photometric experiments with neutral-tinted glass without first finding out whether the absorptive power of the glass was or was not equal throughout the spectrum. Secondly, M. Loewy finds that he cannot rely on a wedge to discriminate differences of light equal to 7 or 8 magnitudes. I reply that, as I use the wedge, no two stars differ greatly in light. It is my practice to contract the aperture of the viewing telescope for the brighter star, as it is not desirable to use very large wedge intervals; but I have found that the wedge is reliable for differences extending through at least 6 magnitudes. The second objection of M. Loewy is, I hope, therefore, disposed of. To show the accuracy of the photometric measures made with the wedge, I have given a table comparing the magnitudes of fifteen stars of the Pleiades group obtained with the wedge, and also as obtained by Prof. Pickering with a photometer of entirely different construction, in which the light of the two stars is brought to equality by means of double-image prisms. The result of the comparison shows that there is an average difference of rather less than one-tenth of a magnitude between Prof. Pickering's measures and my own, which is, I think, very satisfactory, and shows that a great advance has been made on the photometric methods used by Argelander and Weiss.

Mr. Knobel said—I think Prof. Pritchard's results are extremely interesting, but I should like to ask whether he has taken any precautions so as to extinguish the stars rapidly. I have found that if you extinguish the light of a star slowly, the muscles of the eye become strained, and if you strain the eye, you require a smaller aperture to extinguish a star a second time. I would ask Prof. Pritchard whether he has taken any precautions, so as to extinguish the stars rapidly, and whether he takes care that the second measure shall be made with a denser portion of the wedge. With regard to the accuracy which Prof. Pritchard has claimed for his method, it should be mentioned that though the averages may differ from Prof. Pickering's by only one-tenth of a magnitude, I see that there are differences between Prof. Pritchard's separate determinations, which amount to as much as three-fourths of a magnitude; consequently, it can only be regarded as a fortunate chance that the averages agree so closely with the magnitude obtained by Prof. Pickering.

Prof. Pritchard said, knowing the importance of making the observations rapidly, I had the wedge arranged so that it could be moved quickly by hand as well as move slowly by a tangent-screw, and having looked over 1,500 or 2,000 observations I am surprised at the uniformity of the final results. Of course we take the mean, just as they do at Greenwich, with transit observations. You would not expect the interval between all the wires to come out the same. I believe that it would be an exaggeration to say that the individual observations differ on the average by as much as the 1-5th of a magnitude.

Mr. Marth pointed out that Mr. Carrington had described a similar method of determining the magnitudes of stars in Vol. XVII. of the *Monthly Notices.*

The President, in returning thanks to Professor Pritchard, said no doubt if the truth were known a great many things that are described would be found to have been done or thought of before. The great point is, whether useful results are deduced. (Applause).

Mr. Christie read a paper, entitled, "Spectroscopic Results for the Motion of Stars in the Line of Sight obtained at the Royal Observatory, Greenwich." He said, this is the fifth list of such observations which have been published in the *Monthly Notices.* The measures have been made with a half-prism spectroscope, giving a dispersion of 18½ degrees. Since the beginning of 1881 a convex cylindrical lens has been placed in the viewing telescope. Up to the present time the motions of 99 stars have been spectroscopically determined; but the results are, in many cases, still uncertain. It is only to very bright stars that we can apply the method to advantage; in the case of fainter stars, such as are now being included in the list, the observations are necessarily subject to much greater errors; therefore, these results are, in some cases, rather discordant. The individual measures are given, so that anyone can, for himself, form an idea of the relative value of the observations.

Mr. Glaisher read a paper by Mr. Burnham on "A New Method of Bright Wire Illumination for Position Micrometers." Hitherto it has been usual to illuminate the field with faint light, and the wires have been seen as dark objects upon it. The plan pursued by Mr. Burnham is to illuminate the wires. He says the convenience and practical value of this arrangement can only be appreciated by one who has used the old plan and then tried this; a very feeble light is sufficient to illuminate the wires, so that no object which can be seen is now too faint to be measured.

Mr. Neison read a paper entitled "Note on a Term in the Perturbation of the Moon due to the Action of Mars." He said—When at work in the beginning of 1877 on this subject I made a rough calculation, and found a coefficient of several seconds of arc arising from the perturbing effects of Mars. I then communicated the results to the Society, and pointed out that they were only comparatively rough approximations, but that they accounted for an inequality of long period which had been noticed by Sir George Airy, who had pointed out that Hanssen's tables gave places discordant with the observations from 1751 to 1851. Lately a young Frenchman has sent me a paper which he has written as his thesis on obtaining his degree. He had calculated the term with correct accuracy by Delaunay's method, and he finds a coefficient which is exceedingly small; but, like Delaunay, he has not carried the approximations far enough, and he has left out terms as insensible which I think it will be found have considerable value; but I would take the opportunity of remarking that his investigation has been made with very great skill and care, and forms an important contribution to astronomy, although he has not carried it sufficiently far, and I hope that he will undertake the further calculations. I have, however, found reason to modify my original view, and I now find that the coefficient is not as large as I originally believed it to be.

Mr. Knobel read a paper by Dr. Konkoly on "Orbits of Meteor Streams," deduced from observations made in Hungary between the years 1871 and 1880. From the radiant points determined by means of about 5,000 observations of meteors, Dr. Konkoly has only been able to identify two meteor orbits as corresponding with known cometry orbits—viz, with the comets 1854-4 and 1861-1.

Mr. Neison said: This is rather an important paper. If it is correct that out of more than 100 meteor orbits Dr. Konkoly has only been able to identify two as corresponding with cometary orbits, it will show that the connection between comets and meteors is not as close as has been ordinarily supposed, or, if there is such a connection, it would seem that the comets rapidly disappeared, only leaving meteor streams in their track. With all the comets that are observed year after year, it is curious that only two such coincidences should have been made out.

Mr. Christie: There is another alternative, namely, that these meteor streams may indicate coming comets. Schiaparelli pointed out that meteors may be the heralds of comets, as well as the indication of comets that have disappeared.

Mr. Ranyard said: It is possible that Dr. Konkoly means that he has only succeeded in identifying two new comets with meteor streams, in addition to those which were already known.

Mr. Knobel: Dr. Konkoly says that he has only been able to identify two meteor orbits with cometary orbits.

Mr. Ranyard: It must be remembered that most of the comets which are observed do not pass sufficiently near the earth to be observed as a meteor stream; possibly some of these meteor streams may be five or ten million miles in diameter, for the earth takes several days to pass through some of them, but unless a comet passed within that distance of the earth's orbit, we ought not to expect to identify it as a meteor stream.

Mr. Neison gave an account of the new lunar crater, observed by Dr. Klein, in the neighbourhood of Hyginus. He said Prof. Schmidt, of Athens, has recently published his observations of the region, and he has arrived at the conclusion that since the year 1878 the object observed by Dr. Klein has been clear and distinct, and is, in fact, the second most conspicuous object in the whole region, whereas in every one of his observations made previously to that date, he was unable to see any trace of it, and he arrived at the conclusion that here at least we have an unquestionable case of physical change on the Moon. I observed this region myself 25 times between 1871 and 1876, and several other persons observed it up to 1877; no observations appear to have been made of this portion of the Moon, so that we cannot say what happened during that year, but now there can be no doubt that if any observer of experience looks at that region at any time within 36 hours after sunrise, he will not fail to see a great black object. I do not say crater, for it may be a mere physical alteration in the colour of the surface, but after Hyginus, it is the most conspicuous object in that region, and cannot fail to be noticed.

Mr. Bidder said: I should like to ask when was the first recorded observation of this object, and is there any reason to suspect that change is still going on in it?

Prof. Pritchard said: It occurs to me that this is very like the story of our old friend Linné. On one occasion I saw Linné as a small crater, and I rose to fetch another person to vouch for my veracity; but when we came back Linné was gone, and there was a white patch in its place. These changes of appearance may arise from difference of illumination.

Mr. Newall said: I have here a drawing of Linné, which I made in 1875, and I have never seen it since. A few hours makes all the difference in the world in its appearance.

Mr. Neison said: Linné was a small crater, so small that you could hardly see it. No one since 1865 has seen it as it used to be seen before that date. No doubt Linné changes very rapidly in appearance with the illumination; but that is not the case with the great black crater near Hyginus, which can be distinctly seen for 36 hours after it has appeared upon the terminator. Here is an object, not merely visible for a few minutes or hours like Linné, but it is a most striking object, which anybody that is at all used to lunar observations cannot fail to notice.

The following papers were also announced and partly read:—H. C. Russell, "The Transit of Mercury, 1881, Nov. 7th, observed in New South Wales," and "Measures of Double Stars, made at the Observatory, New South Wales"; D. Gill, "Note on the North Polar Distance of the Star Lacaille, 4342"; H. C. Rockwell, "Observations of the Transit of Mercury, 1881, Nov. 7th, made at Honolulu, Sandwich Islands; J. Tebbutt, "Observations of Comet III., 1881, made at Windsor, New South Wales"; J. R. Capron, "Observations of the Lunar Eclipse, 1881, Dec. 5th"; Rev. T. R. Robinson, "Note on the Places of Three Stars in the Armagh Cataloque"; C. Piazzi Smyth, "Revision of Twenty-one Places in the Red Half of the Solar Spectrum, with a Rutherfurd Diffraction Grating at Madeira, during the Summer of 1881"; E. J. Stone, "Observations of Occultations of Stars by the Moon, and of Phenomena of Jupiter's Satellites, made at the Radcliffe Observatory, Oxford"; Mons. Loewy, "Réponse à la Communication fait à la Société Royale Astronomique par M. Marth au sujet de mon appareil pour la détermination des flexures."

THE METEOROLOGICAL SOCIETY.

DURING last year the Council of the Meteorological Society, having regard to the rapid progress, of late years, in statistical meteorology, and the uncertainty that still prevails regarding important questions relating to the physics of the atmosphere, considered it desirable that the Society should supplement the ordinary observations by a series of well-conducted experiments destined to throw light on such questions as the vertical decrement of temperature, the rate of ascension of vapour, the height of cloud-strata, the variation in the velocity of the wind at different elevations, &c. Steps have been taken during the past week to make observations on the first of the questions by the placing of thermometers at the summit and base of Boston Church-tower, which is 270ft. high. This tower is admirably situated for making such experiments, as it is isolated and free from any obstructions, and the ground is quite flat for miles round. By permission of the vicar, Canon Blenkin, the instruments have been placed as follows:—At the summit, one of Dr. Siemens' electrical thermometers (kindly placed at the Society's disposal by Messrs. Siemens, Bros., and Co.) and an ordinary thermometer are mounted in a small screen fixed to one of the pinnacles of the tower; on the roof of the belfry, which is 170ft. above the ground, a Stevenson screen has been mounted, containing maximum, minimum, dry, and wet-bulb thermometers. In the churchyard another Stevenson screen has been fixed, containing a similar set of thermometers, for comparison with those above. All the thermometers will be read every morning at 9 o'clock. The electrical thermometer consists of a coil of wire wound round a cylindrical piece of wood inclosed in a small brass tube; a third wire is joined to one of the wires, and the three, insulated by guttapercha, form a light cable, which is brought down to the base of the tower, and connected to a galvanometer, the terminals of which are in connection with the two poles of a six-cell Leclanché galvanic battery. The instrument is read by depressing a key, which causes the needle of the galvanometer to deflect, a pointer or vernier (moving a contact-roller upon a wire in a circular groove) is then pushed to the right or to the left upon a divided scale, until the needle remains stationary on the zero-point, when the electrical resistance of the wire is measured upon the scale. The number indicated by the vernier is then read off, and by referring to a table of equivalents the actual temperature in degrees of Fahrenheit is readily ascertained.

Simultaneous readings of the electrical thermometer at the summit of the tower, and of the dry-bulb thermometer in the churchyard, will be made frequently during the day by the verger of the church.

The World at the Advent of Man.—Prof. Boyd-Dawkins, continuing his lectures at Owens College, spoke last week of the pleistocene period of the tertiary epoch. Instancing the discoveries of animal remains, representing both extinct and living genera, he came to the conclusion that in the period with which he was dealing the area of the Mediterranean was much less extensive than is seen at present, its bed being well marked out by the present 400 fathom line. Taking that depth as representing the pleistocene shore, he found that the coast line of Europe included Sicily, Corsica, Sardinia, the Balearic Islands, and that land extended over the Straits, joining the two continents at Gibraltar and Malta and Sicily. On that assumption he could easily account for the presence in Europe of animals now exclusively African, such as the hippopotamus, the lion, and the great elephant, and also explain the discovery in Africa of fossil remnants of animals inhabiting colder and more northern climes. Another important point was the relation of Britain to the mainland of Europe. In that case, the 100 fathom line was the clue to the ancient geography, and that line, commencing on the coast of Norway, sank to the north of Denmark and then went out to the west, embracing the British Isles, and touching the present coast in Northern Spain. This union of these islands with the Continent explained the presence in the same fossil-bed of bones of the rhinoceros, the reindeer, the elephant, the great bear, and other animals originating in widely separated zones. A striking instance in connection with that ancient union of islands and continent was afforded by the habits of the Arctic lemming. That animal even now congregated once a year in Lapland in enormous numbers, and travelled in droves through the Scandinavian peninsula, finally marching into the sea. It was in this pleistocene age that the glacial period in English history occurred, and it was at this time also that we had the first traces of man's existence on the earth. Whether man lived before or after the glacial cold era he could not say, but the fact was indisputable that in the mid-pleistocene age men lived and hunted in England, using weapons which were probably of the most rough and savage type, but which were widely distributed over the earth, and formed the most rudimentary stage in the history of civilisation.

SCIENTIFIC NEWS.

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SIR CHARLES WYVILLE THOMSON died last week at the comparatively early age of 51. He will be best remembered as director of the *Challenger* Expedition, a post for which he was well fitted by his previous experience in the *Porcupine*. Owing to failing health the deceased professor resigned his chair in Edinburgh University last year, which he had held since 1869.

The Government "Endowment of Research" Fund of £4,000 is continued for the present year, but the special grant of £1,000 is withdrawn. Applications for grants must be sent into the Royal Society before the end of the present month.

Fifty-one candidates' names are "up" for election into the Royal Society. The council during next month will select fifteen, who will no doubt be elected in June.

Next Wednesday Professors Roscoe and Abel, as presidents respectively of the Chemical Society and the Institute of Chemistry, will hold a reception at the Crystal Palace.

Dr. W. R. Hodgkinson has been appointed Professor of Chemistry and Physics at Woolwich Military Academy, and Mr. L. C. Wooldridge has been elected Brown Professor of Pathology in the University of London.

The memorial stone of an observatory presented to the town of Paisley by Mr. Coats, of Ferguslie, was laid last week. The building adjoins the free library and museum, and a suitable equatorial with other instruments have been selected by Professor Grant, of Glasgow. The property will be intrusted to the Philosophical Institution of Paisley.

Dr. C. Siemens has recently contributed a remarkable paper to the Proceedings of the Royal Society. He holds that all the heat and energy sent from the sun find their way back to the great solar centre. The paper is much too long, and on too recondite a subject, for our columns.

No. 21 of the *Mineralogical Magazine* is a nicely executed geological map of Sutherland by Dr. Forster Heddle, to illustrate his paper on the Geognosy of Sutherlandshire. It is on a scale of half-inch to the mile, and indicates all the mineral localities.

The Glasgow popular science lectures were brought to a close last week by a lecture by Mr. A. R. Wallace on the biological relations of New Zealand and Australia, in which he pointed out that the differences between the two countries were of the most radical kind. The lecturer contended that deep-sea soundings gave trustworthy indications of prior land connections, and pointed out that where islands had natural productions almost exactly the same as those of an adjacent continent, the depth of water between did not exceed 100 fathoms.

The annual meeting of the Institution of Naval Architects will be held in the hall of the Society of Arts on the 29th, 30th, and 31st inst.

Apropos of the discussion about screw propellers, we note that drawings are being made in the United States for a steamship of 400ft. length by 60ft. beam, calculated to make the passage from New York to Liverpool in "five or six" days. The engines will be of 15,000 indicated horse-power. Nothing is said about depth, but no great improvement will be made until that is taken into consideration, and the engine-power above mentioned is, it will be noted, excessive—in fact the "hold" will be mainly "engines" and their accessories.

The Patents Bill of the Society of Arts is to be introduced by Sir J. Lubbock and Mr. W. H. Smith. It has been considerably amended, but still contains the clauses providing for a preliminary inspection of specifications, but not as to novelty or utility. The fees are reduced to £2 10s. on application, and £5 on the grant. Mr. Chamberlain will, it is understood, also introduce a Bill on the subject.

Herr Setterberg, in a communication to the *Annalen der Chimie*, says he has succeeded in isolating cæsium by the electrolysis of a fused mixture of the cyanides of cæsium and barium. The metal is silver-white, ignites spontaneously in air, and generally behaves like potassium.

A Berlin paper relates an amusing story of the famous German scientist, Alexander Von Humboldt, taking advantage of the exemption from duty of the covering of articles free of duty, formerly the rule in France. In 1805, he and Gay-Lussac were in Paris engaged in their experiments on the compression of air. They found themselves in need of a large number of glass tubes. This article was exceedingly dear in France at the time, and the rate of impost on imported glass tubes was something alarming. Humboldt sent an order to Germany for the needed articles, and gave directions that the manufacturer should seal up the tubes at both ends, and put a label on each tube with the words *Deutsche Luft* (German air). The air of Germany was an article on which there was no duty; the tubes were passed by the customs' officers without any demand, and arrived, free of duty, in the hands of the two experimenters.

The dressings of wounds sometimes acquire a blue or green colour. This was inquired into recently by M. Gessard, who found the cause to be a small mobile parasitic organism, which he was able to cultivate in neutralised urine, or a decoction of carrots. It is developed in saliva, sweat, albuminous liquids, &c. The blue colouring matter it secretes is the pyocyanide of M. Fordos. A current of sulphuretted hydrogen, or sodium-amalgam, makes it green, then yellow. The small organism has the same action, by reason of its avidity for oxygen. It may here be stated that M. Richard has lately given some interesting information (*Comptes Rendus*) about a special organism found in the blood of persons attacked by malaria. It is called the *Oscillaria malariæ*, is formed in the red corpuscles (which it renders viscous, so that they stick in the capillaries), and from these it issues in the form of a flexible rod or whip, which, under certain conditions, has a vibratory movement.

The remarkable experiments of M. Bjerknes, imitating electric and magnetic phenomena, by means of pulsating bodies in water, have excited great interest. Recently, M. Decharme has worked at such imitation by another method, using liquid currents, continuous, or interrupted, in air or in water. In one case a conical convergent nozzle, with thick rim, connected with the water-service, and held downwards with the hand, its mouth very near a smooth base, is thrown into vertical vibrations which may produce a sound.) A thin-rimmed nozzle acts still better; in this case, *repulsion* is first, in the other *attraction*. The sensation in the hand is quite like that of holding an electro-magnet, quickly made and unmade in succession. M. Decharme makes "hydro-electro-magnets" with two contrary poles, on the principle indicated, and, in various experiments (*Comptes Rendus*) obtains a *direct* analogy between hydrodynamic phenomena, and those of electro-magnetism and induction (in M. Bjerknes' phenomena, the analogy is *inverse*). Again, M. Elie describes, in the *Journal de Physique*, some ways of imitating the forces that act in a dielectric. Small equal spheres hung in water with wires are set in rotation through the wires at the rate of at least ten turns in a second. Two such spheres repel each other if the rotations are in the same direction, and attract each other in the contrary case. A solid flat surface brought towards a rotating sphere is repelled, and so on.

In different parts of Eastern Switzerland, on Jan. 31st, a meteor of rare size was observed in bright sunlight, between 2 and 3 p.m. According to accounts of persons at Uetliberg, near Zurich, Einsiedeln, and St. Gall, a noise was first heard; then one saw a snow-white lump floating in the air, apparently hardly 50 metres (166ft.) above the ground; a thin sulphur-yellow strip then branched off north-westwards, but presently contracted again into ball shape, the whole suddenly disappearing with play of red, white, and green colour. The meteor fell to the ground with strong detonation at Skauss in Canton Graubündten.

A noteworthy recent case of injury to a chimney from lightning has been recorded from near Douai. The chimney is that of the sugar-refining works of Sen-le-Noble, and is about 170ft. high. The photograph shows a great lateral gap about 30ft. long at the top; thence the course of the fluid downwards is traceable by an irregular fissure of various width. The lightning tore off the spout, deluged the furnace-men with soot, put out the gas-jets, and escaped to earth by a vent-hole.

With regard to connection of lightning conductors with the gas and water-pipe systêms of towns, a paper of directions has been recently drawn up by a Saxon Government Committee (*Deut. Ind. Zeit.*). The following are some of the points in it: Such a connection renders an earth plate superfluous, and is both reliable and recommendable. Those pipe-systems are suitable which consist of iron pipes with socket and nozzle joint and lead stuffing; flange combinations are sufficient only when they have strong screw-nuts. Should the conductor be near a flange-combination, it should be connected with the system on both sides of the flange. The conductor should be connected, where possible, by soldering with soft solder over as great a surface as possible. (Sundry directions are given for this, and for connection where soldering is not practicable). To give protection and facilitate inspection, the parts concerned in the connection should be surrounded with light brickwork. Connection should not be broken during a thunderstorm.

It is now known that tendons (or the terminal parts of muscles) contract; also that they have sensibility and nerves distributed to them. The contraction has been thought to be a phenomenon of reflex nature, that is, a return-action of the spinal cord, caused by direct excitation of the tendon-nerves. But M. Guerin finds reason, both in the structure and the action of tendons, to believe that their contractility is quite of the same order as muscular, and he holds that they show, like muscles, both voluntary and involuntary contraction.

A simple apparatus for getting rid of cockchafers and other nocturnal insects, has been devised by M. Vittellier, of Mantes, and is figured in *La Nature*. It depends on the attraction of light for these insects, and consists of a lamp placed at the top of a movable frame, and having four square-shaped narrowing cases, with metallic reflecting surfaces in the interior, placed round it. The insects fly into these, and strike against a pane of glass, at the bottom of which is a funnel-shaped aperture leading to a bag hung below; and into this they fall in great numbers.

Instead of the usual solid case of the Bell telephone, Herr Konigslieb, of Hamburg, provides a case in which the space between the membrane and the magnet is enlarged into a thin-sided sounding-case, and under this is a resonance-case, which surrounds the other at a certain interval. The resonance-case is perforated in several places. The author claims to obtain thus a considerable strengthening of the sound; also a purer and more distinct transmission.

The expansion by heat of sulphur, caoutchouc, hardened rubber, guttapercha, and paraffin, and the applicability of hardened rubber to compensation pendulums forms the subject of a recent interesting paper by Herr Russner in *Carl's Repertorium*. It is shown that caoutchouc has an expansion more than four times that of sulphur; hence, doubtless, the great expansion of hardened rubber depends essentially on the former and the amount of it present. Varieties of hardened rubber can be produced that have an expansion six to ten times that of iron, so the substance has been suggested for compensations —*e.g.*, a pendulum-bob might be attached to a hardened rubber tube capable of moving over the lower end of the pendulum-rod, and fixed below with a screw. By expansion of the tube the pendulum-bob would be raised. Herr Russner obtained satisfactory proof that the tenacity of the substance is sufficient for the purpose. Another point that had to be considered was the great increase in the expansion of hardened rubber with the temperature (very different from that of iron). The author recommends substitution of hardened cast steel for iron in the pendulum-rod, as this diminishes the divergence. The results with a clock having its pendulum compensated with hardened rubber proved to be quite favourable.

An interesting lecture on porcelain, its history, manufacture, and decoration, has been recently delivered at the Sorbonne by M. Lauth. It is reported in *La Nature*.

The Parisian Gas Company have recently organised at their works at Villette (which is one of their most important centres of production) a museum of the industry of coal-distillation. One finds in it samples of the principal kinds of coal employed, and specimens of all products obtained from the coal, from coke, heavy oils, and ammoniacal salts up to the remarkable aniline dyes, now so numerous. Further, the museum contains types of the principal systems of canalisation, distribution, regulation, &c., of gas. Among historic curiosities is the first gas-engine constructed by Lenoir. On the walls are various instructive statistical tables, in some of which the volumes of the products from a given quantity of coal are indicated very helpfully by means of a diagram.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

VARIABLE STARS.

[19809.]—In the table of magnitudes given by Professor Pickering in his courteous and valuable reply (letter 19072, p. 542, Vol. XXXIV.) to my inquiries, I observe that the estimate of ε Cassiopeiæ is considerably lower than might have been expected. In the case of the other stars, and in the case of the magnitudes given in Professor Pickering's letter in January's *Astronomical Register*, the estimates are larger—some, considerably larger—than those given by other observers (a circumstance due, I suppose, to a difference of standard). But though Professor Pickering makes the magnitudes of α Cephei, ψ Ursæ Majoris, α Persei, β Tauri, respectively, 0·4, 0·3, 0·17, 0·38, greater than those assigned to them by Sir J. Herschel; he makes the magnitude of ε Cassiopeiæ lower than that given for it by the author of the "Outlines." As it seems from this that the difference of light between ε Cassiopeiæ and other stars is greater now than in 1837, it would appear that this star is a variable of Professor Pickering's third class.

Professor Pickering's remarks at the close of his letter in the *Astronomical Register*, Mr. Espin's communication in your number for Dec. 30, and the above remarks, show very clearly the necessity, in photometric observations, for clearly defining the standards employed. In the letter from Messrs. Espin and Read referred to, there is one serious omission: it is said "our comparison stars were taken independently also," and as the results are, for the most part, strikingly accordant, it is unhesitatingly concluded that the method of observation is all that can be desired. But unless we know *which* stars were employed as standards of comparison, and what were the magnitudes assumed for them, we cannot properly compare the results of the comparison—we might almost as well seek to compare fractions of different denominators at a glance. To instance, take the following table:—

Star.	Espin.	Read.	Gemmill.
α Ursæ Min.	2·4	2·4	2·2
γ ,, ,,	3·5	3·0	2·8
δ ,, ,,	4·6	4·3	4·3
ε ,, ,,	4·45	4·4	4·2
η ,, ,,	5·3	5·1	4·5
γ Draconis	2·5	2·5	2·6
β ,,	3·2	3·0	3·1
κ ,,	3·8	4·0	3·8
θ ,,	4·0	4·0	4·05
λ ,,	4·3	4·2	3·9

My results agree pretty closely with those of Messrs. Espin and Read; and when increased by 0·2 (the difference between their estimate of Polaris and mine), the differences are, for the most part, almost entirely removed. But the causes of these differences cannot be ascertained, unless the principle upon which the magnitude of some one among these stars was fixed is known. As my estimate of Polaris is based on the assumption that α Persei is of magnitude 2·1, and as α Persei was my comparison-star, it follows that the reasons why *my* estimates differ from *theirs* could not be examined into unless I knew their estimates for α Persei, or they had stated their comparison-stars, so that I might have placed my estimates alongside theirs. All star-magnitudes are comparisons: as such, various series cannot be compared *inter se* unless the scales upon which they are founded are known.

To follow out my own principle, and give data upon which my results can be understood, I will state my own scale. I base any one series of observations on the assumption that the magnitude of a certain star is a certain amount found by previous sequencing based on the assumption that Capella and Vega are normal first magnitude stars and similar in brightness. I afterwards investigate the magnitude of that star by numerous and careful sequences. Where I have no cause to suspect variability, I take the mean of the various results; but I am slow in so doing, as it is not very easy to tell whether the apparent differences in the magnitudes found at various times for any one star are real differences in brightness, or accidental differences due to weather or condition of eye—by always assuming them to be accidental, we should, no doubt, lose valuable indications of slight or temporary variability. In this way I hope to determine the constancy of light of the stars employed as standards. If I find the earlier assumption wrong, I apply the correction in reducing the result. As it is, I have found α Persei constant at 2·1. Sir J. Herschel gave it as 2·07. I have a suspicion, however, that its *colour* alters. By examining the differences between the extremes of sequences headed by Vega and Capella, I hope to ascertain if any changes *do* take place in these stars. Sir J. Herschel was of opinion that he had found Capella become brighter than Vega between 1837 and 1846.

A careful examination of η Ursæ Maj. has revealed indications of the five-day period spoken of by Mr. Espin, in his letter in your number for Nov. 25.

Colour of Dubhe.—Jan. 2, singularly red; Jan. 8, red, but deeper tint; Feb. 14, red colour very decided.

In letter 19514, p. 352, there were a few misprints; the principal being "sensitive-toned" for "sensitive to red."

S. Maitland Baird Gemmill.

Glasgow, March 10.

JUPITER.

[19810.]—I obtained a daylight observation of the red spot on March 3rd, 1882, as follows:—

	H.	M.
Preceding end on C.M.	1	24
Middle on C.M.	1	51
Following end on C.M.	2	21

When central the spot was fairly well defined, though, of course, with nothing like the distinctness of its evening apparitions.

The brilliant equatorial spot has been closely watched here, whenever circumstances permitted, up to the present time. On Feb. 26th and March 3rd it was recorded as very bright and large when crossing the C.M. of Jupiter. The conjunctions of this object with the great red spot, which recur at intervals of about 44½ days, are extremely interesting to witness, and I shall be glad if any of your readers will endeavour to observe the next, on the evening of March 23rd, when the two spots will have nearly coincident longitude, as they transit the C.M. at about 8h. 26m. p.m. On March 21st at 6h. 47m. p.m. the red spot will be about at mid-transit, while the white spot will be placed N. of its following end, and will arrive at the C.M. some 27 minutes later than the middle of the red. It is important that the relative positions of the two objects be carefully determined by observation on one or both of the evenings mentioned. The actual time of conjunction can then be readily computed as the greater velocity of the white spot enables it to gain 13m. 24s. daily (= 8·1° Jovian longitude) on the red spot. Moreover, the ensuing conjunction on March 23rd is the last which can be observed until the planet's reappearance in the morning sky, when, should the same markings continue visible, they will again occupy nearly the same longitude on the planet on August 3rd. But there are certain irregularities of motion which may affect the relative positions of the spots in the interval, so that the predicted date may not be found exactly conformable with that observed, though both the spots appear to be of marked permanency, and to display a great difference of mean velocity, which has been maintained for two years with little deviation.

Bristol, March 11th. **W. F. Denning.**

ADJUSTMENT OF MIRRORS.

[19811.]—The difficulties suggested by your correspondent, Wm. A. Haren (19805) appear to me purely imaginary: there is no optical necessity for an absolutely exact adjustment of the axis of the tube to the axis of the mirror. The flat is supported in the tube by three bars and a bearing-block, the hole in which should be, and is usually, fixed centrally in the tube by simple measurement. Nothing more is required; the usual adjustments alone then prevent any "tilting" of the mirror. The tube may even be of any shape or size if large enough not to intercept the cylinder of light surrounding the axis of the mirror, and a "stop" could be used to exclude extraneous rays.

Southampton. **T. A. Skelton.**

[19812.]—In reply to Mr. Haren's letter, 19808, p. 11, I some time since called attention, in the English Mechanic, to the difference between mechanical and optical adjustments, the latter being necessary, to be definite, to the perfect performance of telescopes, the former not; and I alluded to the position of the flat as regards the axis of the large tube, as one of mechanical adjustment only. The best and proper place for it is in the axis, as nearly as ordinary measurement and the truth of the tube to a cylinder will allow, that is mechanically; but optically it is of no importance at all. Mr. Haren will, I think, see this to be the case for the following reasons:—

The mirror is constructed to receive a cylinder of rays from the object observed, which are all parallel to its axis, and its parabolic form converges these into a cone with its apex at the focus. The flat intercepts this before it comes to a focus, and reflects it in the direction required, most conveniently at a right angle, or nearly so, but, theoretically, at any angle. What is necessary is, therefore, that the mirror should be perfectly square, both longitudinally and transversely, with the line joining the centre of the mirror and flat, and this is the case where the spot in the centre of the mirror is seen central in the reflection of the flat.

The flat has then only to pass this spot through the axis of the eyepiece, which is done when the reflection of flat is central in the pinholes.

Nothing is here said about the large tube, and indeed it is nothing but a mechanical or conventional arrangement, to enable the two mirrors to be used conveniently with the eyepiece, and to keep off divergent rays.

It is well known that an 8in. mirror, for instance, will perform better in a tube intended for a 12in. than in its own, for reasons which do not now concern us, and if this is so, it is evident that it cannot be of any consequence, within reasonable limits, where the sides of the tube are, and what is their relative position to the axis of the mirror.

All that is necessary is that the tube shall not intercept the cylinder of rays as it falls on the mirror.

Fordingbridge. **T. Westlake.**

MEDICAL REPLIES.

[19813.]—Paralysis (46295).—The subject of paralysis is too large and too complex to enter upon in the vague way in which "C. R. B." wishes. But I may point out that there are various main causes for paralysis. 1st. Disease of the central grey nervous masses, situated within the cranium or spinal canal. 2nd. Disease of various fibrous nerve tracts which connect and co-ordinate the various grey centres (known as commissural fibres). 3rd. Disease of the fibrous nerve tracts (commonly known as nerves), which run out from the central bony cavities, and convey the nervous impulses to the muscular masses in the limbs, which are the true motor organs. 4th. Disease of the muscular masses themselves, as in some cases of chronic muscular rheumatism, lead poisoning, &c. Now, to say which of these is the real cause of the paralysis, and how far certain other factors enter into the condition of a particular patient, is one of those problems which nothing but the skilled eye and the skilled cross-examination of a practical physician can solve. It is, in fact, that prime factor, *diagnosis*, which, alike in the workshop and at the bedside, is the result only of a scientific grip of the subject, practical training of the senses, and inherent artistic capacity for the work. An amateur mechanic may write admirably and usefully upon a subject—say, the lathe; he may have a perfect scientific grip of the subject and inherent artistic capacity for mechanics; but if he have not that practical training of the senses, and that knowledge of materials which is only to be mastered by patient labour in the workshop under skilled teaching, he will select, say, an unsuitable piece of steel for his mandrel; and after producing a beautiful model lathe, with splendidly-constructed chucks, his mandrel-neck will abrade, or his mandrel-nose bend or break, and all his work is useless. Now, in mechanics, the amateur makes a "waster," but he can begin again, and, after a certain number of experiments, such an amateur will master his subject. But if a patient is treated upon a wrong diagnosis, not only is the one opportunity for restoration lost, the patient's system is injured by misapplied drugs, or other treatment which only aggravates the original disease, and adds to his sufferings. Now, if "C. R. B." had a valuable chronometer out of order, he probably would pick out some skilled chronometer maker, and learn from him exactly what was the matter, and what was needed to set it right. He would never attempt to get such information by letter writing. Many years ago, I carried a watch made by Barraud and Lund, which went excellently until a strange man had cleaned it; after that the watch stopped suddenly in the most mysterious way, and at all sorts of odd times. Repeated tinkering with the watch left this capricious and annoying defect uncured. Then the watchmaker discovered that the balance-wheel was too heavy or too light, I forget which, and he put in a new balance-wheel, and kept the watch a month, during which time it went perfectly. On getting it back, the watch stopped again just as before. Ultimately, I took to studying this extraordinary watch for myself, and I found out that so long as it was hung upon a nail it went perfectly, but that when laid upon its back if often stopped. Upon discussing this with another watchmaker, he predicted that one of the pins which held the movement up to the dial-plate was too loose, and that when the watch lay upon its back the movement sometimes dropped, and the hands, clinging to the dial-plate, stopped the watch. On testing the watch, this proved to be the case, and on simply correcting the pin, my poor watch went as well as could be expected after Barraud's balance had been tinkered away. This fairly illustrates what I mean by *diagnosis*, or a clear statement of what is and where lies the cause of the disease. Now, many a man's inside is tinkered away by drugging and other treatment given on an utterly wrong diagnosis, and "C. R. B." tells us that "he has been under the treatment of several medical men, and tried every known remedy to regain his locomotive powers," yet he never seems to have learnt what is the cause of the paralysis or where that cause is located. "R. C. B." had better consult the best physician in his locality, so as to ascertain these fundamental points and learn the precise name which should be assigned to his paralysis. Speaking generally, I should say that a patient who has "tried every known remedy to regain his locomotive powers" before having ascertained these primary facts must have suffered much at the hands of his doctors, and is not now a very promising case. But if he will ascertain these data I may be able to advise upon the machine which he is projecting.

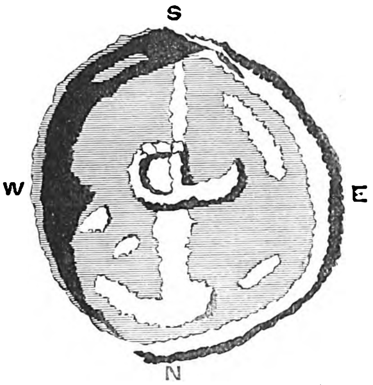
The Teeth (46361). Black specks on the teeth are sometimes due to congenital pittings upon the enamel, these little pits filling with dirt. Such pittings are incurable, and all that can be done is to wash the teeth carefully with tepid water night and morning, and use a little chalk upon a tooth-brush or the end of the finger so as to thoroughly cleans the pits. Such pits may sometimes be safely lessened by smoothing down the surface of the enamel and rubbing off the sharp edges of the pits by means of a little fine emery upon a small ivory burnisher. This makes them less conspicuous, and also makes them shallower and less prone to get discoloured. Other black specks there are which come upon sound teeth where their sides abut upon a cavity in a decayed tooth. Here one tooth becomes hollow; its cavity retains particles of food which turn sour and act upon the enamel of the sound tooth which stands at the side of the cavity. Thus decay in the teeth is infectious, and such hollow teeth should always be extracted so as to save the contiguous teeth, or should be carefully excavated and stopped with gold. To preserve the teeth, avoid all quack preparations, rinse the mouth carefully with warm water night and morning, using a tooth-brush and a little elutriated chalk to cleanse them, if necessary. (2) Avoid such cooks as do not wash grit carefully out of currants, salads, &c., for careless chewing of food containing shot, particles of stone, fragments of chopped bone, &c., often splits the enamel of the teeth, and ruins them. Seizing needles by the teeth, cracking nuts, &c., are also fertile causes of destruction. (3) Never take acid medicines, acid solution of steel, and other drugs, which certainly ruin the teeth and rarely do good otherwise. In such rare cases as may be necessary, these corrosive medicines should be sucked through a straw or glass tube, and swallowed without coming into contact with the teeth; the mouth also should be instantly rinsed with clean warm water. (4) Mothers who would preserve their own teeth from softening due to absorption of their earthy matters, and who would lay the foundation for strong teeth and solid bones in their children should take foods which contain abundance of earthy matters, such as oatmeal-porridge and milk, while nursing and before the birth of their children. (5) Persons having decayed teeth should cleanse the cavities out carefully after meals with a quill toothpick, and rinse their mouths after each meal. A piece of silk thread held between the fingers and passed backwards and forwards between the teeth is a safe and excellent means of cleaning out the interstices. The importance of preserving the teeth while young is much greater than is generally realised until the teeth are ruined.

James Edmunds M.D., &c.

Grafton-street, Bond-street.

PLINIUS.

[19814.]—The unfavourable weather of the last few weeks has prevented me from obtaining more than two observations of this object since the date of my sketch (English Mechanic, Feb. 3, p. 517). On Jan. 27th, 5h. 30m. to 6h. 30m. M.A. 8d. 1h., I made the subjoined drawing of the formation



which shows the general character of the two nearly central objects on the floor observed by M. Gaudibert and myself on Jan. 25th. The most W. had the shape of the letter D reversed, and on its S. side were two bright peaks. The E. object seemed to consist of a hook-shaped ridge (or mountain) extending E. from the N. side of its neighbour. On 24th Feb., 7h. to 7h. 30m., I had a very favourable view of Plinius, and all the features observed on Jan. 25th were again seen with the addition of a small but very distinct craterlet about half-way between the crateriform objects near the centre and the S. wall. It was nearly in a line with the two minute craterlets on the N.W. side of the floor and on the ridge (or range of low hills) which extends from near the centre to the S. wall. In the *Intellectual Observer*, Vol. VIII., p. 29, Mr. Webb, referring to what he terms "the luminous central hill" of Plinius, says—"on two occasions, with two different instruments, and with an interval of more than twenty-five years, I have seen the two summits of the central hill figured by B. and M. as minute craters. Such illusions may easily take place when the shadows of small eminences fall among other elevations of a similar character, and show the necessity of caution in forming conclusions under these circumstances." I have no doubt that the two large crater-like objects seen by M. Gaudibert and myself on Jan. 25th correspond to the "minute craters" mentioned by Mr. Webb, though it is difficult to understand, even after making due allowance for differences in the magnifying power employed, how objects which, under suitable angles of illumination, are now so prominent, were once described as minute. I am much obliged to Mr. Herbert Sadler (letter 19760) for his copy of Plinius from Schmidt's map. The latter shows two openings in the N. walls of both craters. On Jan. 25th and Feb. 24th, there was a very evident break in both the N. and S. walls of the W. crater. Powers used 284 and 350 on an 8½in. Calver reflector.

Bedford, March 4th. **Thos. Gwyn Elger.**

HOW TO MAKE A CHEAP AND ORNAMENTAL BOOKCASE.

[19815.]—In response to the appeal made in letter 19777, I send sketch of a cheap, serviceable, and ornamental bookcase for a small room, suitable to fix up on wall-spaces between two doors or windows.

The shelves hanging on strings, which, doubtless, the wife of many a mechanic has found out, with a little extra weight, or by the act of pulling out a book the whole lot comes down, is one of the worst forms and plans for holding books together. The large and least-used books are at bottom, and the small books nearly out of reach at top; the whole exposed to dust, and, if hung low as a sideboard level, the large books project in the way too much to make the sideboard useful.

I have made several bookcases, and given to those needing such, but the simplest and most serviceable is shown by Fig. 1, side elevation. I have mostly cut the sides out of ¾in. or ⅞in. mahogany, or any hard, close-grain wood, generally odd pieces, from 3ft. to 4ft. long, 12in. wide, for top end, and 2in. at the bottom end, with fine scrolls. The large overhanging at top gives a protection to all from dust, by having a light ⅜in. thick top put on it. The first shelf, at A, shown by dotted line, will take books 13in. deep, 11in. wide; the next, B, 11in. deep, 7in. wide; the next, C, 9in. deep, 5in. wide; and D, 7in. deep, 3in. wide, or thereabouts, the whole resting on a sideboard, S, with strong wall-staples near the top. From 2ft. to 3ft. wide, from side to side, will make a bookcase to hold from one to two hundred books.

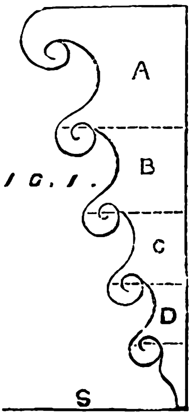


FIG. 1.

The shelves are of ¾in. deal, with the front edges faced with a strip of the same sort of wood as the sides. These shelves are recessed into the sides ⅛ of an inch, and glued and nailed if necessary. A light thin backing of wood or stout paper completes the job, except staining the deal to match the hard-wood.

If all of deal, it may be sized and varnished; but for a cheerful and elegant-looking stain, the deal, or, better, red pine, without knots, can be washed over with ordinary red ink and size. It resembles no wood in common use, but a pink-coloured wood, now and then seen in inlaid work. A coat of varnish should follow.

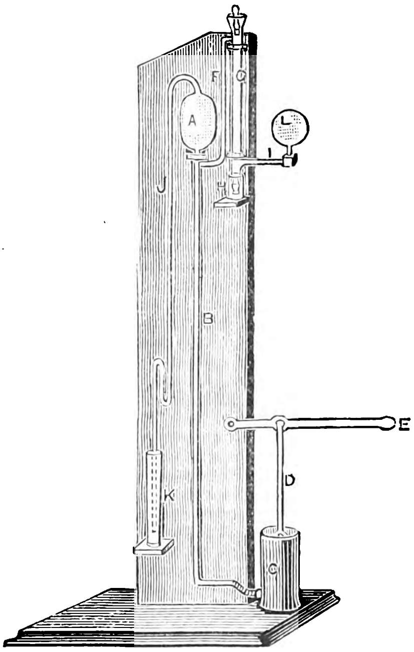
P.S.—If a curtain front is put to cover up the books, let it be on a roller the same as a window-blind, fixed at top.

J. Charles King.

SUTTON'S APPARATUS FOR THE RAPID PRODUCTION OF HIGH VACUA.

[19816.]—I have just received my English Mechanic for Nov. 11, 1881, in which, under the heading "Obtaining and Measuring High Vacua," there is a description of Prof. Rood's improved Sprengel pump: *its limit* is stated to be arrived at "when the leakage of the apparatus is equal to the amount of air that can be removed in a given time."

I send you a description and sketch of a vacuum pump invented by myself some time ago, and which, you will see by its construction, *has a higher limit still*, as the amount of air that can be removed in a given time *exceeds the leakage* many hundredfold; in short, the air can be withdrawn more rapidly than it can leak in. Its construction is simple; there are no stop-cocks nor valves; it is not liable to derangement, and will do in a few minutes that which takes hours on the Sprengel principle.



It is the result of studying the defects of the Sprengel pump.

It occurred to me that the mercury in a Sprengel pump, having to go through the form of numberless drops, the entire surface of the mercury is exposed to the influence of the high tension of the vacuum, and, therefore, air that would with mercury in the mass be retained cohesively, would, in the Sprengel principle, be given up to the vacuum. Another fault I considered to be, that mercurial vapour must be formed at these high tensions, given off from the drops—a fact that can be verified by examining microscopically the junction of a Sprengel fall tube, with its connecting tube to receiver; a gentleman of high scientific eminence having told me that in conjunction with a well-known English scientific gentleman, they had observed this defect.

To overcome these objections I argued that:—

(1) The air must be removed rapidly.

(2) That the mercury must not be in the form of drops.

(4) That the mercury must not leave the pump, but must be used continuously.

I have succeeded in accomplishing this, as the following will show.

A is a glass globe; at its lower end is attached a glass tube B, 36in. long; the lower end of this tube is bent to a right angle, and attached by a short piece of rubber tube to a cylinder C; in this cylinder a piston D is worked by the lever-handle E.

From the upper end of tube B, a branch tube F rises, and is bent to a right angle at the top, and joins the desiccating-tube G, which has its upper end widened into a funnel, and an indiarubber stopper fitted in so as to leave the funnel surrounding it. The lower end of G, also has a rubber stopper, which is surrounded by a glass cap H.

About 2in. from lower end of G, a tube of glass, I, projects, to which is attached the vessel to be exhausted, L.

From the upper portion of globe, A, a glass tube, J, of fine bore, rises, and bends down parallel to B. About half-way down tube J bends back on itself, then returns on its downward course and enters the tall conical vessel K, reaching to near the bottom.

To set the pump in action, the short rubber tube is removed from B and C, and a current of hot air passed for some time through tube B, and thence through the whole of the pump, driving out all moisture and leaving the pump warm and dry.

The rubber tube is then connected and sealed between B and C, and pure mercury previously dried, placed in cylinder C, by removing the piston, which is done by taking a pin out of the junction of D with E, the piston being returned to its place.

The rubber stopper is placed tightly in lower end of desiccating tube G, and its cap H filled with mercury, making an hermetically-sealed joint. Pumice soaked in sulphuric acid, or phosphoric anhydride, is then dropped into G from its upper end till half full; the upper half then being filled with gilded pumice, the rubber stopper belonging to upper end of G is now tightly pressed in, and the funnel end filled with mercury, thus hermetically sealing this joint.

The apparatus is now ready, and is worked by pressing the lever E, and thereby forcing the mercury up into tube B, thence into globe A, the mercury also rising in branch tube F, isolates the vessel L and its connections from communication with globe A.

The mercury being still forced into A forces the air out by the fine tube J, and when the mercury begins to rise in K, the lever E is raised, and the mercury falling back from A, produces in top of A a Torricellian vacuum. The mercury in K now rises into J, until the column of mercury in J exactly balances the atmospheric pressure at K. Any air that may rise in the bottom of J cannot pass the bend, owing to the specific gravity of the air being less than the mercury.

The lever E still being raised allows the mercury to fall from A, and also from the branch-pipe F, until, having fallen below the junction of B with F, communication is restored, and the air expands over from L, and its connections, into the vacuum in A, the mercury column in J lowering at the same time.

The lever E is now pressed down again and the same action takes place as in first stroke, a mass of air equivalent to the capacity of A being removed at each stroke of the piston.

The rapidity with which the vacuum is produced is proportional to the ratio of the capacity of A with the capacity of vessel to be exhausted and connections.

And as the globe A can be made very large, and thereby a great bulk of air removed with each stroke, it follows that the limit of the pump is very high, much higher than it can possibly be with any form of Sprengel.

The gilded pumice is to absorb any trace of mercurial vapour, and the chemical substance in tube G to absorb moisture.

In this pump there is little chance of mercurial vapour forming, as the mercury is not divided into a number of small drops and under high tension for a long period of time.

It will be seen that my form is a departure from the usual mercury pumps, as the mercury is worked in the mass and without the aid of stop-cocks or valves. It does its work perfectly and rapidly.

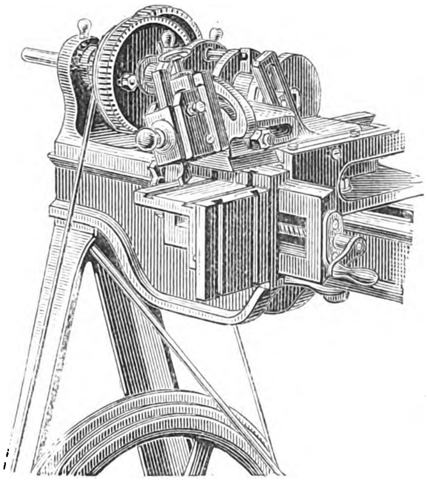
I have not yet measured the vacuum produced, as I cannot obtain the appliances here; but it is easily seen that the vacuum must be very high, and possibly reaches the theoretical limit. In conclusion, the pump is not patented, and therefore all have the liberty of using it.

Henry Sutton.

31, Sturt-street, Ballarat, Victoria,
Australia, Dec. 28, 1881.

SHAPING ATTACHMENT—TO F. CARRE.

[19817.]—HEREWITH I inclose description (which is borrowed from Northcote), and perspective view of Booth's shaping machine. I trust the engraver won't be puzzled.



The instrument, when bolted to lathe-bed, is ready for work. It is capable of shaping a surface 7in. long and 3in. wide at one setting. The motive power is obtained from lathe-spindle, the driving-pin of which engages into a space cut in the machine driving-plate. At the other end of the same spindle as the driving-plate there is a crank-plate, with adjustable crank-pin; but this pin, instead of being connected direct to the slide, is arranged to slide up and down a slotted arm, a square slide block being, however, interposed between the crank-pin and slot to increase the wearing surface. The slotted arm is fixed below upon a stud attached to main casting of machine, and the motion of the crank-pin up and down in the slot causes the arm to oscillate around this stud or fulcrum, but its motion has a varying angular velocity, which becomes greater as the crank-pin arrives at that end of the slot nearest the fulcrum, and less as it approaches the other. In this apparatus the tool moves backwards and forwards over the work, to give the cutting stroke, whilst the work only moves sideways to give the traverse between the cuts. The slide carrying the shaping-head and slide works in V's formed in main casting. It receives its stroke from the slotted arm by a strong connecting-rod jointed to the middle of the slot, and at its other end to the slide by a pin, which is susceptible of a horizontal adjustment. As the slot-arm oscillates it gives a reciprocating motion to the shaping-slide; but owing to the varying angular velocity of former, the slide moves forward slowly and returns faster. Automatic motion is given to the work by means of the ratchet and click (seen on the left of the machine) upon the traverse-screw, actuated by a cam-groove cut in the reverse side of the crank-plate.

Has "O. J. L." come across the overhead apparatus just brought out by this same firm?

C. H. D.

LATHES AND LATHE-MAKING.

[19818.]—THE reply (19770) of Mr. Evans must have been read with great satisfaction by very many besides myself; and in taking advantage of his kind invitation to be more explicit, I would say, that I think it would add to the value of his papers if he gave some such data as he would place in the hands of a workman, who could construct a machine when he knew its general dimensions. Our esteemed instructor is doubtless well aware, that nothing is more unsightly or inconvenient than, say, a slide-rest for a 5in. centre, made strong enough, and, in some respects, big enough, for a heavy 7in. machinist's lathe. Every pound of surplus metal, like every pound of superfluous flesh, is a useless incumbrance.

For my own part, I should not like to see the general plan of Mr. Evans's papers interfered with. He has succeeded in making a dry subject interesting, but to load his remarks with numerical details would make it wearisome; a short table, which might be printed in lesser type and annexed to each mechanical section, would supply all that is needed. Anyone could then copy this into a note-book, and thus have a satisfactory guide to work by.

For instance, turn to page 221, on the Dome Chuck. A table might include: Length and thickness of boss; length, breadth, and thickness of slide-plate; thickness and height of centre of the standard. Next, on page 437, the slide-rest. Length, breadth, and thickness of foundation-plate; height of socket-boss, height and diameter of screwed part and pitch of screw. Length and breadth of face of main slide, vertical thickness of bars, and size of nut-channel. I need not go on to the other parts, as Mr. Evans will see what is needed from the preceding outlines. Such particulars, printed in the ordinary form, *e.g.* ($8 \times 3 \times \frac{3}{4}$), would occupy little space and be convenient for reference.

In connection with this subject, may I offer a suggestion to our friend "Cast Iron"? If he would give a few letters on making the patterns for the following articles, they would be very useful—viz., heads, beds, rests, and other adjuncts to the lathe, followed by others relating to the steam-engine. Mr. Rose's articles, though excellent for general engineering, do not include particulars of such appliances. Cannot small parts of mechanism be cast of iron similar to that of which "Blakey's Boot Protectors" are made? This appears to be a soft zinc-coloured iron, easy to work, free from hard spots, and may be bent without snapping. Are they made of malleable cast-iron?

"Aldebaran," in his practical instructions for fitting up a 2in. telescope, very sensibly recommends amateurs to avoid the use of screws as much as possible. If the cells are made a little deeper, I think they will hold nearly as well for practical purposes as screws—that is, for eyepieces and for o.g.'s, a few very small screws might be inserted, if there was any danger of the cell being shifted. Some time back "Sunlight" promised a sketch of a simple optical screwing apparatus, but the promise was all that appeared.

Many would doubtless be surprised to learn that a good 2in. o.g. could be bought for 7s. or 8s. I do not think there is any necessity to withhold the name or names of those opticians who sell such o.g.'s unless they so desired. They being only the dealers in, and not the makers of, such lenses, no injury could be done to anyone, by mentioning where a 2in. French lens could be obtained at that price.

Orderic Vital.

[19819.]—I HAVE to thank Mr. Evans for his courteous reply to what must have seemed to him rather a fault-finding letter, and it will go far to clear up my difficulty: the other points will probably evolve themselves in working. Referring to one of Dr. Edmunds' remarks as to the depth of screw-threads (or the difference in diameter at top and bottom of thread) it is easily calculable for any given angle, for if p be the pitch of the screw, and d the depth of the cut in making it, we have $\frac{1}{2}p/d$ = tan. $\theta/2$ where θ = angle of screw-tool. $\therefore 2d/p$ = cot. $\theta/2$. $d = \frac{1}{2}p$ cot. $\theta/2$, or if t = thread = $1/p$, d = cot. $\frac{1}{2}\theta/2t$ and the difference in diameter is twice this. in the case of $\theta = 60°$ cot. $30° = \sqrt{3}$. $\therefore d = \sqrt{3}/2t = \cdot 839/t$.

I should very much like to know how, in the earliest period of mechanical engineering, screws were first produced; indeed, now the subject (happily) has once more come to the fore in "ours," if any correspondent could give us a sketch of the history of the lathe, and the development of some of its parts, it would be of great interest to a large section of our readers, I imagine.

Scorpio.

ORNAMENTAL TURNING.

[19820.]—IN reply to the letter of "A Country Parson" (19806), I take the opportunity of pointing out that the class of turning represented is of quite a different description to that done by Mr. Coulson, whose production is very fine; and, moreover, to work up the lower parts to anything like the proportions of a cocoa-nut naturally grown, is not an easy matter. I think if our friend could, or would, see the original, his adverse opinion might be changed; and although it may not meet his taste, I find it appreciated by many of our correspondents who do this class of work.

J. H. Evans.

DYNAMO-MACHINES.

[19821.]—IN reply to "Quæstor's" inquiry, dynamo-machines may have their field-magnets excited in four different ways. In the first, the "main" current is used for exciting the magnets: in this case, one armature brush is connected to one end of wire on field-magnets, the other end of wire being taken to the lamp (or lamps, as the case may be). In the second method, the "shunt" current is used, the armature being arranged so as to give rather more current than is needed for external work, a bye-pass, or shunt wire, is wound round the field-magnets so as to take a portion of the current. The wires leading to the lamps are connected to the armature brushes, as are also the two ends of the wire wound round field-magnets.

In the third method, adopted, I believe, in the Brush machines, the advantages of the two preceding methods are supposed to be combined by the combination of the methods, and if properly proportioned, it should give good results. The arrangement of wires is evident.

In the fourth method, a "separate exciting machine" is used, and the wire on the field-magnets of the large dynamo must be fine or coarse, according to the kind of exciter used. The lamps are connected to brushes, and field-magnet wire to terminals of exciter, which, of course, will also excite itself. The theoretical weight of wire required in any given machine to give an equal current of the same electromotive force with the same expenditure of energy (or horse power) will be the same in each method, and the plan adopted must depend on the work. If the resistance is constant, it is not a matter of importance which system is used; if the current is required to keep up in quantity in spite of an increased resistance, "the shunt" should be used; but where a machine supplies a single arc-light I much prefer the main, as a slight increase in the resistance of the arc diminishes the current, and this, reacting on the field-magnets, still further reduces it, so that the lamp quickly adjusts itself and brings the carbons to their proper position; but if the shunt is used, an increase of the R of the arc throws so much more current through the field-magnets that the main current may be actually increased, the adjustment of the lamp then taking place in the wrong direction, an abnormally long arc is produced, which gives a fine chromatic effect, but is not suitable for practical lighting. Dr. Siemens, in his paper on his shunt-current machine, states that the R. of the field-magnets should be made at least ten times that of the armature, and that the extra R. should be made up by adding to the length, and not by reducing the size of the wire. This gives the shunt machine an undue advantage; and he states that the principle of the shunt-current gives a better result as regards horse-power, the fact being, that if an equal weight of wire be used, the two methods will give, practically, the same result. It is easy to show that if the weight of wire is the same, the power absorbed to produce a given current under an equal electromotive force, or what is the same thing, through an equal resistance, will be also equal. To take definite figures. A 10 ampére current is required through 4 ohms, which will require an E.M.F. of 40 volts. I have previously given approximate weights of wire for this size of machine.

Suppose that 4,000 feet of wire are wound on the field-magnets, and that it is of such a size as to give a resistance of 10 ohms (this would be about No. 16 B.W.G., and 50lb. of it), then using this wire as a shunt, as the E.M.F. is 40 volts, the current passing through it will be 4 ampéres, and the current evolved by the armature will require to be 14 ampéres. Suppose the R. of the armature to be 1 ohm, then the external circuit 10 ampéres, with 40 volts E.M.F. = 400 ampére volts; the field-magnets 4 ampéres, with 40 volts E.M.F. = 160 ampére volts; the armature 14 ampéres (it will require 14 volts to make 14 ampéres pass through 1 ohm), 14 × 14 = 196 ampére volts. Total number of ampére volts, 756.

Now suppose the same machine (that is, a machine of the same pattern) is made to work on the main-current principle, and it will be seen that the ampére volts required to give an equal external current will be the same if the same weight of wire is used. As there were 4 ampéres passing through 4,000ft. of wire, and it is necessary to magnetise them to the same extent, and there will be 10 ampéres (or the main current) now passing, the wire will only require to be 4-10ths of its previous length, or 1,600ft., and as it has to be the same weight (50lb.), its resistance will be found to be 1·6 ohm. The armature wire having only 10 ampères passing instead of 14, will only require to be 10-14ths of its previous size, which for an equal length would give it a R. of 1·4 ohm.; but as it is proposed to use an equal weight, it will be necessary to make it four-tenths longer, which makes the R. up to 1·96 ohm.

Then the current everywhere being 10 ampères, we may add all R.'s together: External R. is

4 ohms., magnets 1·6, armature 1·96; total, 7·56 to force 10 ampères through, which will require E.M.F. of 75·6 volts; therefore total energy is equal to 756 ampère volts as before, thus proving that the economic efficiency of the two systems is the same, provided the same amount of capital is invested in copper wire.

This naturally leads to the question (asked by J. Hezmalhalch, query 46233) as to the best size of copper wire to use in a machine. This simply depends, as has been pointed out by Sir W. Thomson, with regard to leading wires (and the same calculation may be applied to the machine) on the interest on the cost of copper as compared with the cost of power, for the larger the wire the less the R, and therefore the less will be the work uselessly absorbed in heating the wire. But in the machines that are likely to be made by amateurs the cost of power will be of less consideration than the first outlay, and the only limit it will be practically necessary to consider will be the fact that a certain size must be used to prevent such undue heating of the wire as would be likely to injure the insulation. This is the basis on which I gave No. 12 as a suitable size for conveying about a 10 ampére current.

"J. H." also asks why in finding the horse-power I multiply by 44. He will find the same figure used this week (March 10) by Prof. Ayrton. It is the value in foot pounds of a current of one ampère under an electromotive force of one volt acting for one minute. A useful figure to remember (derived from this) is that 750 ampère volts are equal to one horse-power, 44 / 33,000 = 750. My letter is much too long already, so that I will not remark on "Conrad's" letter till next week.

R. P.

[19822.]—THE gentlemen who are so anxious to have full details of dynamo-machines can scarcely be aware of the calculations required to determine the best form of machine to give a particular result. Many machines can be made on the same principle to give similar results; but to determine the best size, and quantity of wire on field-magnets and armature-coils, is a matter involving much experiment and labour. It is not likely that those whose business it is to work out these things will gratuitously present their results to the world. I have neither time nor inclination to do so; but if any gentleman possessed of the requisite skill and appliances likes to make dynamo-machines, my advice to him is to first study thoroughly the laws of magneto-electric induction, after which he will be in a much better position to produce a satisfactory result than if he had merely put the machine together from rule-of-thumb instructions. I may give one hint to some disappointed ones—viz., that a dynamo-machine—self-exciting—connected up in a particular way, can only give a current when revolved in one direction. Hence, if the disappointed amateur, who can get no current from a seemingly perfect machine, will reverse his field-magnet connections, he may be gratified with a good result. I have never seen this fact in print. It is correct enough, as a little thinking will show anyone conversant with the subject.

"Conrad" (letter 19799) criticises adversely the Brush machine. Now, I don't want to be rude; but the context suggests the doubt to my mind that "Conrad" does not know the Brush machine connections or arrangement of field. He is under the impression that the bobbins are only able to contribute to the current during a quarter of each revolution—viz., when "approaching or receding from the poles of the field-magnets." Now, as a matter of fact, during this quarter of a revolution the bobbins are cut out of circuit altogether, that position being the weakest part of the field. The strongest is between the pole pieces. I shall be glad to see his machine described in "ours."

Humble Bee.

WATCHES.

[19823.]—IN reply to "Watch-Man" (19801), pocket chronometers have the usual detached chronometer escapements, cylindrical hair-springs, and compound balances. Half-chronometers are merely first-rate lever watches, with compound balances and isochronal hair-springs, very carefully adjusted for temperature and positions.

A regulator would be of little use in the above watches, for if they are of good quality, so small will be the error of their rates, that the ordinary watch-regulator would be far too rough an adjustment for them.

They are regulated by the alteration of the timing-screws. This is, I believe, a very delicate operation, which can only be performed by professional watchmakers, who have special dexterity and great experience.

Half-chronometers are usually keyless, and have no fusee; those of good quality have, instead, a tapered mainspring. Their "winding error" (if I may be allowed to use that term) is two or three seconds per 24 hours. The keyless mechanism of these going-barrel watches is very simple, and not easily put out of order.

Keyless watches, with going fusees, are made, but their mechanism is complicated, and liable to derangement. Chronometers are usually made to wind with a key, and have fusees. If they are properly adjusted, they have no "winding error."

Good English levers (not compensated for temperature) in use, treated with ordinary care, and uniformly (*e.g.*, not sometimes placed at night under a warm pillow, and sometimes on a cold dressing-table), the weather as regards temperature being moderately steady, will go with an error of about one minute per week.

The difference between summer and winter temperatures, however, will cause variations of five or ten minutes per week. I think the best way to answer the remainder of "Watchman's" queries will be to give him the rates of—first, a chronometer, very seldom worn, usually kept flat in its case, but exposed to variations of temperature; secondly, a half-chronometer, spring-tail lever, keyless with going-barrel, in wear, and placed flat on table at night. Both are of the finest workmanship, by E. Dent and Co.:—

Date.	Chronometer	Half-chronometer.
1881.	From Dent's cleaned.	
July 23 ..	G.M.T. ..	Going very irregularly.
30 ..	+ 10s.	
Aug. 6 ..	21s.	
13 ..	31s.	Sent to Dent's to be cleaned.
20 ..	46s.	
27 ..	54s.	

Absent from town. Took chronometer with me to North of Scotland.

Date.	Chronometer.	Half-chronometer.
1881.	From Dent's cleaned.	
Nov. 3 ..	— 41½s. ..	Received from Dent.
7 ..	47s. ..	G.M.T.
12 ..	50s. ..	— 5s.
15 ..	52s. ..	8½s.
19 ..	56s. ..	11s.
26 ..	55s. ..	15s.
Dec. 3 ..	1m. 2s. ..	19s.
12 ..	1m. 7½s. ..	22s.
27 ..	1m. 17s. ..	20s.
31 ..	1m. 16½s. ..	16½s.
1882.		
Jan. 7 ..	1m. 14s. ..	10s.
21 ..	1m. 16½s. ..	16s.
31 ..	1m. 19s. ..	25s.
Feb. 18 ..	1m. 6s. ..	23s.
25 ..	59½s. ..	21s.
Mar. 4 ..	50½s. ..	14s.
11 ..	43s. ..	11s.

From this table it appears that both watches are over-compensated. The chronometer gains 51s. in about a month in the warm weather in London, but it loses 98½s. in the cooler weather of Scotland in two months; it continues to lose until the end of January, but now it is gaining as the warmer weather advances. These watches have no secondary compensation.

Edward M. Nelson.

[19824.]—IN reply to letter 19801, below are the recent dates on which I took the rate of my watch (which I wear in the usual way) together with its daily rate:

	Slow. m.	s.	
Dec. 23, 1881....	1	43	....Daily rate.
Jan. 2, 1882....	2	1	.... 1·8s.
Jan. 10, 1882....	2	15	.... 1·7s.
Jan. 20, 1882....	2	32	.... 1·7s.
Jan. 30, 1882....	2	52	.... 2·0s.
Feb. 8, 1882....	3	12	.... 2·2s.
Feb. 21, 1882....	3	35	.... 1·8s.
Mar. 3, 1882....	3	52	.... 1·7s.

Rosicrucian.

TRICYCLES.

[19825.]—HAVING read with much pleasure the able discussion on tricycles, which has been going on in the "E. M.," I should like to offer a suggestion, subject to correction by "Our" practical ones. It has often struck me, when riding uphill, that an enormous loss of power occurs when struggling with the pedals just past the dead-centres, and that if we could reduce the leverage against us at that time we should reach the top of the hill with much less exertion. Could not this be done by making the toothed chain-wheels slightly oval instead of circular, and placing the longer axes at right angles?

Most of the writers in the "E. M." prefer the rotary-action to the lever; but a lever-motion, if well arranged, does away with the dead-centres, as each pedal reaches its highest point and begins to descend before the other reaches its lowest: a fact which ought to, and does, as far as my experience goes, place the lever before the rotary for hill-climbing. I, however, am looking forward to the practical application of doubling speeding as the real solution of the hill-climbing difficulty, and trust that the manufacturers' motto will be—

Onward and Upward.

REPLIES TO QUERIES.

**⁎* In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[44998.] — **Railway Continuous Brakes (U.Q.)**—In reply to "A Driver," I beg to inform him I have only seen his query on my way home from Calcutta, hence my apparent inattention. My hydrostatic brake was first run between Camden-town and Kew in 1853, and afterwards on the Shrewsbury and Hereford Railway in 1854 and beginning of 1855, when I left it to join H.M.S. *Cyclops*, in Black Sea. My brake is not self-acting, although it could be made so, nor would it in its present form act on bursting of tubes or breaking away of trains. But why should such things take place if properly made, and couplings tested as our cables are. I always contend the means to apply a continuous brake should be in the driver's hands, yet I provided for the guard doing so. Depend, if a universal brake is ever adopted, it will be some simple and inexpensive plan, and not the expensive and complicated ones now on trial. Having a brake that cannot be always depended upon is far more useless for public safety than the old ones used since the introduction of railways. I was in America in September last, and I examined some of the brakes used in that country. On the railway from Washington to Baltimore, the favourite brake is Longridge's air brake. The point with me when I introduced my plan, was a simple and inexpensive brake, as I well knew railway companies then would not spend their thousands as they do now on experiments, caused, no doubt, by Her Majesty's letter and the voice of her subjects.—EZRA MILES, Retired Engineer, R.N., High Wycombe, Bucks.

[45569.]—**Velocity of Water in Sewers.**—To "J. C. S. B."—Please show in plain figures how you arrive at the value of R (·567), and also of the area of flow, which you put down as 1·6 in your reply to the above in the 17th Feb. issue, and oblige.—SANITAS.

[45619.]—**Wave (U.Q.)**—I do not know about Channel waves in particular, but I give the substance of results collected by Professor Rankine from experiments by Scott-Russell, Thomas Stevenson, and others. (1) The utmost height of a wave in open sea is held by scores to be 43ft. Breakers 150ft. high have been observed on S.W. coast of Ireland by the Earl of Dunraven. The height of waves in deep water depends on their distance (or "fetch") from the weather-shore, where their formation commences. Mr. Thomas Stevenson gives the following formula as nearly correct during heavy gales when the fetch is not less than about six nautical miles:—Height in feet $= 1·5 \times \sqrt{\text{Fetch in nautical miles}}$. Mr. T. S. also gives the following table of pressures of waves, as observed by him, against a vertical surface, at Skerryvore:—

	Summer average.	Winter average.	Storms.
In lb. per sq. foot ..	611	2086	6083
In feet of water	9·8	33	97

"Subscriber" will find some further information in Molesworth's Engineers' Pocket-book. At the depth he mentions the water would scarcely be disturbed by the storm above.—GLATTON.

[45700.]—**Tools for Bending Iron.**—I send sketch of a tool for bending flat iron 1½ by ⅜.

FIG. 1.

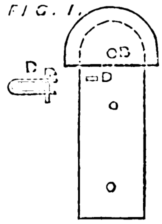


FIG. 2.

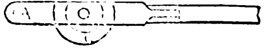


FIG. 3

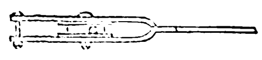
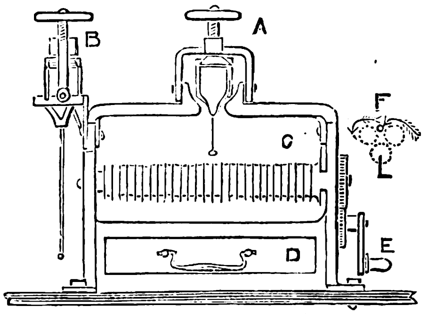


Fig. 1 is bolted down to vice-bench, Fig. 2 is the lever, Fig. 3 is a side view of the lever, A is bolted on to *b*, and *c* is a loose wheel, *d* is a clip to hold the iron to bend.—CHEPSTOW.

[45823.]—**Oval Chucks (U.Q.)**—See answers to 46206.—JACK OF ALL TRADES.

[45823.]—**Oval-Chucks.**—Seeing no one better qualified has answered your query, I venture a reply. I think what you want is a copying-lathe, not an oval-chuck. If, however, you have a slide-lathe, you may easily add what you want, and could then do much useful work. You will want an overhead motion to drive a rotary-cutter in slide-rest, and an iron pattern of the handle you want to make. Fix this pattern at the back of the lathe-bed, and parallel with it, in such a way that it will make equal turns with the mandrel. Then fix to slide-rest an arm carrying a small roller to press against iron pattern, being kept up to it by a weight. The cross-slide of saddle must be slightly slacked, and the screw withdrawn. The rotary cutter will then move to and from the centre, copying the movements of the roller on the pattern. Put the leading-screw in gear with a slow traverse, move cutter up to its position, and you can make as many handles as you like. The shape of cutter is important; it must be well sharpened, and revolve at a great speed, and the work turn slowly.—F. A. M.

[45711.]—**Rotary Pill Machine (U.Q.)**—The sketch will give you an idea how this is made; it consists of a frame which two fluted rollers run in, C, with a draw underneath to catch the pills as they fall through; A is a press which the pill-mass is put in, and forced through a hole in the bottom, in which is one, two, or three holes a trifle less than the pill you wish to make; when the pipe is formed, lay it along the rollers, and turn the handle E until the pills fall through; F is end view, showing how they are geared; the rollers and press are generally gun-metal.—Jack of All Trades.



[45849.]—**Artist's Canvas (U.Q.).**—This can be bought at any artist colourman's, but if not to be got in your neighbourhood go to a draper's, and get some round threaded Holland—this is not callendered,—and suit yourself; it can be got of almost any grade. See that it is fine and even threaded; the flat thread is glazed surface, and when wet is gouty; for the other part see answer to 46119.—Jack of All Trades.

[45922.]—**Chrysoide.**—I presume this is a fancy name for one of the yellow metals which the Birmingham metal-workers know so well how to make. If so, it is mainly compounded of copper with the addition of zinc and tin. Manheim gold is copper 3, zinc 1, tin 5. A yellow metal for dipping is made in a roundabout way from bronze 2, copper 1, and a minute portion of tin. The bronze is made of 7 copper, 2 tin, zinc 3; and when the final mixture is made, 10 parts of tin are added to every 640 parts of copper. Most of the alloys of this class are made of the metals mentioned, but sometimes antimony and arsenic are also brought into use, but not where brittleness is to be avoided, in the case of the former.—Nun. Dor.

[45938.]—**Soldering.**—No doubt the series of notes on plumbing now appearing will contain some hints on lead burning or autogenous soldering, which is the highest branch of that part of the mechanical arts, so far as manipulation is concerned. It is accomplished either by pouring melted lead along the joint (rather into the runner formed in the sand covering the joint), or by means of the oxyhydrogen blowpipe (coal-gas and bellows). A good many failures will be made before success is attained, as much skill is needed in blowing long enough and not too long, the difference being a fraction of a second. On p. 356, Vol. XII., the old plan is well described; an article on autogenous soldering appears on p. 515, Vol. XX., and a useful reply on p. 559 of the same volume.—Nun. Dor.

[45943.]—**Pressure of Water.**—If the supply-pipe is a long one an increase of size would no doubt be beneficial. The meter would slightly check the flow. Use straightway-cocks in the supply. If the motor is of the right size, 36lb. to the inch would be ample to yield one horse-power.—Sunlight.

[45977.]—**Artificial Cable.**—The "artificial cable" used by the School of Submarine Telegraphy—now on view at the Crystal Palace—is a rather expensive and complicated piece of apparatus, or rather two pieces, for one part is used for providing sufficient resistance, and the other for imitating the effects of induction. A visit to the Palace would probably be the best way to get full information.—Sydenham.

[45986.]—**Refrigerator.**—Take notes from the refrigerators sold. Then make a double case of zinc, which stuff with sawdust or dry powder, such as charcoal. Line the recess in the wall with thick felt, spongy kind, three or four inches thick, and protect all doors by the same means. Of course you will put a drain in to take away drippings from the ice. and that may have a bend when outside the refrigerator so as to prevent air getting in.—Nun. Dor.

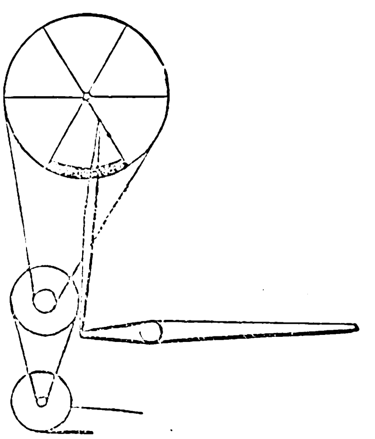
[46019.]—**Sausages.**—Two mistakes crept into my reply; for "flayed" read "hayed," that is, the herbs should be well harvested and of a good green, not black and musty, as generally supplied, and for "¼lb. allspice" read "¼oz." I have made some hundreds of pounds, for which our family used to get great praise, but the herbs and spice we could never get supplied with fit for use, so used to harvest and grind our own.—Jack of All Trades.

[46061.]—**Model Engine.**—To "Sunlight."—Being from home I cannot refer to the No. of the "E.M." which states the size of cylinder, &c. As I may be away for several weeks, kindly repeat dimensions of cylinder, and I will then with pleasure tell you what you want to know.—Sunlight.

[46069.]—**Automatic Arrangement.**—The printer has destroyed the sense of my suggestion as to this arrangement in last issue. For the sentence, "Projecting from lower side at middle of each division a pin or tooth-clack," &c., read, "Projecting from lower side at middle of each division a pin or tooth, clock to work a worm-screw which said teeth take into."—Scotch Working Mechanic.

[46082.]—**Driving Smith's Fan.**—I beg to say that being only an amateur smith, I have not had the chance of trying my skill on iron 4in. square, though I have welded more than half that substance. If "J. J. A." will come over here to Tramore, co. Waterford, Ireland, at any time of day and any month of the year, I shall be at home to show him the fan, and also show him how a fan can be blown with a pole, bellows fashion, which he fails to see, as he does many other things. Perhaps, in return, he will tell us how to weld a piece of hot to one of cold iron. Query: Did he ever do it?—J. Perry.

[46082.]—**Driving Smith's Fan.**—As "J. J. A." fails to see how I blow my fan with a pole, I have inclosed a rough sketch (¼in. to the foot) of the whole affair, and I can assure him that it is far from being a "bleak blasted blower," and instead of running at 500 per minute as he proposes, it runs much nearer 2,500 per minute with steady blowing. It runs much easier than anyone would imagine; but still, to keep at it as I have to, from 6 a.m. till 8 p.m., makes it hard work, and that is the reason I put my query. Many thanks to our obliging friend "Sunlight" for so clearly answering it.—Hot Iron.



[46089.]—**Muffle Furnaces.**—Can Mr. A. E. Morris say if such a furnace as that described by him on p. 620, March 3, would do for burning colours on plaques and small articles of porcelain; and, if so, what dimensions would be necessary for articles 12in. diameter and 4in. high?—W. Wilson, Hollingbourne, Maidstone.

[46094.]—**Paper Negatives.**—I presume that the calotype process for obtaining negatives on paper would suit "F. C.'s" purpose; but he will find no information in modern photographic books, as to the *modus operandi* of that process. The introduction of collodion has, by its superior sensitiveness and definition, rendered it obsolete; there are few of the present generation of photographers, I imagine, that have ever seen a paper negative. Nevertheless, it will render suitable subjects with charming effect, more artistic (to my mind) than collodion. The process is as follows:—Take 40 grains nitrate of silver, dissolve in three ounces distilled water, add 32 grains of iodide of potassium, well shake the bottle, and then allow the precipitate to settle. Wash the precipitate with two or three changes of water with agitation, then pour off the water closely and add 2oz. distilled water, in which 400 grains of iodide of potassium has been dissolved, shake up well, when the yellow iodide of silver will be dissolved, then add distilled water a few drops at a time, which will make the surface of the solution turbid, but it will clear again on being shaken. Add more water cautiously until the solution will no longer clear on being shaken, add a few grains of iodide of potassium with shaking, which will restore the transparency. It then only remains to filter, and it is then ready for use. The paper, which has been cut 1in. larger each way than the required negative, is then attached to a thin board by a couple of pins at the top edge, held in an inclined position, and the double iodide of silver and potassium applied to its surface by means of a large camel-hair pencil, mounted in quill (not metal), after the manner of applying a flat-wash in water-colour, taking care that the solution does not touch the pins or pass to the other side of the paper. There is no need to exclude daylight from the room in which this operation is carried on. Hang up to dry; and when perfectly dry, immerse the papers in a large pan of water, about half a gallon of water to each 10in. by 8in. sheet. Take care there are no air-bubbles attached to the surface of the papers, and leave them to soak for 24 hours; afterwards take them out and hang up to dry. If properly washed they will keep indefinitely in a portfolio. When required for use, attach to the board as before, and sensitise in a room lighted only by yellow light, by applying to the prepared (yellow) surface a solution prepared as follows:—Take nitrate of silver 50 grains, distilled water 6½ drachms; when dissolved add glacial acetic acid 1½ drachms (which keep in darkness); take gallic acid ¼oz., hot distilled water one pint; agitate well, and allow to stand 24 hours to sensitise; take 1oz. distilled water, 20 drops of above silver solution, 20 drops gallic acid solution, mix, and apply to the paper by means of a brush made of a piece of ½in. glass-tube, with a tuft of cotton-wool stuffed into one end. This should be applied copiously, first cross-wise, and then up and down the paper. Then allow the liquid to drain from one corner of the paper, and blot off the remainder with clean blotting-paper, taking care not to rub the sensitive surface. This must be done without a ray of white light entering the room. What remains of the solution must be immediately thrown away, and the glass containing it scrupulously cleansed for another operation. It remains then to attach the paper to a support for exposure in the camera. My practice has been to have pieces of glass cut to the proper size for the camera frames, and laying the sensitised paper upon some clean blotting-paper, face downwards, place the piece of glass on its back, fold over the edges, and by the application of gum-water, attach them to the back of the glass. When so secured, turn over and leave in a horizontal position for a few minutes, when the paper will have dried flat to the glass. A number may be prepared at the same time sufficient for the day's work, and made up into a packet. They should be placed face to face with a piece of clean blotting-paper of the same size between each sensitised surface. I change the papers in the field by means of a bag made of three thicknesses of black glazed calico, made large enough to pass over the shoulders down to the hips, with a square of yellow calico let into the front to admit sufficient light, and fastening round the waist with a piece of elastic band. The next thing is the exposure, the time of which, of course, depends on the light and the aperture of the lens in proportion to its focal length. A day in which sunshine and cloud alternate is the most favourable, for when sunshine continues during the whole of the exposure, the contrasts are generally too violent to be pleasing. On the other hand, a sky entirely clouded is apt to produce too little contrast of light and shade. This process allows some latitude in the time of exposure: from five minutes to a quarter of an hour is generally sufficient. Much depends upon the subject; it is best to err rather on the side of too long an exposure, than of too short. The plates with paper attached, when packed together, must be put in a flat box, impervious to light, to be conveyed to the scene of which you wish to obtain a picture. To develop the pictures, you take a piece of plate-glass a few inches longer and wider than the negatives, and placing it on a table, level it truly. You then take one of the plates from the box, and having laid it face downwards on a piece of clean blotting-paper, remove the paper by cutting round the glass with a penknife; then attach the negative to the sensitising board as before. Now observe the aspect of the picture as a guide to mixing the developing solution. This is composed of aceto-nitrate of silver as previously prepared for sensitising, but without any addition of water, and the solution of gallic acid. If no trace whatever of the picture be visible, mix the aceto-nitrate and solution of gallic acid in equal proportions. Should the sky and high lights of the picture be slightly browned, add two parts of aceto-nitrate to three of gallic acid. Should the sky and high-lights be very strongly out through great over-exposure, add one part of aceto-nitrate to three of gallic acid. This mixture must be made in a perfectly clean glass, and applied to the picture with a brush made as before directed, with clean cotton wool, passing it rapidly over the picture, beginning with the sky, bringing it down with a flowing edge to the bottom, taking care to leave no spot untouched. The quantity required for 10 by 8 picture will be about one-third of an ounce. In a minute or two the development commences; then repeat the process with gallic acid alone. Use the same brush and glass, and apply the gallic acid copiously; first longitudinally, and then transversely. Now pour some gallic acid upon the middle of the glass slab, and spread it by means of the brush just used. Remove the picture from the board, and lay it face downwards upon the gallic acid on the slab. The development, which should now be rapidly advancing, must be carefully watched. When the dark parts of the picture begin to appear through, it will be time to lift it up and examine it against the light. The development should not be arrested until the details in the deepest shadows are fully out. Be very careful not to wet the back of the negative with the developing solution, and also in the previous stages not to touch the sensitive surface with the fingers. When the development is complete, lay the negative face downwards on the surface of clean water in a dish, which change once or twice. All this must be done in a yellow light, or by the light of a rushlight or small benzoline lamp. To fix the picture, make a strong solution of hypo-sulphite of soda in water, in which immerse the picture until the yellow iodide of silver is thoroughly dissolved out, which can only be ascertained with certainty by daylight. Finally, wash the picture in abundance of common water, changed several times, then leave it to soak in water for several hours, in order to remove all traces of hyposulphite, and hang up to dry. Before printing from the negative it should be waxed, which is easily accomplished by taking an earthenware dish with upright sides, which stand in another larger one, into which pour boiling water. The negative is then placed on the bottom of the inner dish, which should previously have had a cake of clean white wax rubbed over it. Then rub the wax over the negative both front and back. The heat will, in a short time, cause the wax to thoroughly penetrate the pores of the paper. Care must be taken that the negative is quite dry before waxing; also that water does not get into the inner dish. Many negatives may thus be waxed together in a short time. When they are thoroughly penetrated by the wax, take them out singly and hang up. It remains now to finish them by ironing between sheets of blotting-paper with a moderately-hot smoothing-iron, until no shining patches of wax remain on either side. Care must be taken not to crease them in the process of ironing. It only remains to say a few words on the paper best adapted for negatives. The French papers are not good, being sized with vegetable matter; a gelatine-sized paper is requisite. Five-and-twenty years ago there were papers in the market specially made for the purpose. Hollingworth's negative was very good. I myself preferred Turner's; I do not know if these are obtainable now. I am not acquainted with Morgan's. I have some of the proper paper still, and would send a sample for experiment on receipt of address. I prefer printing from these negatives on plain (ammonium) salted paper, or a paper prepared with serum; albumenised paper I think altogether unsuitable.—AN OLD PHOTOGRAPHER.

[46100.] — **Lever 'Scapement.** — "Lock and Draw" must not, no, nor anyone else, follow the advice given on page 13, No. 885, as he will most certainly get his 'scapement out of angle, and out of upright, too. The 'scapement after such treatment would have to be repitched all through. The banking-pins would be wrong, and so would the hole through the pallets and lever that pin them and keep them in angle. It would be difficult for a good workman to succeed in this, equipped with necessary tools. If the 'scapement is nowhere else faulty, perhaps opening the one banking-pin might relieve it enough. Should the 'scapement only be slightly shallow in the 'scape-wheel and pallet-depth, it might be cured by slipping on the roller-staff a slightly larger roller than the present one—or less alteration still may do; set the roller-depth deeper—or just take off the present roller, place the same on a fine piece of steel, and hold it near the flame of a very small lamp, just to warm it, taking care not to blue it, and carefully *set out* the *ruby-pin* just a trifle, that will probably carry the pallets far enough in the 'scape-wheel over the rocking-faces. The advice given not to alter the faces of pallets is good. If you do the job as there specified you will certainly ruin the watch, and perhaps have to have an entire new 'scapement. No one could successfully do such a job without the ability, and the help of a good depth tool, and upright tool, or a mandril.—T. FREEMAN, Nuneaton.

[46118.]—**Slide-Valve and Piston.**—If the slide-valves leak, the only way is to take them out and examine the valve-face. If the face is not cut or scored, you may be able to put it to rights again. You would first want a perfectly true surface-plate, and to this you would have to file and scrape the slide-valve so that it bore all over. Then using it as the surface-plate, get up the valve-face to it. But if the face is cut or scored at all, it will need planing, which you will need to get done. —SUNLIGHT.

[46122.]—**Hydraulic Ram or Water-Wheel.** —I should say, by all means use the hydraulic ram for the purpose E. Hurley requires. Working fall, 6ft.; height of ascension-pipe and water to be elevated, 40ft.; quantity to be raised in 24 hours, 50 gallons; quantity per minute, ·0347 gallons; diameter of bore of drive-pipe, ·375in.; length of ditto, 40·80ft.; inclination of ditto, 1-11·50; diameter of orifice in seat of arresting-valve, ·5625in.; drop of arresting-valve, ·0933in.; number of blows or strokes of arresting-valve per minute, 39·5; area of the discharging orifice between the arresting-valve and its seat, when the water is flowing therefrom, ·1646in. The drive-pipe here given is the medium, or best length for this particular working fall and ascension-pipe elevation. It may, however, be for minimum length 32·60ft., and for maximum length 49·00ft. The quantity proposed to be raised—50 gallons per day—is very small. I find that at least 30 gallons per day should be calculated for general purposes for each individual residing in the house, and it is far better to have 50 gallons per head per day, bearing in mind, for good sanitary results, that the water-closets and sewers should be kept clean, and all fæcal matter carried away to a distance. I would therefore suggest to E. H. to lay down an inch ram, with a drive-pipe the length previously stated, and a bore of 1in. This will raise about seven times the quantity he named (50 gallons), —350 gallons per day, and ample for a house containing from seven to ten residents. The difference in cost would be very trifling: for instance, you can purchase of the importers a $\frac{3}{4}$in. ram for 36s., 1in. for 44s., $1\frac{1}{4}$in. for 56s. I refrain from mentioning names of persons and places, that my reply hereto may not be considered invidious, or an attempt to advertise. No doubt the publisher of the "E. M." will be pleased to insert an advertisement in the regular way of business for E. Hurley. I may further inform E. H. that the number of makers of hydraulic rams in England may be counted upon the fingers of both hands. Their several kinds vary in successes and failures, as well as in principle. Some put them down by "rule of thumb." Hence there are many failures, with sometimes a chance of success. Others, I believe, go into the matter thoroughly and scientifically with good results. You will find in the "E. M.," from the earliest date, this matter has been written on and discussed, up even to the present time. The late Professor Rankine wrote sundry articles upon it in the *Engineer*, Vol. XXXIII., pages 55, 84, and 163, in 1872. In the first two pages quoted he gives certain empirical rules, which I fear are of little value, except as incentive to a further investigation and study of the subject. In the last article, p. 163, he gives the mathematical theory of Venturoli, who, I presume, was an Italian. In the 9th clause he says, "In the present state of our knowledge it is impossible to determine the values of K^2 V^2, except through experimental trials of actual rams." In his steam-engine and other prime motors, p. 211 and 212, the subject is treated of very concisely; certain empirical formula are given, which may be possibly of use in a particular case. These are the only English writings on the subject that I am aware of. The earliest patent I can find is by Boulton and Watt, No. 2207, dated Dec. 30, 1797, price 1s. The next by Montgolfier, jun., No. 3992, dated March 14, 1816, price 10d. A London firm is reported to have obtained a patent at a much later date. I, however, have been unable to trace it in my search through the Patent Office Publication of Specifications. D'Aubriesson, in his "Traité d'Hydraulique," gives an article upon the Hydraulic Ram, with tables of the heights, quantities, and co-efficients of useful effect of those made by the Montgolfiers, father and son. Also of a portion of the experiments by the savant, Eytelwein, who made 1,123 experiments in investigating its construction. This is the best and most voluminous article that I know of published on this subject. These experiments were made 1804, and no doubt, with our better mechanical knowledge and principles of construction, we ought to succeed beyond that attained nearly 80 years since. Those who succeed best in England, as well as those who sometimes succeed, keep the manner of laying down "a trade secret." I do not condemn them for it. Even Prof. Rankine, before quoted, was unable to obtain sufficient and reliable data in his investigation. Still, it is to be done, and is done. The different makers vary considerably. In the bore, length, and inclination of the drive-pipes, even when working under the same height of fall and vertical height of ascension-pipe, in diameter as much as 2· to 3·, and area as 4· to 9·, so that within certain limits a fair result may be attained. But it will not do to copy a particular case, and consider that all others should be exactly in the same proportion. Each particular working fall and vertical height of ascension requires a certain length of drive-pipe. It should not be more nor less than a specified length; so is its diameter of bore regulated by the gross quantity of water (run to waste and elevated) and the working fall.—TUBAL-KAIN.

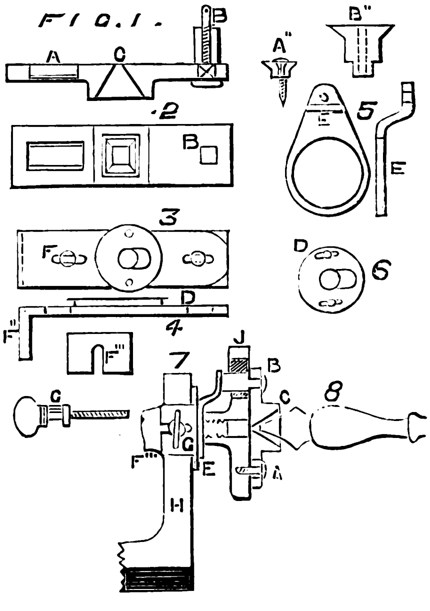
[46132.]—**Fluoric Acid for Soldering Iron.**—It is to be hoped that the querist will not waste time and money in making the "mess" given on p. 14. The recipe is a very old one, and is often given by "old hands" to greenhorns. Like many other gifts, it is parted with at its full value, though, strange to say, it appears in a modified form in Spon's "Receipts."—NUN. DOR.

[46148.]—**Fret Saw and Lathe.**—Thanks to Mr. Hoskin for his reply. I want to cut mahogany $1\frac{1}{4}$in. My flyweel is 29in. in diameter. Is not the saw inconveniently near the upright? I think of putting bearings on the latter, and so bringing the saw a couple of inches further out.—J.

[46162.]—**Nascent Oxygen.**—Many thanks to "Analyst" for his answer to my query, and promise of further information. I did not intend to ask how to obtain nascent oxygen by decomposing chlorate of potash with manganese. But how to safely decompose it when mixed with the black oxide, for the purpose of liberating a larger quantity of nascent oxygen than is obtainable by the usual practice of saturating the black oxide alone with sulphuric acid, diluted to about 60 Twaddell. I have long practised the latter mode of obtaining nascent oxygen for the purpose of bleaching oils, and fats, but as chlorate of potash contains more oxygen than the black oxide, I am anxious to know how it can be treated so as to obtain the best result for my purpose.—J. P.

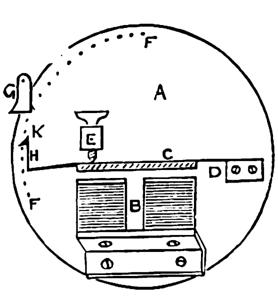
[46171.] — **Electric Communications.** — If "Motion Plate" could visit the Crystal Palace Electric Exhibition, he will see working models of Stroudley's patent train communications, at Messrs. Garnham and Co.'s stand, 144, Eastern Gallery.—PEGANREDSTUFF.

[46206.]—**Oval Chuck.**—I suppose your mandrels come such a little way through your headstock that you have no room for the fittings. If if you have 5-16ths of an inch between your face-plate boss and headstock, you will be able to get this arrangement in; but if you have not more than an eighth of an inch, you can dispense with the adjusting slide F. Fig. 1 is a piece of either wrought-iron or cast, best wrought-iron bar $1\frac{1}{4}$in. by $\frac{3}{4}$in., shouldered down as shown, to $\frac{3}{8}$in. thick at both ends. There is a slot at A, and a square hole at B, and a taper-square hole at C; this is the slide. The flush side is next your face-plate A″ is a small guide-block to be fitted in A. B″ is another fitted in the slot in face-plate and square hole B, and fastened up to the shoulder by the long screw, the end of which comes through and forms the connecting pin for eccentric strap; 2 is the front view; 3 is the adjusting plate upon which the eccentric is screwed; 4, side view of same; F″ is the end, shown again at F‴, with a



slot into which the screw G engages by the double collars; this screw is screwed into the edge of hood and stock for adjusting eccentric to what is required: 5 is the eccentric strap; 6, eccentric; 7, the whole in position in section, with handle turned; I is an ordinary driving-chuck or face-plate. If you dispense with 3, fasten the eccentric with two screws upon lathe-head and slots in the eccentric for adjusting. The wood you wish to turn should be tapered down to go into the taper hole in the slide; the eccentric adjusting slide and strap make out of 3in. No. 10 B.W.G. hoop iron. When the whole is fitted, make a pan about 2in. deep of tin or sheet iron, get ¼lb. vegetable black, and take equal parts of the white ash, sifted very fine, from under your grate, ¼oz. prussiate of potash; dissolve this with 1oz. of table-salt, and mix your ash and vegetable black up like mortar; line your pan, and pack your things in it, with a layer between, and the holes filled, and plaster all over to keep the air from them; place them on the top of kitchen-fire, and get them to a red heat, and keep them at that for an hour or two, when take them off and bury them in the ashes, or in some sand, and you will find them very hard without distorting them. Do not slake them in water. This will give you a good oval chuck, with little trouble or expense, with which you may turn any tool-handles or hammer-shafts.—Jack of All Trades.

[46208.]—**Electric Clock Dials to Beat Minutes.**—I am making one as follows, and have every reason to believe it will answer well :—A,



wooden disc fitted to turn freely on pivots, and to carry minute hand; F, brass pins (60) round edge of do. about ¼in. long; B, electro-magnet receiving current every minute from primary clock; C, soft iron keeper; D, spring; E, stop screw (not in electrical connection); H, a piece of very flexible steel; K, brass triangular hook. The magnet acting on the keeper once a minute draws it down, and moves the disc on the distance of one pin; when keeper is released the hook, K, falls over the next piu ready to act upon another current being sent; G is a stop hanging loosely on pin to prevent the hook, K, from turning back the disc. The hour hand is worked from the minute hand, as in an ordinary clock.—H. A. Dawkins.

[46209.]—**Photographic.**—As this has only been partially answered by Mr. Lancaster, perhaps you will allow me to supplement his reply. There would be no difference in light transmitting power betwixt pot and flashed colours if of the same tint; but I may tell "No Sig." that practically pot ruby is unknown. I have seen samples of it, but it is not a trade community. There are difficulties in the way of manufacture; secondly, pot colours are in all cases lower in price than flashed or stained; but any such price as 2s. per foot is simply extortion. The best ruby can be bought at 8d. per foot, and second quality at less than this. Of course, in country places, it would be dearer, but even then 2s. is far too much. It might be information for your correspondent if I add that three kinds of coloured glass are made—pot, flashed, and stained. The difference being—pot is coloured throughout, flashed is a thin film of coloured metal blown on white glass at time of blowing, and stained being burnt in afterwards. Blue is to be had pot and flashed; ruby, flashed only; green, pot and flashed; purple, ditto; opal, ditto; yellow and orange, pot and stained; stained red, stained only. —E. Holmes.

[46211.]—**Engine for Driving Lathe.**—To "Sunlight."—Very much depends on the work to be done. I would not advise less than a 3in. bore and 6in. stroke engine at least. Length of cylinder inside, 8in.; thickness of piston, 1½in., packed with Ramsbottom's steel rings; walls of cylinder and steam-chest might be ½in. when cylinder is bored, the steam-chest being that thickness in the casting; steam-chest, 4in. long and 3in. wide inside; steam-ports, ⅜in. wide and 2⅜in. long; bars between the ports, ⅜in. wide; exhaust-port, 1in. by 2⅜in.; steam-pipe might be, if short, ¾in. in the bore; if any length, 1in.; exhaust-pipe, 1½in. bore; slide-valve, 2¾in. by 3in. wide; exhaust-port in valve, 1¾in. by 2⅜in. wide; eccentric with ½in. throw, and consequently giving valve 1in. travel; crank-shaft, 1½in. diameter; flywheel—if space available, 2ft. 6in. diameter; if limited for room, 24in. may be used; weight, say 50lb. As to governors, that must depend on the class—whether of the old Watt form or high-speed ones.—Sunlight.

[46217.]—**Model Electric Engine.**—As I have made several models of electric engines, I beg to offer "W. F. C." a description of one. A^1 A^2 are magnets made of soft iron 2½in. long, covered with No. 22 wire, which are placed 5-16in. apart; B is the beam 4¾in. from C to D, and 3in. from C to B, worked by E 2½in. from B to E; at E the keeper is placed 1¾in. by ½in. (Fig. 2); F is the contact breaker, 1¼in. long; G is the connecting-rod, 1in. long; H is the flywheel, 3in. diameter; I I the flywheel standards, 3in. high; J J the beam standards, 3in. high; K is 7in. by 4in. Fig. 3 is a section of the contact-breaker, and mercury cups M M M connected by N to E. The engine works by the magnets pulling alternately. When the current runs through the magnet A^2 it draws the keeper E towards it, when the contact is broken by one wire of the contact-breaker being lifted out of the mercury; the flywheel then carries it over the dead point, when the other wire of the contact-breaker dips into the mercury on the other side, when magnet A^1 is connected and draws the keeper to it; the flywheel then goes over the dead point again, and so on. This engine works admirably with one Bunsen. The parts can be made twice as large, and a small pulley-wheel can be placed on the flywheel. The beam, standards, and contact-breaker are made of wood or any suitable material.—R. W.

FIG. 1.

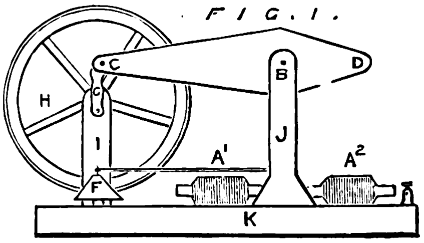


FIG. 2

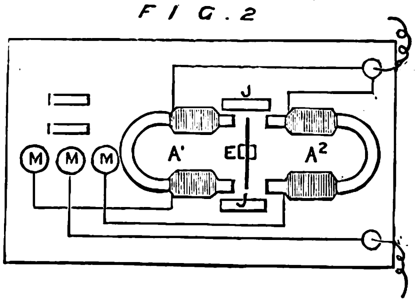
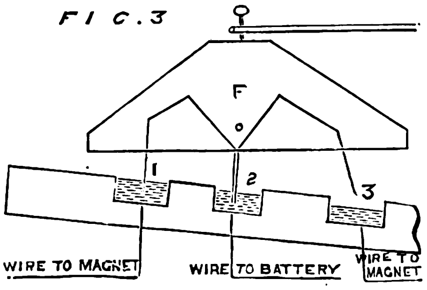


FIG. 3



[46222.]—**Link-Motion.**—Your query is not very precise. You should give the dimensions of the steam-ports, and other elements of working, as explained in my answer to query 46220. You will perhaps get the information you want by reading it. From what you say, if I understand right, you have begun wrong. The throw of eccentric cannot be determined before you know the link you are going to use. The rocking-shaft will simply give to the slides a motion reverse of that of the eccentric-rods. The radius of curvature of link is 3ft. 3½in. − 1¾in. = 3ft. 1¾in., as said in above reply. The link's length has also been mentioned in the same reply. All such dimensions are dependent upon the room you can dispose of for them in your engine. It is a very unlucky idea to use a straight link with the same gear. You will not secure any of the advantages of the curve link, and besides it will not work symmetrically. Adopting Allan's straight link will be a very good plan, and answer quite as well as the shifting link; but it requires a long distance between the valve-face and the engine-shaft, and it is not simpler in construction, save that it is not curved, but it is not a gr eatsaving of trouble.—E. Gobert.

[46225.]—**Steam-Launch.**—I should consider the 3 h.-p. Cochran boiler, good as they undoubtedly are, too small for a 4 h.-p. nominal engine as your 6in. cylinder would be, and therefore it would be hardly possible to get the full power out of the engine. I, therefore, could not tell you what speed you would get with a boat 28ft. by 6ft. 6in. beam; but, looking at the dimensions generally, perhaps as much as six or seven miles per hour. The lines of the boat would greatly influence the speed. Thus I could put such lines into a boat that with the dimensions you name the engine-power as stated would give, say, a speed of eight to nine miles; yet, with the altering of lines, same engine and boiler should not drive the boat as much as six miles an hour. I should decidedly also advise you to have the next size boiler if you intend to run up to 300 a minute. It really is not fair to expect the 3 h.-p boiler to do it, as it could only be done by forcing it for a short time, and shortening the life of it thereby.—Sunlight.

[46234.]—**To "Peganredstuff."**—You could hardly attempt a more difficult task. The sort of escapement referred to is about the worst and most defective principle ever brought out. The impulse received being only once in two vibrations, is hardly enough to overcome the immense friction of the swing arbor pivots and light pendulum. Experienced hands are often puzzled what to do with them. I will, however, give a few suggestions in the matter. If much cut, it would be better to make new pallets, taking care to have as little drop inside and out as is safe, left as hard as possible, and the acting surfaces well polished. As I have observed, these timepieces are very delicate, it is necessary you should see movement quite clear. Have mainspring out, and be sure that is also clean, and oil with good oil, both mainspring, all holes, and escape-wheel teeth.—Peganredstuff.

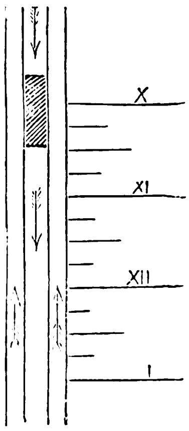
[46237.]—**Lithography.**—F. W. Thomas need not be much surprised that his sketches will not print if they have been left aside for a considerable time. The cause of failure is the action of air on the printing-ink, the gum having failed to keep it out. The remedy in such a case is to dissolve away the old ink, by means of turpentine, and to "rub up" with fresh ink. In doing this, the less of the gum rubbed away the better, as it performs good service in preserving the white parts of the stone. In some cases I have seen benzine substituted for turpentine, but in either case the sketches will "rub up" as good as ever.—D'Evlyn.

[46248.]—**Amateur Dramatic Club.**—"A Fellow Workman" does not say how many his company numbers, or whether he has any means of making any scenery, &c.; but I should suppose his company would be rather limited, and, of course, he must choose his piece to suit. Unless he can obtain the help of a few ladies, I am afraid his choice will be somewhat limited. I will suppose he is able to do so. He will find a very good farce, in one act, for three males and four females, in Mr. J. L. Toole's great piece, "Ici on Parle Français." It is very good throughout, and very funny, if the part of Spriggins is well played; and requires no expensive costumes or scenery. I should say it would be very suitable. Then there is another I can recommend, for three males and three females; a very pretty piece, indeed, and also very funny, if the part of Paddles be well played. It is a comedietta, in one act, entitled, "Which is Which"; time, present day; so no costumes or expensive scenery are required for it. Then there is a roaring comedy in "Checkmate," by Halliday, in two acts, for seven males and five females; only it is a little more extravagant, and takes more getting up; the scenery, also, is more elaborate, but it will pay you well for getting up if properly done. Then there is the well-worn, but ever good, "Box and Cox," a farce in one act, for two males and one female. Now, if this piece is not worn out in your country, I can strongly recommend it as easy to get up and exceedingly funny, with some very nice acting in it, especially poor old Mr. Buckstone's favourite character, Mr. Box. This also requires no scenery nor costumes. By playing one long piece and one short one, you can make a very nice evening's amusement. There is a very good short piece for two male characters, in "A Most Unwarrantable Intrusion," by S. M. Morton; it is a farce in one act, and takes three-quarters of an hour to represent. It is exceedingly funny, and a splendid piece altogether. Caution—whatever you do (unless you have been well used to acting in public a long time), do not try to get up a drama or tragedy piece, as nothing is more painful to the audience and annoying to the performers, than either done badly, and it is wonderful what a lot they do take doing. Then you will want wigs, whiskers, moustaches, paints, &c. In ordering a play you must ask for the *acting* edition of the play you want.—W. Lissington.

[46263.]—**Porous Slabs.**—Plaster of Paris is a bad substitute; better buy the porous slabs to be obtained so cheaply, when their durability is taken into account.—W. J. Lancaster.

[46263.]—**Porous Slabs.**—Thirteen years' experience convinces me these are the worst batteries in use. You had far better have single cells joined up with wires or bands of copper: troughs are rarely ever water-tight between the partitions and difficult to clean; a syringe is required to draw off and replenish them. Plaster of Paris for porous plates will not do at all, it gradually dissolves in a Daniell's (at least I have found it so); Wedgwood ware plates are sold, but it is very difficult to secure them in a trough, and they are quite as dear as porous cells if of good quality.—An Associate of the Society of Telegraph Engineers.

[46267.]—**Curious Clock.**—There are two glass tubes, one within the other; the inner tube contains mercury and also atmospheric air; at each end, the inner tube communicates by a small orifice with outer tube, and consequently the mercury in its descent has to force the air out of the inner tube to the outer, and thus the rate of descent is regulated, the descending arrow in inner tube is the air forced downwards by the weight of the mercury; the air escapes by the small orifice, passes into the outer tube, and ascends in it, as shown by the two lowermost arrows; when it reaches the top of the outer tube it enters the small end of the inner tube, and thus as fast as the air is forced out below, it enters above, as shown by descending arrow above the mercury; outer tube is hermetically sealed.—Peganredstuff.



[46277.]— **Refractors.** — The oldest form of erector was one in which three lenses formed the whole eyepiece; the results are not nearly so satisfactory as the present two-lens eyepiece and two-lens erector. I have, during the last week, had a peculiar eyepiece, in which the eyepiece proper consisted of an arrangement of four lenses, but nothing that I know of equals a well-made erecting eyepiece of four lenses in all.—W. J. Lancaster.

[46282.]—**To "Sunlight."**— The theoretical pressure on the cylinder of a gas-engine I should not like to express an opinion on—it might be most misleading. Neither do I think it is worth while to go to theory when practice tells us all we want to know. You ask me what is the actual pressure? Well, it varies with the strength of the mixture. But a properly-designed engine should use such a proportion of air and gas that the maximum average pressure should be about 190 to 200lb. on the square inch. I have had as much as 210lb., and as little as 27lb. A good motor using compressed mixture should develop about 200lb. as a maximum. If we go much over that, the pressure and temperature border on line over which many practical difficulties crop up. Although I should be quite prepared to design and supply an engine to give pressure as high as 350lb. to the inch, I have all the information needed to do so, but there are details that would be likely to suffer under the great pressure, at least with engines at present in use. No doubt the pressure in the cylinders of gas-engines will be increased in time. And I am also sanguine that in a few years we shall have gas-engines with cylinders no larger than steam-engines of the same power. And knowing these facts, I may add that I am already considering the question of increased pressures. But until I see my way clear on several points which would be prejudiced by mere pressure, I shall be content with an actual pressure of about 200lb. on the inch.—Sunlight.

[46286.] — **Geneva Watch Cleaning.** — If "Darius" will refer to a recently-published letter of mine, he will, I think, find something instructive as regards watch-cleaning. In the letter referred to I gave instructions how to clean a lever watch. What is there written will apply, in great part, to a Geneva. First of all, after taking the movement out of the case, and removing hands, dial, cannon-pinion, &c., place a bristle, or something fine and pliant, in the escape-wheel, unscrew and remove the cylinder and its bar, withdraw the bristle, and let the watch run down. If the watch has a "bar" movement, the spring may be let down (if not already down), by putting a key on the square, firmly held, and easing the click out. After this, unscrew the 'scape-wheel bar, and the other bars, or plate (if a ¾ plate), in regular order. After all has been cleaned, and the holes carefully pegged out, replace each part as it was before, oiling after it is put together. When you clean the cylinder you must exercise great care. Turn the stud of the regulator half-way round, so that the hair-spring may pass out from between it and the pin adjacent to it; take hold of the bar in the left hand, and let the cylinder hang freely down. With the nippers take a firm hold of the hairspring stud and ease it out of the bar. After cleaning the bar and pegging the jewel-hole, slightly oil it; clean the cylinder from dirt, or anything that has attached to it, and replace as before, not forgetting to turn the regulating-stud over the pin, with the hairspring free to play between. The escape-wheel teeth should be touched a little with oil. A portion on two or three teeth will suffice. I here take the opportunity to correct an unintentional error which I made in the letter previously referred to—i.e., as regards the quantity of oil required to a pivot. I then stated that only as much oil should be applied as would make a spot on paper, as large as any full stop in my letter. I had in my mind's eye a larger stop than was actually to be found there. However, very little oil, comparatively speaking, is necessary. Having, then, replaced the cylinder, put in the set square and affix the cannon pinion to it; fit the motion-wheels, dial and hands, set in case, and wind. Respecting cylinder pivot fitting, an amateur would have to be particularly skilful to do this job satisfactorily. First, remove the hairspring and collet, then drive out the old plug with a suitable punch, and shellac an arbor over the body of the cylinder, filling the hollow so as to make it perfectly rigid. If you have a roughly made plug and pivot, fit it into the cylinder and with the "turns" a horse-hair bow, and suitably shaped gravers and pivot files, shape and reduce as may be required. The new pivot must be made perfectly free in the jewel hole, and you must observe to get the correct "end-shake." The plug must not protrude inside the cylinder, but should be left flush with the notch. It is a very delicate operation, and requires not a little skill to do properly, so unless "Darius" is prepared for a fidgety and somewhat difficult task, I would advise him to send his cylinder to a jobber accustomed to this class of work. The ferrule may be removed from the cylinder by soaking in spirits of wine.—Alfojoe.

[46289.]—**Cleaning and Relacquering Brass Chandeliers.**—You, of course, know everything depends upon having the brasswork free from grease or dirt: unless you are very careful on this point, you will never get the work a good colour. Perhaps the better way for you to accomplish what you want will be to boil the brass parts in a strong solution of pearlash until apparently clean, then place them into a vessel containing a solution of aquafortis, about one of acid to three or four of water; let them remain in this solution for an hour or so, afterwards washing them well, and scouring, if necessary, with sand until every part is clean, then make up a solution of equal parts of nitric and sulphuric acids, and add to it about one-third part extra of nitric acid, having zinc dissolved in it in the proportion of about one zinc to three acid. When boiling dip the articles in until they have the colour you require; 20 to 30 seconds will be ample. Then swill well in plenty of water, and place all the parts in fine sawdust until dry. When dry you can rub up with soft rags and a leather, and when just too hot to hold, lacquer the whole of the parts that will be at all exposed. When going through the process above, take care not to handle any part of the brasswork; and, above all, do all the work out of doors, or in a place with a large chimney, to take away any fumes of nitrous acid, which are most deleterious to the lungs.—W. J. Lancaster.

[46293.] — **Electro-Motor.** — I am pleased "A. A." has been so successful in making the motor. Now he will be able to make the motor go quicker by adding more battery power. He has evidently wound his electro-magnet successfully, otherwise it would not hold so much weight; but strength of current and speed of revolution go together, and any speed can be obtained by adding more cells. The armature should come down as closely as possible on to the cores, so as to leave scarcely room for a piece of paper to go between when passing each other; then the slightest alteration in the position of the commutator will make all the difference in velocity, and he might with advantage put on eight armatures, and make a wheel for commutator with eight divisions instead of the six, as now. I shall give every particular as to weight of wires, &c., in papers on coil-making.—W. J. Lancaster.

[46294.—**Thermo-Electricity.**—To "Sigma."—I have not seen the article referred to, and have not any details specially bearing on the subject. But I know that some time since great things were expected from metallic sulphides, and more especially from galena and sulphide of silver. I made some experiments which did not induce me to go any further. In fact, I do not believe in any good results likely to arise from substances having high resistances, nor do I expect real useful work will ever be done in this way by compound substances whose molecular condition is liable to be modified by heat. In fact, tempting as the direct conversion of heat into electricity looks, there is really no practical success attained in this direction. Noe's battery seems, on the whole, the most advantageous, chiefly from the form of its construction.—Sigma.

[46296.]—**Harmonium or Organ.**—I have a large harmonium to which I thought of adding a second manual on the American system. I had had the tubeboard some time, and was making American organ. After considering the great space required for two separate sets of reservoirs and feeders, concluded it best to keep to the American plan. If your reservoir is large, you may have four "feeders" and reservoirs in half the space required for the exhaust and force bellows combined. With regard to adding more reeds to the present instrument, if "Beta" will advertise his address I will inform him how I am designing to accomplish the same without an additional set of pallets. But as some weeks will elapse ere I can test the idea, it had better become an accomplished fact before appearing in print, or would have sent. —D.

[46297.] — **To Mr. Lancaster.** — There are plenty of lathes that would help you much in making a motor; for instance, the table below, which is reduced from Sprague's excellent work on electricity, would be invaluable to you if committed to memory, and what now seems to be an insurmountable difficulty can be easily overcome. You will be compelled to believe the seller's word as to the conductivity of wire supplied, or spend a lot of money in apparatus for testing yourself. The former is the more practical method, and in nine cases out of ten may be relied on. I shall be pleased to give any further information you may require.

B. W. gauge.	Ft. per pound.	Ft. per ohm.
12	27·32	1170·6
14	46·28	691·0
16	78·24	408·8
18	132·22	241·9
20	206·60	154·8
22	322·81	99·1

—W. J. Lancaster.

[46298.]—**Glycerine.**—This can be made from the alkaline mother-liquor of the soap-works (from which the soap has been separated by means of common salt), by neutralising with sulphuric acid, removing the excess of that acid by carbonate of barium, evaporating the filtrate to a syrup, digesting it for several days with alcohol, separating the alcoholic liquid from the $NaSO_4$, which crystallises out, decolourising with animal charcoal, again evaporating to a syrup, exhausting the residue with strong alcohol, and finally evaporating the filtered solution over the water-bath. A more economical method of separating glycerine from spent soap lyes is that patented by H. Reynolds. The liquid is first reduced by evaporation, and raised nearly to the boiling-point, by being passed through a heated still-like vessel, or heated in any other convenient vessel. It is then passed into a second vessel, where it is met by jets of superheated steam, at a temperature of 380° to 400° Fahr., which raises it to the boiling-point and evaporates the glycerine, carrying the vapour upwards with it, and leaving the salts to deposit in the vessel. Commercial glycerine may be contaminated with lead or lime. The former may be detected by sulphuretted hydrogen, the latter by dissolving the glycerine in its own volume of alcohol, containing 1 per cent. of H_2SO_4, in which case, if lime be present, a precipitate will be formed. It is also often adulterated with sugar, which may be detected and estimated by means of chloroform, in which glycerine dissolves with ease, whereas cane-sugar and glucose are quite insoluble. The liquid is first heated to expel the water contained in it, then mixed with chloroform; the whole is then poured upon a tared filter, and repeatedly washed with chloroform, after which the filter with its contents is dried at 212°, and weighed.—F. BARKER COOKE.

[46299.]—**Precession of the Equinoxes.**—Any astronomical work of any importance will give both the annual precession, and the amount that precession has accumulated to. Since the formation of the earliest catalogues on record, the equinoctial points have receded among the stars 30°, which is equivalent to one complete sign of the Zodiac, and the amount of this retrograde motion is 50·1″ per annum. Now, by a very simple calculation, we can find when the sun was in Aries at the Vernal Equinox. Reduce the 30° to seconds, and it will equal 108,000″ then ÷ 50″ (taking round numbers), which is the annual precession, and this shows us that it is about 2,160 years since the sun was the same degree in Aries that it is at present in Pisces at the Vernal Equinox. This brings us to the early days of astronomical record. If "Astrologos" can find the exact number of degrees that the sun is in the sign Pisces, then by the same method of calculation he will be able to find "when" it first entered that sign. Precession was discovered by Hipparchus, the celebrated Greek astronomer, about 150 B.C.—A. MANOCK.

[46299.]—**Precession of the Equinoxes.**—If "Astrologos" would study and master the effects of Precession, he would be able to answer his question, because he would understand better than anybody else what it is he wants to know. It is not more difficult to understand the theory of precession than any other simple astronomical phenomenon. Let him carefully examine a globe and remember that the equinoctial point recedes along the ecliptic at the rate of 50·1″ per annum. By an easy process in simple arithmetic, he will then be able to find its past and future time and place all round. He will find the constellations, as such, are not equally divided along the Ecliptic, and also that a part of "Cetus" intervenes between Aries and Pisces, so that, in point of fact, "the change" directly "from Aries to Pisces" never did take place at all. The equinox, since it first entered the "constellation" Pisces, has already moved along 28 degrees nearly; therefore: As 360° : 28° : : 25,868 years (the time it takes to go right round) to 2,012 years ago, since "the sun first entered the constellation Pisces at the Vernal Equinox." This is only approximately correct, the exact time being, probably, something short of 2,000 years ago.—DRACO.

[46300.]—**Broken Drills.**—The easiest way is to measure very carefully and get the exact place of hole on other side of plate, drill a rather smaller hole to meet point of broken drill, and drive it out with a wire or small punch. I have often had the same happen. If there is any of the broken drill you can get hold of with pliers, you can sometimes, by heating the brass, which will expand more than the steel, loosen the drill and draw it out. But often the cutting-edges are imbedded, and so the drill cannot get loose. The one fault of the Morse drills is their tendency to break in the smaller sizes and in deep holes. They have not "relief" enough at the back, and so work tight after getting a little way in.—TREADLE.

[46301.] — **To "Sunlight."** — Simplest form would be an externally-fired one, say 24in. long, 6in. diameter, with a good dome about 4in. diam. and 4in. high. If made of 3-16ths plate, should stand anything up to 60lb. or 70lb. with the greatest safety. That is with ends riveted in properly. Your ¾in. bore cylinders should stand 45lb. steam, if they are properly made. Six screws would give enough holding power if they were properly tapped in.—SUNLIGHT.

[46303.]—**Medical Coil.**—To MR. LANCASTER.—It is not often I have a doubt as to the real meaning of a query. Yours, I apprehend, has reference to a coil in which the primary and secondary are both different circuits. In that case, the secondary is insulated from primary, and the two ends of secondary go to the handles to be held by patient. The primary is coupled to battery, one wire going direct to one pole of battery, the other going through vibrator to the other pole of battery. This wire is broken when the vibrator is pulled towards the bundle of wires inside primary.—W. J. LANCASTER.

[46304.] — **Hardening Brass Wire.** — You might perhaps render it elastic by placing a steel mandril inside the spiral and then dressing the outside well with a light hammer. I know of no other way of making brass springing. It may be rendered hard and brittle by being heated red-hot and cooled slowly.—GLATTON.

[46306.]—**Telephone v. Bell.**—1. The magneto current generators are far superior to batteries, and are maintained at less expense. 2. If you use a transmitter, two or three cells at each station would be required; this would dispense with magnetos. 3. Any form of indicator will do if the coils are of suitable resistance. 4. You can ring two bells at the same time. 5. The sound produced would be as loud as the electric, as the magnetos could be made powerful enough to melt the bell coils. 6. I have known the Leclanché cell remain effective for four years without requiring water or sal-ammoniac during that period. The best form of magneto is one with a Siemens armature placed longitudinally between the arms of a powerful magnet. If you are near here, call, and I will show you one.—GEORGE TOLMAN.

[46308.]—**Telescope.**—To MR. LANCASTER.—The lenses belonging to your opera-glass will work their best as they are for astronomical purposes. Just look at the cluster of the Pleiades or pick up any part of the Milky Way—you will be able to count three times the number of stars you can see with the naked eye. The focus of your lens is too short to be of any value with convex eyelenses. As it is, with its concave eyelens, it forms a sort of small Galilean telescope.—W. J. LANCASTER.

[46311.]—**Horizontal Engine.**—See my reply to query 46211. For boiler, if externally fired, you might use one 4ft., or 4ft. 6in. long, by 1ft. 6in. diam.; firegrate, 15in. by 12in. I am supposing that you do not do any excessively heavy work in the lathe, and that it runs fairly easy. Slide-rest must depend on what is the construction of lathe-bed, and if to be hand-traversed, or self-acting in all directions. Let me know what you want, and I will endeavour to help you.—SUNLIGHT.

[46312.]—**Repairing Cylinder Face.**—What you want is to get the valve-face planed in place. There are many firms who would do this, as there are several forms of machines made to bolt on and do the job, being driven by hand-power. Some years since I designed such a machine purposely for cases like yours, where the steam-chest does not come off at the valve-face level. The slide-valve of course you can easily get off, and get it planed and scraped up again all right. I am sorry I cannot afford you more assistance than what I have stated above.—SUNLIGHT.

[46313.]—**Roof for Lean-to Hot-House.**—I put up a lean-to about the same size as "Muscatel" requires. In the roof I have a mid-rib on which I placed rafters of ⊥-iron 1in.; painted them one coat red-lead, and glazed with 21oz., each pane cut round at bottom. This makes a light and yet strong roof, and cheaper than wood. If "Muscatel" will advertise his address I shall be glad to give him full particulars and plans.—C. R. T.

[46314.]—**Closet-Cistern.**—Examine the air-pipe which comes up from supply-pipe to the top of cistern; most likely it is broken off about half-way down, and when the water reaches the top, where it is broken off, it runs down the air-pipe into the supply-pipe. You can put a new leather on the valve by unscrewing the nut close under the leather, and have an air-pipe from trap, as the foul air will come up when the pan or valve is shifted.—JUMBO.

[46314.]—**Closet-Cistern.**—There is usually a bent pipe in the cistern to get the fullest effect from the rush of water upon the opening and shutting of the valve, and possibly you have bent this down somewhat whilst fumbling at the valve. In order to fit a new leather empty the cistern, place a spanner on the squares of the valve-seat and unscrew it, disconnect from the wire, re-leather, and replace.—J. J. A., Liverpool.

[46315.] — **Ethoxo Limelight.** — This light appears to me to be a great improvement on the spirit form in use, as a better light can be got. I have been trying various experiments with it to get a perfect light and also a simple form of apparatus. But I am so much from home that my experiments have not been concluded. If "Exhibitor" can let the matter rest for a week or two, I hope to bring my experiments to a finish, and will then better advise him. I have now some three or four plans, but think I can still further improve them, or at least one of the best. The mixed gas-jet can be arranged to work with it; but a special jet is far better. As to hydrogen-generator, the one I use stands in a small cabinet, and acts splendidly; but it is not on the wash-bottle plan. Two glass vessels stand one over the other, the bottom one containing the hydrogen, as also the zinc cuttings. The upper chamber holds the acid and water, only the pressure of the gas as it is generated drives the acid solution into the upper vessel, thus giving a fine pressure. I pass the hydrogen, which is then under a pressure of over 24in. of water, through a regulator on the top, which allows it to pass to the lantern at a pressure equal whatever is wanted to balance the oxygen-bag, or oxygen-generator, as the case may be.—SUNLIGHT.

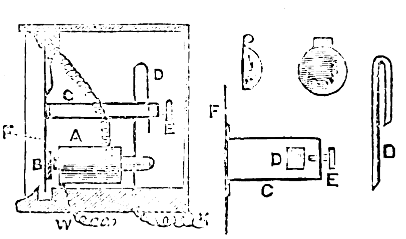
[46317.]—**Ferns.**—Allow the fronds to dry between paper in a book under slight pressure; then when dry, coat them with blacklead, put on damp, allowed to dry, and then polished gently with a tuft of cotton wool. See that the blacklead is all over the frond, otherwise the deposit will be in patches. You might carry a wire down the centre of the back of the frond, then you would be more likely to have a good coating of copper all over.—W. J. LANCASTER.

[46317.]—**Ferns.**— "Single Cell" can obtain beautiful electrotypes of ferns and leaves thus:—Take a sheet of letter-paper and rub it slightly with sweet oil all over; wipe all the oil off, so as to leave only a greasy surface; lay the frond, back downwards, on the paper, and after spreading it out properly, cover with a piece of blotting-paper, and press flat for a minute or two; this will grease the leaf and prevent adhesion. Now turn the leaf carefully over, and then with a camel's hair-brush cover leaf and paper with melted wax, brushing over layer after layer. Make the wax-cast pretty thick, and stick a penny or two on the back to make it sink, waxing over the pennies. Then carefully pull paper and frond off the wax, and a beautiful impression will be left, which blacklead and immerse in the usual way. Proved many times.—B. H.

[46318.]—**Protecting Steam - Pipes.**—Make hay ropes about 3in. circumference, wrap them close round steam-pipe; coat this with at least 3in. or 4in. of puddled clay, mixed with plasterer's hair or cut hay to keep it bound together. This I have tried with a long steam-pipe, underground, and found it most effectual in retaining heat.—ATKINSON.

[46320.]—**Motor.**—When you say you desire a motor, what sort of one have you in mind? From being a movable affair, a water-motor would not be admissible. Clockwork would be not of much service, as it would need to be wound up before it would actuate the weight? How long at a time do you need the power? It will be a difficulty; but perhaps if you give more particulars I may be able to help you.—SUNLIGHT.

[46322.]—**Electric Sign.**—I send a rough design for this, which I hope will answer your purpose. A thin sheet of metal F is fixed by its upper edge to a box, the other edges being free, so that it can vibrate, pendulum fashion. Holes are cut in this, and little concave reflectors (as shown below) are suspended in these by their upper edges, which are formed into simple hinges. Thus, if the plate F is made to oscillate, all the pendant discs vibrate in their respective holes. To obtain this oscillation, an electro-magnet A is fixed to the box, and opposite to it is an armature B, which forms part of plate F. A strip of brass, C, is bent as shown below, and attached to F. A screw, tipped with platinum, E, passes through it, and when the apparatus is at rest presses on a piece of platinum soldered to the end of a brass spring, D, which forms one of the terminals to which the battery is connected. The spring D is shown below separately. The curly lines show connections. The battery being connected with the two wires shown at base of box, the current enters at W, passes through magnet to top of F, thence by C to E, and back to battery by D and X. The action is similar to that of an electric bell. The spring D, particularly the upper part, should be weak.—GLATTON.



[46323.]—**Pumping by Steam.**—Far better to sink a well at hand than to attempt to connect an 8-h.p. engine to a well 200 yards distant.—J. J. A., Liverpool.

[46323.]—**Pumping by Steam.**—Your query is not particularly clear; but I take it that what you want is to first pump the water from the well for the engine feed-pump to draw from. Now it all depends on the levels. If the lift is but trifling, an ejector could be easily made to draw water from the well, and deliver it into a tank close to engine. If that cannot be done by reason of the weight of lift, then it remains for you to adopt one of several plans: one would be to drive a wire rope off the engine to actuate a pump at the well, and so get the water to the engine feed-pump. Another would be, if the vertical lift is not more that 28ft. or so, to use a vacuum pump, as they are sometimes called. A cast-iron vessel is connected at the bottom end with the well by pipes, and to the steam space of boiler at the top, proper valves and stopcocks being fitted to the iron vessel and to the water and steam-pipes. Steam from the boiler having been admitted, and the air expelled from the iron vessel, the steam admission is closed, and a vacuum quickly forms. Water from the well then flows in, fills the vessel partly. By turning on a stopcock to the tank the water now flows out by gravity, and the operation is repeated; or sometimes I have seen the apparatus placed above the water-level of boiler, and hence the water is fed direct into it Would either of these plans suit you?—Sunlight.

[46325.]—**Intensity Coil.**—1. It depends on the resistance of your primary coil, and ditto the secondary. 2. A coil giving 2in. or 3in. spark is sufficient for vacuum-tubes, exploding gunpowder, &c., &c.; you must look out, for the other purpose, one of the best induction-coils you can obtain, but do not attach this to the tubes, or you will require a good supply.—George Tolman.

[46325.]—**Intensity Coil.**—There is no exact ratio between cell-power and size of coil, but an average of 1 quart Bunsen to every 1-5in. spark will be about as much as it is well to use. (2) You will not get a coil that will enable you to heat a piece of platinum-wire; the current from the cells alone will do this, and fire gunpowder with a fuse. The coil will, however, help you in firing powder. You should get a coil that will give what we call a fat spark, and see that the coil gives the length stated by the vendor before you purchase it. (3) The calcic protosulphide CaS does phosphoresce when just made, and should then be put into a glass tube and hermetically sealed.—W. J. Lancaster.

[46328.]—**Lodger.**—By the Lodgers' Goods Protection Act, 1871, when the superior landlord distrains or threatens to do so, the lodger must make a written declaration claiming and describing his property. and must give this to such landlord or his bailiff. He must also state that the rent due from him has been paid, or if not he must then and there tender it to the superior landlord. If, after being served with this declaration, he still distrains, the distress will be illegal, and the lodger can apply to the nearest police magistrate for an order for the recovery of the goods, which order, upon proof of the declaration, will be made against the landlord.—Fred. Wetherfield, Solicitor, 2, Gresham-buildings, Guidhall.

[46329.]—**Chromate of Calcium.**—I have never had occasion to prepare this salt; but if required only in small quantity, I should prepare it by neutralising a solution of chromic acid with lime. If "W. T." requires it in large quantities, and will write again, I will do my best to devise a convenient and economical method of preparing it. —Analyst.

[46329.]—**Chromate of Calcium.**—This is obtained by dissolving calcium carbonate in aqueous chromic acid, or as a light yellow precipitate, by mixing concentrated solutions of chromate of potassium and calcium chloride. Also by roasting chrome ore, in fine powder, intimately mixed with chalk, grinding the roasted mass with water, and adding sulphuric acid until the liquid has an acid reaction, in which case dihydric calcic chromate is formed, and remains in solution. Calcium chromate ($CaCrO_4$) is moderately soluble in water, insoluble in alcohol, gives off its water at 200° C., and is afterwards very sparingly soluble. The anhydrous salt is used as a pigment.—F. Barker Cooke.

[46330.]—**Cream Separators.**—I do not know if this is what you want, but the sketch illustrates the principle of a cream separator. Imagine a "wheel of life," or Zœtrope, with the slots filled up, and a flange round the edge projecting inwards. This being filled with milk is set in rapid rotation, which by centrifugal force causes the milk to stand up against the sides. Enough milk is poured in to just touch the edge of flange, and the speed is increased and kept up for some minutes. The milk being denser than the cream is thrown outwards with greater force and displaces the latter, the two being separated into two layers, of which the inner one is composed of cream. (See Fig. 2.) When the separation is complete, a portion of skim-milk (the amount of which is regulated by experience) is added, and this flying outwards displaces its own bulk of cream, which escapes over the edge into a trough which surrounds the apparatus, and shown in section in Fig. 2.—Glatton.

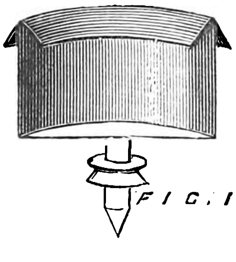


FIG. 1.

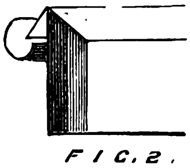


FIG. 2.

[46332.]—**Electrical Resistance.**—Water offers the highest as far as I am aware. I believe a glass tube, filled with water, 12in. in length, offers as much resistance as the Atlantic cable. Wheatstone's Bridge and galvanometer.—George Tolman.

[46332.]—**Electrical Resistance.**—Every textbook gives the information asked for. Common distilled water gives a very high resistance, so do alcohol, turpentine, or any liquids not subject to electrolytic decomposition. The methods and instruments required are the Wheatstone bridge, or differential galvanometer and measured resistances, which involve a long description to be found in every book on the subject.—Sigma.

[46333.]—**Gregorian or Cassegrain.**—Supposing spherical curves are used, the small "concave" in the Gregorian form violently magnifies the aberration of the large mirror. The small "convex" in the Cassegrain form partially corrects the aberration of the large mirror. The "flat" of a Newtonian does not affect the aberration of the large mirror, but simply diverts the cone of rays. The radius of the small "convex" in the Cassegrain form may be from ¼ to ⅛ of the larger concave. In Vol. XXXIII. are several letters on the "Cassegrain," including two from myself, giving a rule for determining the distance between the mirrors when the radii are given, pages 116 and 209. If "G. L. E." had given the distance between the mirrors, I would have suggested an approximate radii for them.—A. N. H.

[46334.]—**Gas Purifying.**—We do not know the arrangement of "Rosicrucian's" small gasworks; but in order that the purification of gas may be effectual, it is essential that the gas, after passing the hydraulic main, pass on to the condenser, washer, and, finally, the lime purifier. After the gas has passed through the washer, a great amount of its impurity has been extracted; but that it may be better fitted for use, and freed from the remaining impurity with which it is contaminated, it is passed through what is known as the lime purifier. This purifier consists of a large air-tight veessel in which are arranged a series of perforated trays in a horizontal position. On each of these trays is a layer of slaked lime, which the gas is brought in contact with, and thus divested of the remaining sulphur impurities. After this, the gas may be conveyed to the gasholder, and considered fit for use. With reference to the quality and purity of gas, this will depend upon the class of coal the gas is obtained from. London gas, which is principally made from English coal, gives a light equal to that of fifteen sperm candles, while the gas in Edinburgh, which is made from the Scotch Cannel coal, gives a light equal to, I believe, thirty sperm candles. The fact is technically expressed by saying that London gas is fifteen candle-gas, while that in Edinburgh is thirty candle-gas. The rate at which gas is burned when its illuminating power is being determined, is five cubic feet per hour, and the flame thus produced is scientifically compared (by means of suitable apparatus), with that of a sperm candle, whose rate of burning is 120 grains per hour. If our querist is wishful to obtain a large quantity of gas, he will find Cannel coal to answer his purpose; but, of course, he will also find it more expensive. —A. Manock.

[46335.]—**To Mr. Lancaster.**—You may use the permanganate of potash in boiling water, if you wish. The heat will not affect the permanganate to any extent; but if any infected clothing is placed in the solution, the action of the permanganate is very rapid; but, at the same time, it will be as equally effective as with the other clothes in the cold water.—W. J. Lancaster.

[46336.]—**Telephone Circuit.**—If "Meme" will say what telephones he proposes to use, whether receivers only or a receiver and transmitter at each end, I will show how to connect it as he wishes. Any simple switch arrangement will suffice to cut the bells out of circuit and place the telephones in connection with the line and batteries. It needs only for a connection to be made between both telephones and bells, with the line and batteries at each respective end, and then to insert a switch which by turning a key (or similar arrangement) will break the connection between bell battery and line, and join up the telephone with battery and line, or *vice versâ*, at will.—F. C.

[46336.]—**Telephone Circuits and Calls.**—Some time ago I described just the thing you want; but you can easily make a simple switch with as many ways as pieces of apparatus to be used. Thus Stud No. 1 might put bell in circuit; Stud No. 2 put telephone in, and 3 microphone. You can, if you like, have telephone in circuit with microphone, and the mere hanging of the telephone on to a hook throws in the bell; then by lifting off the telephone, a little spring lifts up the hook, and will throw telephone and microphone in circuit.—W. J. Lancaster.

[46337.]—**Steam Launch.**—To "Sunlight." —First let me ask you, have you at least three square feet of grate surface in your boiler? I should hardly think you have. Heating-surface also is entirely too small. I should want, for such an engine, at least 30 square feet of heating surface, and more if possible. It depends on the class of boiler. It is possible in a boiler but little larger, if any, to get the required surface. A Cochrane boiler would do so in the size nearly. I write this from home, therefore cannot refer to makers' lists. But, at any rate, the boiler you name is too small.—Sunlight.

[46338.]—**Sulphide of Calcium.**—This substance may be prepared by passing a current of hydrogen sulphide over quicklime heated to redness in a glass or porcelain tube, until it ceases to be absorbed; or, if the presence of a little free carbon is no objection, by heating a mixture of two parts of calcium sulphate (plaster of Paris) and one part of finely-powdered charcoal to redness in a Hessian crucible. The crucible may be covered, but vent must be left for the escape of the carbonic oxide which will be evolved.— Analyst.

[46338.]—**Sulphide of Calcium.**—This can be made (1) by passing sulphuretted hydrogen gas over lime ignited in a porcelain tube, water and calcium sulphide being formed, as $CaO + H_2S = CaS + H_2O$; (2) by decomposing the sulphate at a red heat with carbonic oxide, as $CaSO_4 + 4\,CO = CaS + 4\,CO_2$; (3) by strongly igniting dry sulphate of lime in a charcoal crucible, or with one-third of its weight of charcoal: 100 parts of ignited gypsum, heated to whiteness in a charcoal crucible, yield 51·52 calcium sulphide, $CaSO_4 + C_2 = CaS + 2CO_2$; (4) by igniting pure lime, or its carbonate, with half its weight of sulphur in a closed vessel, $4\,CaO + 4\,S = 3\,CaS + CaSO_4$.— F. Barker Cooke.

[46338.]—**Sulphide of Calcium.**—You have evidently been making or trying to make CaS_5, the calcic pentasulphide. You, I suppose, want to make the calcic protosulphide CaS, the phosphorescent salt. Canton made it from oyster-shells in an impure form by putting the shells in an open fire for half an hour, then allowing them to cool; and picking out the larger and whiter pieces, he packed them with one-third their weight of flowers of sulphur in a crucible with a cover luted on. This crucible was heated for an hour in a hot fire, and eventually the phosphorescent sulphide was taken out, broken up, and hermetically sealed in glass bottles. The best way is to put it in glass tube flattened over, and seal the ends up.—W. J. Lancaster.

[46339.]—**Dynamo-Machine.**—You evidently mean for two 20-candle power incandescent lamps. I shall shortly be able to give you this information, as I am making up several sizes of dynamo-machines for one, and any number of such lamps. —George Tolman.

[46339.]—**Dynamo-Machine.**—It is possible to make such a machine, but at present there is not a good and simple form of machine to be within any amateur's ordinary means. I have been at work for some time with motors and dynamos, and shall, I hope, have something good and simple before long.—W. J. Lancaster.

[46342.]—**Estimation of SH_2 and CO_2.**—Gas-liquor does not give off SH_2 or CO_2 when boiled with lime, as both these substances would be fixed by the lime. If it is the SH_2 and CO_2 in lime which has been used for the purification of coal-gas, that "L. D." wishes to estimate, I shall be glad to describe the process, if he will write again.— Analyst.

[46343.]—**Smith's Fan.**—In reply to Albert Hall, I hope to have all dimensions, with sketches, made out for you by next week, unless you communicate with me by post, as I am afraid the particulars will take up too much room. You will see my address in reply 46082.—J. Perry.

[46349.]—**Model Steamboat.**—I am not able to refer to my file of the "E.M." for the reason stated in reply 46337, or I could refer you to the woodcut and all information with pleasure. You want a boiler about 8in. or 9in. long, and 4½in. wide, the height being, perhaps, 6in. to 7in. But a reference to back numbers would give you the desired information, as I have given all details several times.—Sunlight.

[46349.]—**Model Steamboat.**—I am at present making a tin boat, 4ft. in the keel, 9in. draught, and 7in. beam. Her boiler is of copper, about as thick as strong note-paper; length 9in. by 3in., having a flue of 1½in. at one-third from the bottom, and fired with benzine, mixed with paraffin oil; boiler is riveted with round brass tacks and then solder-sweated. I use no safety-valve, but in the piece of short tube for supplying her with water, I stick a small cork, and this will be blown out ere the boiler bursts. The lamp is filled up inside with cotton wool, and then takes half-pint of benzine. This gets up the steam well.—J. J. A., Liverpool.

[46350.]—**Lantern Optics.**—There will be no appreciable difference between the colours. A simpler experiment is an ordinary coloured lantern-slide: all the colours have the same focus, and if one is in focus every other colour will have the same focus precisely; this is very different to ordinary chromatic aberration. A series of circles painted on the glass slide, the centre being violet, then I, V, G, Y, O. Red outside will produce a concave on the screen and, *vice-versâ*, a red centre and violet circumference will produce a convex on the screen.—W. J. LANCASTER.

[46351.]—**Leclanche Battery.**—The white deposit formed is an oxychloride, not an oxide, and the only way of preventing is the thorough saturation of the carbon with melted paraffin, by means of a prolonged soaking at just over the melting point.—SIGMA.

[46351.]—**Leclanche Battery.**—The cause of the oxide forming on the lead cap is on account of the salts creeping. You should have the carbon-plate 3in. above the porous cell, and soak in paraffin wax one half the length of plate. All the Leclanché carbon-plates that I have seen are too short.—GEORGE TOLMAN.

[46351.]—**Leclanche Battery.**—Heat the top of the carbon until the lead begins to soften, then plunge the carbon to a depth of at least 1in. in boiling paraffin; leave it in the paraffin for half an hour, then remove and put in cell: this will prevent the creeping up for a long time, and when bad do them again.—W. J. LANCASTER.

[46352.]—**White Fungus on Fish.**—I have seen it stated that this fungus is caused by overcrowding, and that it can be removed by sponging the fish with a strong solution of salt-and-water, immediately replacing it in fresh water, and repeating next day, if necessary. A note to *Land and Water* would be sure to elicit a scientific reply.—ROSICRUCIAN.

[46352.]—**White Fungus on Fish.**—All the information on the subject up to August, 1880, "C. O." will find in detail in the report on the disease which has recently prevailed among the salmon in the Tweed, Eden, and other rivers in England and Scotland, by Messrs. Buckland (late), Walpole, and Young. The Blue-book, 1s., may be had from any of the Queen's printers. The latest theory as to the origin of the fungus was, that it is the outgrowth of a parasitic worm invading the fish. This theory was published in *The Scotsman* a few days ago, and signed by a surgeon, who presumedly had studied to some extent botany and zoology before leaving college.—W. ADAMS.

[46354.]—**Telephone Transmitter.**—I have tried this form of microphone, and could get no better results than yourself. If you require a good form of transmitter I will send sketch of one. The primary of induction coil is inserted between battery and microphone, the secondary one end to line the other to telephone, the other end of telephone to earth or return wire. I have been unable to perceive any gain with the coil. The intensity of three cells is better than the quantity of one passed through the primary, which soon polarises the cell. I have known the Blake transmitter fail with a half-hour's conversation, on account of the cell becoming exhausted.—GEORGE TOLMAN.

[46356.]—**Analysis of Alloys.**—It would take much more room than the editor would allow to answer your query properly. You will find full particulars in Fresenius's "Quantitative Analysis," and in Bloxam's "Laboratory Guide."—F. BARKER COOKE.

[46357.]—**Clock and Watch-Making.**—To "ALFOJOE," &c.—I am very pleased to give "No Trade" a few words of encouragement in his laudable desire to learn a little of the watchmaking craft at even so late an age as thirty years. It is confessedly very late in life to set about learning a new trade; but I am able, from my personal knowledge, to speak of two instances where young men have forsaken the calling of their earlier days, and have become in one case very proficient in the trade, and in the other actually a skilled workman, and now in possession of a large and lucrative jobbing and sale trade. In the latter instance, the young man who, as an intimate friend of mine, is necessarily well known to me, had not, at the age of 22, so much as taken a watch or clock to pieces. Only twelve years have elapsed since he made the new departure; but having a taste for mechanical pursuits, he bent his whole energies to the work, practised self-denial in a most remarkable degree, as he gave up a lucrative but objectionable calling, and received little or no salary for nigh upon two years in return for the instruction he received. Having made a change and pushed on well in two subsequent situations, he started in business for himself in a small way, and has since made an increasing and uninterrupted success of it. As regards the former instance which I spoke of, the young man was a paperhanger, but had, in his spare time, "pottered" with clocks, &c. When his apprenticeship expired he applied himself wholly to clock working, and used occasionally to assist in the same house in which I was then working as watch-jobber. He, too, when last I heard of him, had a business of his own, and was doing fairly well. So "No Trade" will see that it is possible for him, if he is prepared to practise patience and perseverance, and, above all, a little self-denial, in a pecuniary sense, to be that which he desires. If you have a friend in the trade, or, if not, can make one, and obtain the desired help or counsel, lose no time about it. Strike while the iron is hot, and take as your motto, "Nil Desperandum."—ALFOJOE.

[46358.]—**Galvanometer.**—The galvanometer referred to by "M.M.I.Sc.S." is a horizontal flat coil non-astatic galvanometer. It is wound with very fine wire to a resistance of about 1,200 or 1,300 ohms. It is used with the Wheatstone bridge, for which purpose it is well adapted, being very sensitive and portable. The dial is graduated with degrees. The maker is Elliot. The pivoting is jewelled, if I remember rightly.—HUMBLE BEE.

[46360.]—**Roofing.**—Port Dinormic slates, 14in. by 8in., or 16in. by 10in., hung on two galvanised malleable hammered nails. Nothing would look so well as slates. Cost per square of 100 yards about 190s.—J. M. CALLUM.

[46361.]—**Bicycle.**—The idea that "turning back the extremities of the fork," for say 2, or even 3in., would elasticise it, or that it would travel anything straighter is a baseless one. What strain would be eliminated? The saddle could be advanced one step to the rear, were the backbone itself not so curved.—J. J. A.

[46365.]—**Income-Tax.**—I think "J. W.'s," difficulty has arisen from the way in which he has made his return. The amount of his pension and appointment should have been set down separately and paid upon, while the deduction should have been made from the remainder. Had he done this, then, beyond the £40 pension he would have shown only £170, and taking the allowed £120 therefrom, there would have been £50 left, which, with the £40, would make the £90 on which he has paid. There is no doubt that lately the "screw" has been put on the income-tax, and officers finding out omissions have made the most of them. "J. W." should return carefully next year.—FRED. WETHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall.

[46368.]—**Clock.**—Try the back, having removed the three screws through the case near the front, and you will find it turn a little way in one direction. Having turned it as far as it will go, by a little manœuvring it will come out, bringing the works and face with it. The setting-stud will come off; the winder generally is pinned on tight. I was puzzled the same as you till I found out the bayonet-catch that keeps the back in place.—TREADLE.

[46369.]—**Vacuum Tubes and What Can be Done with a Coil.**—As, I think, I stated in my answer to "W. R. C.'s" original query, I shall be pleased to send a few articles on "What to Do with a Coil," including a description of vacuum tubes, and an account of the truths which may be gleaned from experiments with them. I have not done so yet, partly because of pressure of other work, partly because the offer having until now passed unnoticed, I concluded that the subject was hardly of sufficient general interest to warrant our editor in finding me space.—ALFRED W. SOWARD.

[The proffered series would be most welcome.—ED.]

UNANSWERED QUERIES

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, Ezra Miles has replied to 44998; Glatton, 45649; Jack of All Trades, 45711, 45849.

45672.	Balloon, p. 433.
45676.	Colar Gold Fields, 434.
45681.	Church Bell Hanging, 434.
45694.	Wood-Engraving Machinery, 434.
45696.	Ornamental Glass Work, 434.
45697.	The Cape and Natal, 434.
45702.	Yacht, 434.
45703.	Dynamo-Machine, 434.
45707.	Cut Crystals, 434.
45711.	Rotary Pill Machine, 434.
45724.	Gramme Dynamo Machine, 435.
45730.	To Silver Engravers, 435.
45732.	Japanese or Chinese Kettle, 435.
45733.	Whitening Zinc, 435.

45923.	Brazing Bicycle Forks in, p. 522.
45930.	Cupola Work, 530.
45956.	Magnetic Variation, 530.
45959.	Bourdon Pipes, 530.
45964.	Glass Transparencies, 530.
45965.	Musical Wire Gong, 530.
45974.	Jute and Cotton, 531.
45981.	Test for Oils, 531.
45987.	Siemens Dynamo Armature, 531.
45988.	Microscopical, 531.
45990.	Organ Pipes, 531.
45992.	Compensating Expansion Balances, 531.
45995.	Embossing and Gilding on Glass, 531.

QUERIES.

[46371.]—**Barlow Lens.**—Would some correspondent kindly inform me which lens in the achromatic combination Barlow lens is crown-glass; which flint, and which should be placed towards the object-glass of the telescope?—X. Y. Z.

[46372.]—**Classification of British Beetles.**—I shall be much obliged if anyone will inform me where I can find a good classification of the British Coleoptera? I have "Common British Beetles," by the Rev. J. G. Wood; but the classification in it is rather confused, though, in other respects, it is a most useful work.—A LADY ENTOMOLOGIST.

[46373.]—**L. & S.W.R. New Coupled 6ft. 6in. Bogie Engines.**—To "METEOR."—Can you inform me how many of the new coupled 6ft. 6in. bogie express locos., built by Peacock, there are on the L. & S.W.R.?—WYKEHAMIST.

[46374.]—**Gauging Water.**—Can any reader inform me of the mode of calculating the discharge of water through the rectangular-stepped notches used in brooks for gauging the variable flows? I have abundance of formulæ for the individual rectangular notch, but I fail to find any for the stepped notch.—G. A.

[46375.]—**Steam Trap.**—Can any reader inform me, from actual experience, of the best steam trap or siphon in use?—G. A.

[40376.]—**N.B.R. & L.B. & S.C.R. Engines.**—Will some correspondent give the distribution of the weight of the following engines?—North British Railway 6ft. 6in. bogie express, "Abbotsford" class, and 6ft. bogie tanks by Mr. Drummond. London, Brighton, and South-Coast Railway, "Grosvenor," and six-coupled tanks (Terriers). Also the wheel-base and distribution of weight of "Abbotsford" and "Grosvenor" tenders?—MOTION-PLATE.

[46377.]—**Electro-Motor for Tricycle.**—Will anyone kindly tell me if any electro-motor in conjunction with a secondary battery has been arranged for driving a tricycle? and, if so, what weight is thereby added to the machine, and what speed is attainable?—R. E. B.

[46378.]—**Bevel Wheels.**—I wish to drive a machine by treadle, with two bevel-wheels. What I should like to know is, which would run the lightest—a 6in. wheel into a 3in., or a 12in. into a 6in.? I wish to run the vertical shaft twice to the horizontal shaft once.—BEVEL-WHEEL.

[46379.]—**Gramme Dynamo Machines.**—Would "Sigma," or some other electrical authority, kindly help?—We have several of the above-named machines at work in our works for electric lighting. On several occasions they have become so hot as to char the covering on the wire of the revolving parts. Would too hard pressure of the brushes cause this? Should they only touch lightly on the revolving copper plates? The person in charge of them says, when they touch lightly, the fire flashes freely from them, and they become hot; but I incline to think the brushes are pressed too hard up to their work, and produce heat through excessive friction. Sometimes the machines are covered with copper dust. One got so hot, that the wood insulators on the spindle went on fire. Would imperfect insulation between the wire and the spindle cause this?—NORTH BRITON.

[46380.]—**Electric Human Skull.**—Will any of "ours" give me a drawing, with clear instructions, how to fix a set of teeth and eyes in a human skull, and how to work the same by electricity?—LES DENTS.

[46381.]—**Three-Legged Dead-beat Escapement.**—Will "Alfojoe," or some other kind correspondent, describe (with sketch) the three-legged dead-beat escapement?—PROGRESS.

[46382.]—**Flat Feet.**—To DR. EDMUNDS.—Can anything be done to improve flat feet in a child under four years of age? A few remarks, in Dr. Edmunds' lucid style, on the treatment generally—as far as the parents are concerned, of flat feet, bow legs, knock-knees, weak ankles, would, I think, be useful.—H.

[46383.]—**H.P. of Locomotives.**—Could not some of your correspondents give us particulars of the indicated h.p. and consumption for power of locomotives? Now that the subject is being taken up, information as to the performance of engines in actual service for goods and mineral traffic would be interesting to your readers.—CONOD.

[46384.]—**Balance Springs.**—Would some of "ours" kindly say the easiest and quickest way to coil or recoil balance-springs? and oblige—GUYOT.

[46385.]—**American Birch Stain.**—Will anyone tell me what cabinet-makers stain wood with to imitate American birch?—JOINER.

[46386.]—**Cold-Air Engine.**—To "SUNLIGHT."—Could you tell me whether I should be infringing on anyone's patent by making a cold-air engine, and if not, will you kindly help me as to what kind of machine will be best, and size that will be required to supply a cylinder of 3in. bore? And will you also oblige by giving me the advantages of hot air over cold air?—SUMMIT OF ENGLAND.

[46387.]—**Boiler.**—I want a boiler for engine of following dimensions:—Length of stroke 2¾in.; bore of cylinder, 1¼in. Could "Sunlight" or any reader give me size and form for burning coal?—SAM WELLER.

[46388.]—**Plaster Blocks.**—I want to make some plaster of Paris blocks, 5in. × 4in. × 6in. thick. Could any friend give me any information how to make the plaster set quick and very hard? I find that, after being dried in the foundry-stove, and then used in the sand, they get soft. If they are dried quick, they crack. Can there be anything done to prevent this?—LADLE.

[46389.]—**Finding Moon's Position.**—The plan which I explained appears to give the position of the moon with regard to the earth with as sufficient accuracy as I require: at any rate, it agrees with the two examples given by "F.R.A.S.," and with other observations made since. I have placed over a circular map of Northern Hemisphere, a piece of tracing-paper, with hours ruled from 1 to 24h. exactly, as on the map underneath. On Feb. 17th the moon is new at 14h. 49m.; now if the tracing-paper is turned until 14h. 49m. is on the meridian of Greenwich, the sun is 9h. 11m. west of this meridian. On the 17th the hour of the Transit of Aries is 2h. 10m.; and counting eastward from this point, a longitude equal to the sun's right ascension, which is 22h. 3m., it gives the sun's position 137 west longitude. Counting the longitude equal to the moon's right ascension, which is 21h. 59m. from the same point (Transit of Aries), 2h. 10m., it gives the position of the moon in the same longitude. Finding the declination of each luminary, the sun is 11° 54s., the moon, 6° 59′. For the longitude of the moon is equal to its right ascension, and its latitude to its declination. When the moon is in conjunction, she is over the centre of New Guinea. On the 18th the moon is on the equator at 21h.; right ascension, 23h. 10m.; transit of the First Point of Aries, 2h. 6m., which would give her position when on equator, about 65° east longitude. This method is simple enough, if it may be considered accurate, but am quite open to correction on the point. What I wished to know with regard to solar eclipses was, the average length of time occupied from the beginning to end of eclipse. Thus the eclipse on May 16th begins generally at 16h. 52m., and ends at 22h. 20m. Will "F.R.A.S." kindly tell me the longest and shortest time an eclipse can take. I ought to have said, I suppose "penumbra" and not "disc" in my last question. With regard to the lines showing the extension of eclipse on the diagrams in *N. A.*, I should have thought they could have been explained, so as to give some idea on what principle they are drawn, without mathematics. My object is certainly not to make calculations, but to understand why they take the shape they do.—W. L. O.

[46390.]—**Turning Cotton Calender Rollers.**—The rollers of calender are 5ft. long, and 2ft. 6in. dia.; and as I run a deal of heavy cloth from 36in. to 45in. wide, the rollers wear down in the middle where the cloth is run. I want to know the best way to turn, or rather scrape, the ends of rollers down (in their places, of course) to make them comparatively true and smooth; great accuracy is not required. What kind of tools should be used? What speed should the calender be run at while scraping? And should the rollers be kept slightly wet or dry during the operation?—G. H.

[46391.]—**Anæsthetics.**—Can anyone inform me how ethydene-bichloride is made? At present it costs about 6s. 6d. an ounce; and considering its great value as a safe and efficient anæsthetic not interfering with the action of the heart, it is a great pity that it is not cheaper, so as to be universal.—SURGEON.

[46392.]—**Froth.**—How is it that when a mixture of soap and water is agitated, a froth is formed on the surface? Is it due to absorption of air, or to chemical reaction? Also, how does calcium carbonate, and other mineral salts found in spring-water, hinder this froth from being formed?—SOAP.

[46393.]—**Soap.**—What would be the action of potash, or any other alkali, upon a solution of soap—stearate of soda, for instance? Also, has soap, or its solution in water, any action on lead, and if so, what?—SOAP.

[46394.]—**Timing French or Other Pendulums.**—I find in Britten's book, pp. 159: "Timing French Pendulums. — Escape-wheels of French pendulus [what is "pendulus"?] make two revolutions a minute, or four vibrations to each tooth. They may be quickly brought to time by counting if the beats of pendulum per minute equals four times the number of teeth in escape-wheel." The first part of this I don't understand—viz., "French pendulus make two revolutions a minute, or four vibrations to one tooth." I am trying to "time" a French timepiece. I find 32 teeth in escape-wheel; therefore, according to latter part of above rule, I say 32

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128 = motions of pendulum per minute.

But I find the French pendulum in question moves about 160 times to one minute of regulator, and yet this French timepiece seems to keep time. Will someone who understands pendulums and numbers, answer without fractions or back numbers?—GUYOT.

[46395.]—**G.W.R. Engines.**—Can any correspondent give dimensions, or, if possible, sketch, of one of the G.W.R. (late B.E.R.) four-coupled bogie saddle-tank locos., 2042 class?—STENTOR.

[46396.]—**To "Aldebaran."**—I have been informed that in a terrestrial telescope there are more lenses than in an astronomical one. If this telescope were used for astronomy, would the extra lenses lessen power and definition of instrument? If so, what lenses should I have to remove to remedy this deficiency?—WYKEHAMIST.

[46397.]—**Slide-valve.**—To "SUNLIGHT."—Would you kindly inform me in what way the double slide-valves seen on beam-engines work, so as to cut off steam at various fractions of the stroke, as required by engineers? A sketch would greatly oblige—WYKEHAMIST.

[46398.]—**L. & N.W.R. Engines.**—Would any reader of the "E. M." kindly supply me with the names and classes of the following engines?—955, 221, 513, 488, 846, and also where they are stationed.—T. R. H.

[46399.]—**Small Quantity Battery.**—To MR. LANCASTER.—Will you kindly inform me whether I can have a small battery (without liquid) that will fuse fine wire? I have made a chloride of silver one, but that will not do it. I know that a small bichromate would do this; but I want one without the necessity of withdrawing the zinc when not in use, and that would stand being turned upside down, and be permanent for, say, a few days. Size, about 4in. square, or less.—CARBON.

[46400.] — **Winter's Plate Electrical Machine.**—1. Having succeeded in making a stout 15in. circular plate of glass, with a 6-8in. hole in the centre, I should much like to construct a Winter's plate machine; but never having seen one, only a diagram in a small catalogue, though I have made cylinder machines and a small 8in. plate (ordinary), and know how to insulate the parts—make the woodwork, make framework, what I want to know is, how to make the ring for condenser, and the best material to make it of, and size? The rubbers, how to make, and what of, for the best—for a Winter's plate machine? Also, how to make a diamond spotted jar? I have made lots of ordinary Leyden jars; I have also succeeded in making small coils. 2. Also, I thank the Editor for diagrams, and inserting Mr. Andrew's coil, p. 15, last No.; and thank Mr. Andrews for his explicit manner. Please, why is the coil divided into three parts for the secondary current? Is it better so than wound from end to end without divisions, and why? Would Mr. Andrews give us a diagram of a good winder, as 1lb. of 36 wire would be about one mile long, and would require some winding?—MUDDLED INQUIRER.

[46401.]—**Arago's "Popular Astronomy."**—In the translation of this work, published in 1858, by Prof. Grant and Admiral Smyth, there appear three star-maps. In these, the following stars are assigned the magnitudes appended:—Gemini: β, δ, ϵ, θ, μ, ν, 2. Perseus: ϵ, γ, 2. Draco: γ, β, 3. Cassiopeia: ζ, 2. Ophiuchus: α, 1. Cygnus: α, 1; γ, ϵ, 3; η, 4. Ursa Minor: β, 3. Pegasus; γ, 2. Auriga, ι, 4. Taurus, ζ, 4. Can anyone tell me the authorities? Mistakes there are in the maps. Castor and Pollux are reversed; the same stars have different magnitudes in different maps, &c. Also, whence came the constellation, "Duo Asini"?—S. M. B. G.

[46402.]—**Cement.**—Is there any cement which will stand the heat of boiling tea? I ask, because I wish to repair certain very old and very fine china cups and saucers, which have been broken, and which (as favourites) we are loth to turn into mere ornaments.—HOUSEKEEPER.

[46403.]—**Cottage-Building.**—Will some reader give me some hints as to building a cottage of five rooms, all on a ground-floor? Brick, and faced up with yellow bricks; rooms about 14ft. square, 10ft. high; rubble-fronted, with bay windows in front. The probable quantity of materials and cost? Have plenty of spare time on hand; could do most of the woodwork myself, and general superintendence.—EMPLOYMENT.

[46404.]—**Medical Battery.**—Will any kind reader tell me how to construct a medical battery in the cheapest form?—IRON MOULDER.

[46405.]—**Stains on Dry-Plate Negatives.**—Will Mr. Lancaster, or some other reader, tell me how I am to remove yellow stains from dry-plate negatives? I use the pyro developer. Also, how can I bring some negatives back to their original printing quality? They were intensified with mercury, and have gone quite yellow all over.—J. L.

[46406.]—**Rainband Spectroscope.**—Can Mr. J. R. Capron, or any other reader, give description of the spectroscope used for detecting rainbands?—R. B.

[46407.]—**Tricycle.**—To J. A. JEFFREY.—In "ours" of the 23rd July, 1880, I notice an illustration of a tricycle, designed by Mr J. A. Jeffrey (letter 17507). As I am desirous of purchasing one of the kind, I shall feel exceedingly obliged if the maker will communicate with me, and give further details, or a catalogue of tricycles which have been manufactured of the best and latest approved descriptions. I have seen several tricycles, such as "Flying Scud," &c.; but I approve the one illustrated in your journal of the above date.—JEHANGIR HORUMSJIE, 31, Cawasjee Patell-street, Fort Bombay, Feb. 16th, 1882.

[46408.]—**Copper Salts.**—In "Workshop Receipts" I read: "Zinc, as soon as immersed in a solution of sulphate of copper, decomposes the salt, and is covered with a muddy precipitate of copper. It is neccessary to give the zinc a thick coating of copper in the bath of double salts before submitting it to the action of the sulphate of copper." Will someone be good enough to inform me, in plain terms, how this "bath of double salts" is to be made and used? I have read over all that I could find in "Workshop Receipts," and in several works of chemistry bearing on this subject; but it is my misfortune rather than my fault that I am quite at a loss to know how to perform this apparently easy operation.—D'EVLYN.

[46409.]—**Sulphuric Acid.**—Will "Analyst," Barker Cooke, "Chemistiana," or some other kind brother-reader please inform me how to obtain the percentage of $H_2 SO_4$ in ordinary sulphuric acid from the sp. gr., without having to resort to a sulphuric-acid table? Some time ago a fellow-workman told me that Dr. Ure used a factor which, when multiplied by the sp. gr. gave the percentage of $H_2 SO_4$ direct.—CHAMBERMAN.

[46410.]—**Velocity of Discharge from Pipe.**—Would anyone tell me what would be the velocity and discharge of a 2in. and a 3in. pipe respectively, of a mile in length, with a fall of 500′?—E.

[46411.]—**Bad Eyelids.**—To DR. EDMUNDS.—I am very much troubled with pustules or pimples upon the eyeballs (as described on p. 512, Vol. XXXIV.), and every time they come, they leave little scars. I have now suffered with them for more than nine years (since I was 14 years of age); vision is damaged of both eyes, especially the right one. I have tried several medical men in the neighbourhood, and have used a great quantity of lotions and ointment—but to very little purpose. Last summer my eye was seriously affected with one of the pimples on the edge of the pupil, which left a scar, similar to the description given in answer to "Ten Years Reader," query 19706. The colour of the white of my eyes is not what it used to be; it is darker, especially the corners—it might be with using the lotion. Sometimes they are bloodshot, and feel stiff or dry when reading or doing anything with artificial light. I am now using an ointment, called the "Poor Man's Friend," which was recommended to me by a lady, by applying a little on the eyes when closed every night. I may also state that I enjoy general good health.—J. W., North Wales.

[46412.]—**Pendulum Spring.**—Will "Nicholls" tell me how to get old spring out of pendulum collet? Also, how to cut off inner end to admit pendulum collet? Also, how to tell the proper strength and size, and to get true in the flat after it is pinned in the collet?—PIVOTER.

[46413.]—**Bamboo Whistle.**—Could anyone advise how I should set out the sound-holes for a large whistle of bamboo, similar in design to the tin whistles sold at the toyshop, and about the size and pitch of a full-size flute (Lower F, I think, is the name of the pitch)? I want the dimensions of the holes, and distances apart from centres of each; also the diameter and bore of tube.—HARMONICUS.

[46414.]—**Electric Engine.**—To MR. LANCASTER.—I have long been anxious to make one to drive a tricycle which I see you propose doing. I shall be glad of any particulars you can give me to make such a motor. Can you, or any other reader, give me information as to carbonic acid gas engines? I mean an engine to work by carbonic acid gas, with a generator instead of a steam-boiler.—E. A., Liverpool.

[46415.]—**North London Railway.**—Can any reader oblige me with a sketch of one of the bogie-tank engines, inside cylinders? and also of one of the outside cylinder engines of the N.L.R., with details of dimensions, &c.? What is their power?—E. E. R. TRATMAN.

[46416.]—**Precipitating Alcoholic Solutions.**—Will some contributor of "ours" tell me how to precipitate the resinoids, &c., from their alcoholic solutions? I made a tincture, 3oz. of bark powdered to the pint S.V.R., put 1oz. of this into a winebottle, and added one pint water; it has thrown down a precipitate, but will not clear itself.—ONE IN A FIX.

[46417.]—**Instantaneous Photography.**—What are the theoretical laws that rule the successful taking (by photography) of an object in motion? I presume that the shutter of the lens must open and close in a time during which the subject in motion to be photographed has not appreciably moved. Now I have read of an express train in motion being photographed as if it was still. Reckoning its speed at 50 miles an hour, this gives the train a speed of 73ft. per second. It is obvious that even a 10th of a second's exposure would produce a blurr, and if only 1-73rd second's exposure was given, would not the movement of the train through the foot of space be sufficient to make the impression indistinct? This is the point of my query: can any shutter worked by mechanical appliances by means of the hands, be opened and closed in so short a period as even 1-50th of a second? To me it seems impossible; and I altogether doubt the statement that exposures of not more than 1-500th of a second have been taken.—IN THE DARK.

[46418.]—**Photography.**—Will some kind reader please give me a detailed account of 1. The kind of gelatine to use for making up a solution with bichromate of potash for producing a sensitive film on a sheet of zinc for the purpose of printing on under a negative after the style of collotypy or Woodbury type? 2. The quantities of bichromate potash and gelatine, and mode of preparation, and evenly covering the plate with the mixture? 3. The best plan to follow, after having exposed the plate under a negative, to obtain a suitable picture to print from in ink after the manner of ordinary printing? 4. Is it necessary to work this in the dark, as I am—IN WANT OF LIGHT.

[46419.]—**Telescope.**—To "ALDEBARAN."—I have a 2¼in. Ross; it is a marine glass. How am I to make it into an astronomical one? Cost £8 when new, and so ought to be a good one.—WYKEHAMIST.

[46420.]—**Cupola.**—Will "Sunlight," or some other reader kindly send sketch of a cupola furnace for melting 4 or 5cwt. of iron, with list of tools and appliances necessary for working a small foundry?—A CONSTANT SUBSCRIBER.

[46421.]—**Boat-Building.**—I wish to build an iron boat suitable for sea-coasting that one or two could manage. Will any reader please give size for plates and ribs, and could I build it in streaks or plates, or is there any good book on iron boat-building? If so, what price, and where could I obtain it? Please give directions for cutting out plates, and so forth; am a smith by trade.—BLACK VIC.

[46422.]—**Organ.**—To MR. DRESSER.—Encouraged as I have been by your most explicit articles in the "E. M." on "The Organ and How to Make It," from time to time, I have got well on with a small two-stop organ—viz., CC to G, 56 pipes of S.D. and Wald Flute, Ten. C to G, 44 pipes. The twelve bass pipes of S.D. I have placed on a separate soundboard at the back, to save space laterally. Will you be so kind as to favour me with a descriptive sketch of a simple octave coupler to be used in connection with the treble part of S.D. and Wald Flute—viz., Ten. C to G, 44 pipes? The 12 S.D. pipes I do not wish to couple to treble, but to use them as bass to others. I have also room on my treble soundboard for a Piccolo to Ten. C. I may add that my action is as per your instructions, the fan frame.—JARVIS BRASSFACE.

[46423.]—**Gravity Clocks.**—To "CLERKENWELL CLOCKMAKER."—Is it necessary to harden and temper the barrel-arbor of these clocks?—J. R. H.

[46424.]—**Circular Saw.**—Lately, when cutting wood by means of a 6in. circular saw, I found that the wood was cut to a curve, although the guide was accurately placed, and the wood carefully fed up to the saw. On removing saw from spindle, and placing straight-edge across the face of saw, I found it was not flat as it should be, but convex or concave, depending on which side the straight-edge was placed. Will some person practically acquainted with circular saws and the treatment proper for them in such cases as the one described, kindly advise me what to do to make my saw flat again, and keep it so? Perhaps "Jack of All Trades" will help—CIRCULAR SAW.

[46425.]—**Gelatine Emulsion.**—Can any of "ours" inform me how long the above will keep in stoppered bottles after it has been washed, and best way of washing same, and if it will keep best without being washed?—DARK SLIDE.

[46426.]—**Blackleading Scorched Iron.**—I have a steel and black fender, and the bottom plate will not take blacklead. It brushes off and looks smeary. Can you inform me what I can do it to make it take the blacklead? I wrote to the house I had it from, and they said it was what they termed a "scorched plate." The distance is too great to return it, so if anyone could inform me, I should be obliged.—HOUSEKEEPER.

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FRIDAY, MARCH 24, 1882.

PHOTOMETRIC STANDARDS AND IMPROVEMENTS IN GAS ILLUMINATION.

THE statements made with regard to the photometric value of many of the electric lights now seeking public favour have undoubtedly done much to stimulate an inquiry into the subject of photometry, a branch of science which has long been in anything but a satisfactory state. So long as the lights to be measured kept within the moderate bounds of twenty, or even fifty candles, little difficulty was experienced in arriving at an approximately accurate estimate of the power of any given lamp; but with the advent of the electric light, and so many systems competing for recognition and support, it becomes almost of the first importance to be able to gauge, with some approach to accuracy, the merits of the rivals, purely from the point of view of illuminating power. Incandescent lamps are stated to be of 15, 20, or even 50 candle-power, and there should not be any very great difficulty in ascertaining how far the statements may be trusted; but when we come to use lights of 2,000 candle-power, and especially one said to be of 150,000 candle-power, now exhibiting at the Crystal Palace, the suspicion arises that the "power" has been assigned in a haphazard fashion, and represents rather what the sponsors consider it ought to be, than what it really is. It is tolerably obvious that the Bunsen, and similar photometers, are practically useless when we have to measure the illuminating power of a light said to be equal to 2,000 candles, and it is not by any means a reflection on the veracity of those who claim 150,000 candles for a certainly wonderfully brilliant arc light, if we venture to say that, for aught we or they know, the light in question may be either 100,000 candles or 200,000, for the simple reason that at present we are without any trustworthy means of measuring lights of such power. The method proposed by Dr. Paget Higgs of estimating the candle power of the arc by the heat radiated, or of taking it as the second power of the work in the circuit, may give an approximately accurate result, but at present there is no evidence to show that it is anything more than arbitrary basis, as far from the real truth as a supposition adopted for the purpose of showing the working out of a theory. As a matter of fact, it is not at all certain that the methods usually adopted for measuring lights so comparatively feeble as a twenty-candle gas-burner are capable of giving more than an approximately accurate result, so that the magnitude of the difficulty can be readily appreciated when we have an arc light nominally of 2,000 candle-power to deal with. Profs Ayrton and Perry have sought to meet the difficulty by comparing the electric light with that of the standard sperm candle after the former has passed through a concave lens, so arranged that the diverging ray has been reduced in intensity to the equivalent of, or to something comparable with the candle. The two shadows are examined through ruby-red, and subsequently through "signal-green" glass, the latter being most favourable to the electric light, but they hesitate to take the mean as the relative illuminating power of the arc compared with the candle. Probably their method is as useful, and gives results as correct, as any other that has been proposed; but in view of the fact that it is not easy to determine with accuracy at all times the illuminating power of a light nominally of, say, 30 candles, it will be understood that when an arc-light is said to be of 2,000 candle power, the statement can be accepted only with a certain amount of reservation. In a paper read before the Society of Arts by Mr. Harold B. Dixon, the Secretary of the Board of Trade Committee appointed to report upon three proposed photometric standards, the author showed that a number of standard sperm candles by different makers gave different results when employed in testing coal-gas which the committee had every reason to believe was perfectly permanent, so far as its illuminating power was concerned. The gas was stored specially for the use of the committee by Mr. G. Livesey, at the South Metropolitan Gas-works, and packets of candles were tried against others by the same maker, as well as against candles from other firms. As evidence of the uselessness of candles as standards, it will be sufficient to mention that while one pair gave the gas an illuminating power of 16, another pair made it 18·5, and this difference, be it noted, on the same day. On another day, the power, as given by two pairs of candles, was 17·1 and 19·5. Similar differences were found by taking the average result given by ten candles from different packets. With one lot the average illuminating power of the gas was estimated as 15, with another at 17·2. Personal equation may have some slight effect in reading off the illuminating power; but the real cause of the difference would appear to have been disclosed by the comparison of some of the candles themselves in a test of twenty minutes, readings being taken every minute. In this trial differences of more than 18 per cent. were found, and within two minutes a variation of more than 12 per cent. It will be remembered that ultimately the committee reported in favour of Mr. A. V. Harcourt's air-gas flame as a photometric standard, because a series of experiments showed that concordant results were always obtained with it. The hydrocarbon used is obtained from purified petroleum, and has a specific gravity approximating to that of pure pentane, but it invariably contains some tetrane and hexane. A series of observations made every minute upon two air-gas flames showed that in no case did they vary more than ·1, while the mean shows a difference of ·01 only. It appears, then, that a standard light of a really trustworthy character is available for measuring the illuminating power of lamps of comparatively small candle-power, and it remains to be seen in what way it can be utilised to measure the powerful arc lamps now so familiar. It will be remembered that besides the powerful compound gas-burners recently made by Bray, Sugg, and not least by Wigham, an important innovation has been introduced in the shape of the regenerative gas-burners devised by Dr. C. W. Siemens in this country, and also by his brother Herr F. Siemens, of Dresden (vide pp. 532,555, Vol. XXXII., and p. 372, Vol. XXXIII.). In these burners not only is the air-supply heated, but so also is the gas, and from the statements of Mr. A. V. Harcourt, in a paper read recently before the Society of Arts, we learn that with a lamp of Herr F. Siemens' pattern the extraordinary light of 5·8 candles per cubic foot of gas has been obtained. That result was found by Mr Keates using a smaller burner than the usual size, and of a different form, but with ordinary specimens of the regenerative burner Mr. Keates obtains 5½ candles per cubic foot of gas. What that means will be understood when it is stated that a London argand—the standard testing burner—gives only 3·2 candles per cubic foot of 16 candle-gas, while common No. 3 union-jet gives only 1·3 candle per cubic foot per hour. Mr. Harcourt's experiments with the Siemens regenerative burner did not yield results so high as those obtained by Mr. Keates, owing, it appears, to the lamp being one specially made for a different quality of gas; but as compared with a 100-candle argand of Sugg's make, which gave 3·64 candles per cubic foot, the Siemens gave 4·8 candles, so that there is obviously a very high economy due to the regenerative principle, which amply covers the extra cost of the lamps. The application of the regenerative principle, as it is called, is not altogether novel, for it appears that so long ago as 1843 Faraday used a burner in which the products of combustion were drawn down between an inner and an outer glass chimney; and later, Dr. Frankland used a somewhat similar device with the avowed purpose of improving the light. Whether the Siemens regenerative burners will come into use for street-lighting purposes remains to be seen—probably they will be voted too complicated; but as coal-gas, for its complete combustion, requires about five times its own volume of air, and its illuminating power depends on the heat of the flame, it is obvious that an advantage in light-giving power must be obtained by heating the air supply as hot as possible; and if that can be done in a simple manner, great economy can be effected in gas-lighting. With gas-lamps of a known power of, say, 100 candles—some existing lamps are of 180 candles—we have a possible standard by which to compare the electric arc, and those who have seen the two lights will have little difficulty in deciding which arrangement would most effectually illuminate a large room or a hall—20 Siemens' 100-candle regenerative gas-lamps, or one so-called 2000-candle arc light; but in that case, the gas-lamps, by being distributed, would have an unfair advantage, for an arc light, no matter of what power, can be distributed only by the aid of reflectors. Therein lies the vantage of gas as compared with electricity; and as the incandescent systems can at present scarcely compete with the improved gas-lights on the score of cost (though on this point a different opinion is expressed by Mr. Swan, whose remarks will be found on p. 29, last number), it would seem that the latter are likely to run the "new light" a very close race; still, as the possibilities of improvement are greatly in favour of the electric light, it will in all probability beat its rival in a tolerably near future.

REVIEWS.

Elementary Lessons in Electricity and Magnetism. By SILVANUS P. THOMPSON, B.A., D.Sc. London: Macmillan and Co.

THIS work appears most opportunely at a time when many persons are asking for information on electrical subjects, and though it is obviously intended for students, the general public will be able to turn to its pages with the certainty of obtaining trustworthy information. The author says that his work is but the introduction to a very widely-extended science, and refers the student who desires more information to the works of Faraday, Mascart, Maxwell, Thomson, and Wiedemann; but, although these are "elementary lessons," we may fairly consider that the reader or student who makes himself familiar with all that is to be found within the covers of this book will understand a great deal more of the real nature of electricity than many of those who have learned the subject as taught at some of the schools. The theory put forward in these pages, as would be expected by those who know something of the author's work, is that electricity, whatever its real nature may be, is one, not two; that it is not matter, nor is it energy; but it resembles both in one respect—it can neither be created nor destroyed. The doctrine of the conservation of electricity, like that of the conservation of energy, teaches that we can alter the distribution of electricity, by causing more to appear at one place and less at another; but we can neither destroy nor create it, although we may appear to do so, when we turn a plate-machine, or immerse plates of different metals in certain liquids. Frictional and current electricity and magnetism are so intimately connected one with another, that it is next to impossible to obtain an accurate knowledge of one branch without knowing something of the two others; so Professor Thompson has devoted the first three chapters to a simple exposition of the prominent facts as seen in experiments, reserving a consideration of the points of connection until in later chapters he introduces so much of theory as is consistent with the character of the book. The reader who takes up the work with a determination to understand it, will find that he requires only the merest smattering of algebra and geometry, while the numerous illustrations will materially assist him in comprehending the text. The unit terms employed throughout are the volt, ohm, and weber, but an appendix mentions the changes proposed at the Congress held in Paris. A number of problems and exercises on each chapter are printed at the end, and complete the work as a textbook for schools and science classes.

The Watchmaker's Handbook. By CLAUDIUS SAUNIER. Translated, revised, and considerably augmented by JULIEN TRIPPLIN and EDWARD RIGG, M.A. London: J. Tripplin; New York: Keller and Co.

THIS handbook is a combination of two works by M. Saunier, translated and edited by M. Tripplin, a watchmaker of Besançon, and Mr. E. Rigg, of the Royal Mint, a gentleman who is an acknowledged authority on the subject in this country. M. Saunier's works are recognised and extensively used in the technical schools of the Continent, and a glance through the pages of the English translation, or rather edition, will suffice to show that it is a work admirably adapted to the wants of "improvers" and amateurs, and especially so in the case of those who are entering for the technological examinations. It is, in fact, a complete manual of practical watchmaking, and contains besides many hints which will be found useful by mechanics in many branches of the different trades. The work is divided into six parts, which treat respectively of arithmetic, geometry, and measurement; of the materials employed in the art, their preparation, treatment, and application; of the health of the workers, and their habits in the shop; of tools and appliances; of repairing and examining watches; and, as a conclusion, about 100 pages are devoted to practical receipts and workshop hints, many of which will be found of considerable value not only by tyros, but also, we suspect, by numbers of watchmakers scattered over the country. It is, in fact, no undeserved praise of this book to say that it ought to form part of the stock-in-trade of every watchmaker, no matter how skilful he may be; for if he can improve on its teaching, there are students willing to learn, and space for his remarks. The illustrations are mainly in the shape of plates, containing about 200 separate figures, and are placed at the end of the volume; but scattered through the text are a number of woodblocks of special interest. The editors have done their work excellently, and have not lost sight of what is too often considered a mere minor matter; for, besides providing a table of contents and an index, they have inserted cross references in a very thorough manner, so that the workman will experience little, if any, difficulty in referring to any point on which he may require information. We need not say that is a very important consideration in a "handbook," and this book is, we have no hesitation in saying, a real vade-mecum for the watchmaker and jobber. It should be distinctly understood that it is essentially a practical manual, and is the companion volume or complement of Saunier's "Treatise on Modern Horology."

Useful Information on Electric Lighting. By KILLINGWORTH HEDGES. London: E. and F. N. Spon.

INFORMATION about electric lighting is now sought by so many of the public that, although this is the third edition of Mr. Hedges' manual, we can appropriately devote a few lines to it, especially as it has been revised and enlarged. Many persons who happen to be acquainted with the expenses of installing the electric light, will scarcely go with Mr. Hedges in asserting that "it surpasses by far in economy and beauty all other known illuminants," especially as in another part of his book he thus speaks of undoubtedly the most beautiful system:—"If lighting by incandescence becomes the practical success its advocates believe it will, it is still doubtful whether it will ever be sufficiently economical to warrant its superseding gas in all cases." Here we have obviously a difference of opinion; but there are many hints in Mr. Hedges' book which intending users of the electric light will do well to read before investing in plant. By the way, why does he head some of his pages "Division of the Electric Light," and puzzle his readers with division of the current and division of the light? In that and some other points the book requires another revision; but nevertheless it is a useful guide to those who understand nothing about the subject and have no time to acquire a knowledge of even the rudiments. In a section of "cautions" Mr. Hedges says that if alternating currents be used, or a machine of very high electromotive force, as in the Brush system, it is dangerous to touch any part of the gear at all when in action, especially if standing on metal or on the damp ground. If that is the case, how are the attendants to know when any bearings become hot? An explanation of terms is given at the end of the book, and there we find that electromotive force means the *force* which develops electric tension or potential. There are some other statements of the same vague, not to say incorrect, character.

We have also received *The Watch and Clockmaker's Handbook*, by F. J. BRITTEN (Kent and Co.), a useful work containing much information for the trade, and a number of illustrations, many of them referring to "novelties," so far as the average jobber is concerned. A table of differences of time between Greenwich and other places would be useful if it were trustworthy; but according to this book Ramsgate is 5m. 55s. slow compared with Greenwich, while Margate is 5m. 55s. fast; further, Portsmouth and Plymouth, are both put down as 16m. 16s. slow, and yet this is the "fourth edition."——*The Miners' Manual*, by L. A. ATHERLEY-JONES, B.A. (Cassells), is a legal handybook for miners, whether employers or employed, and is dedicated to the Durham Miners' Association. It is a summary of the laws relating to mines, employers and employed, conspiracy, trade-unions, and royalties, and as it is provided with a good index, will be a real miner's "manual" of the law as it affects his calling.——*Geometrical Exercises for Beginners*, by SAMUEL CONSTABLE (Macmillan and Co.), is a little book which will be helpful to students who are unable to obtain at all times the assistance of a tutor.——*Treatise on the Combined Circular, Spiral, Multi-Index Slide-Rule*, by THOS. DIXON (the Author, Buttershaw, near Bradford, Yorks), is a revised edition of a little book that is found useful by mechanics in all branches, and by all engaged in making calculations. It contains a number of examples and copious tables for use with an instrument which is equivalent to Gunter's scale nearly 50ft. long.——*The Philosophy of Advertising*, by HENRY SELL (the Author, Bolt-court, E.C.), is a work that contains many useful hints to advertisers, and an extended list of the various media for their announcements.——*A Treatise on the Theory of Determinants*, by THOS. MUIR, M.A. (Macmillan), is a full exposition of the theory in a form suitable for students, and is probably the only book which deals separately with the branch of mathematics known as determinants, in a compact and handy form.——*Slide-Valve Gears*, by HUGO BILGRAM (Philadelphia: Claxton, Remsen, and Haffelfinger) is a book we noticed when it first appeared; but Mr. Bilgram sends us another copy, as he thinks that questions will arise as to the relative value of his system as compared with those of Zeuner and Reuleaux. Mr. Bilgram offers to reply to any inquiries relating to his method, and as his book is published at one dollar, those interested in slide-valves and their setting will no doubt add it to their libraries. We gave an article from Mr. Bilgram's pen on p. 537, No. 881, which will give a general idea of his method.——*The Tricyclist's Vade-Mecum* (Chas. Cordingley, Hammersmith), is one of those publications which describe the various machines in the market much in the same way as they are described by their makers. As a guide to the choice of a machine it is simply a puzzle, and the generally good advice tendered as to diet, &c., is rendered ludicrous by the statement that oatmeal water is the best of all thirst-quenchers, and has the advantage of supplying *silica* to the bones.

We have also to acknowledge *Railways and Locomotives*, by J. W. BARRY, M.I.C.E., and F. J. BRAMWELL, M.I.C.E. (Longmans); *Handbook of the Polariscope*, adapted from the German of H. Landolt, by D. C. ROBB and V. H. VELEY (Macmillans); and *Vibratory Motion and Sound*, by J. D. EVERETT, M.A. (Longmans).

ON THE IRRATIONALITY OF THE SPECTRUM IN ITS RELATION TO THE ACHROMATISM OF OPTICAL INSTRUMENTS.—VII.

By "ORDERIC VITAL."

(*Concluded from page 584, Vol. XXXIV.*)

BREWSTER gives the approximate position of the mean ray, in the spectra of five different media, the first having the most action on green light, and the fifth the least.

1. With sulphuric acid, the mean ray is about the middle of the green space.
2. With hydrochloric acid, the mean ray is about half-way between the middle of the green, and the junction of the green and blue.
3. With crown glass, it is at the junction of the green and blue.
4. With flint glass, it is slightly advanced on the blue space.
5. With oil of cassia, it is considerably advanced on the blue space.

I now pass on to consider what conclusions may be drawn from the preceding investigations, respecting the properties of glass which is suitable for optical purposes.

And, in the first place, it is obvious that if the secondary spectrum can be eliminated, it must be accomplished by altering the composition of crown glass For a reference to the diagram of spectra will show, that there is a greater discrepancy in the position of the colour, lines for crown glass than for flint glass, and if it is possible by any means to produce a crown glass, which has less action on the green and red portion, the secondary colour can be practically neutralised.

But if this cannot be accomplished, the minimum of chromatic aberration must be obtained, by properly combining the two species of glass. For it will be evident from the diagram, that there is considerable difference in the amount of dispersed colour, produced by crown and flint prisms. It was shown that the greater the difference in dispersive power, the greater is the amount of outstanding colour; so that the first general rule is:—

1. In forming an achromatic combination, crown and flint glass should be used, which have the least possible difference in their dispersive powers.

Thus it would seem that in Fraunhofer's list—crown glass, No. M, and flint glass No. 3, whose dispersive powers are as 8 : 11; and in Chance's list, soft crown and light flint, whose dispersive powers are as 14 : 19, form the most suitable media for combination.

Hence, when two lenses are achromatised (taking δ as the value of the quotient obtained by dividing the crown focal length by that of the flint) such qualities of glass should be used as will permit the value of δ to be about 0·7, or preferably greater; but certainly not very much less.

2. The first rule involves another one—viz., this—if the difference in dispersive power is a minimum, evidently we must have a flint of low dispersion and a crown of high dispersion.

But flint glass of a low dispersive power has a low specific gravity, and, I believe, it has been found easier to manufacture large homogeneous discs of such glass, than of the denser qualities. Hence it would seem advantageous, both theoretically and practically, to use light flint glass in an achromatic lens.

In support of this argument, Brewster quotes the example of the optician Tully, who deservedly obtained a high reputation for the excellent qualities of his object-glasses. His flint lenses varied in specific gravity from 3·192 to 3·466.[*]

There is another matter which is worthy of consideration—viz., the adjustment of the four curves in an achromatic lens.

Two conditions, though not absolutely essential, should, if possible, be fulfilled:—

(α) Chromatic correction is best obtained when the interior surfaces are in contact.

(β) For ease and simplicity of workmanship it is desirable that the crown lens should be equi-convex.

Two other conditions are absolutely essential:

(γ) The curves must satisfy certain given focal lengths.

(δ) They must be so arranged as to destroy the spherical aberration.

The two latter conditions can always be satisfied; generally (α) can be combined with them, but all the four bring the problem into very limited compass.

If we have a crown and flint combination, differing much in dispersive power, a short-focus crown lens, having deep curves, must be used with a long-focus flint, having shallow curves, and conditions α, γ, and δ require the object-glass to be of the Herschel form—a double convex, flatter curve in front, with a concavo-convex flint lens.

It would seem that this form is better adapted for correcting the secondary spectrum, than a double convex with deeper curve in front, united to a double concave. For by reducing the convexity of the anterior surface, we contract the red and green part, and oppose the secondary by a tertiary spectrum; but as the great difference in dispersive power giver more colour uncombined, there is, perhaps, very little difference to be discerned in the action of the two distinct constructions.

But by reducing the dispersion of the flint, the crown-curves approach to equality, and the second lens may be made double concave. When the focus of the crown is to that of the flint as 3 : 4, or the value of δ is 0·75, the front lens may be equi-convex, and the two interior curves may be made equal and opposite.

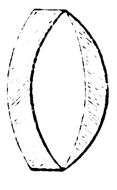
In adjusting the forms of two lenses, to destroy spherical error, the correction should be made with such curves as give the least possible aberration for each lens (due regard being paid to the other conditions); a slight discrepancy between the theoretical and practical curves will then introduce no appreciable error. Now, although this principle cannot be rigidly adhered to in computing the curves of an object-glass, it is always advisable to have as little error as possible for the flint lens to correct. The best form of convex lens has the deeper curve outside; but this is not applicable, since it would cause the inner curves to be very unequal. An equi-convex lens, though causing rather more spherical error, is much better suited for satisfying the condition of interior coincidence.

The alteration in the inclination of the crown prism in Exps. 66, 67, and 68, would seem to indicate that it is possible to neutralise, or even over-correct, the secondary colour, by using a reversed meniscus crown lens, combined with a concavo-convex or bi-convex flint lens. Probably achromatism might be secured by making the first lens plano-convex; but there still remains the question of correction of spherical error; and I think this could hardly be accomplished in such a combination.

It is the common practice to place the crown lens in front of the flint; but, in some kinds of object-glasses, it might prove an advantage to place a convexo-concave of flint in front of a bi-convex or perhaps meniscus crown lens. Such a combination would most likely answer best for camera-lenses or for opera-glass objectives, for the rays on the front lens should be converging rather than parallel.

With regard to an achromatic combination, consisting of two lenses of the same species of glass, Brewster gives a diagram similar to Fig. 9: a convexo-concave lens is placed in front of a reversed meniscus lens. Although each has one concave surface, that of the first is much the deeper, making it a lens of negative focus; while the second one has its focus positive. I doubt whether such a combination could be used as an object-glass, for it does not seem possible to correct the spherical error, which must be considerable; and the wide interior space, arising from the curves being both concave, is another great objection. Brewster does not give any rules for finding the proper ratio of curves; and, indeed, it scarcely seems likely that they can be deduced otherwise than by experiment.

FIG. 9



At this point I must, for the present at least, conclude this series of articles. It has been my endeavour to give a somewhat detailed account of Brewster's researches on the dispersion of light, and I have added such remarks as my own studies have enabled me to make. This applies especially to the first portion devoted to the explanation of various kinds of spectra. Possibly errors may have crept in here and there, and if any such should meet the eye of the reader, I trust he will make a note of them. Brewster's theories may not be accepted by all: even Dr. Wollaston could not agree with the conclusions regarding the alterations in the spectrum by varying the refracting prismatic angle. But I think it is pretty evident that theory and practice agree as to the formation of the tertiary spectrum, which conclusively demonstrates that such an alteration does take place. Perhaps the fact that two lenses of the same glass may be achromatic may lead to some useful result—with eye-lenses and micro-objectives, if not with telescope object-glasses.

Among the readers of this journal there are, I know, many interested in practical optics; to all such as have not access to Brewster's book I trust the foregoing summary of his investigations may prove of some service.

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[*] Probably the lighter quality was the most used, if we may judge from the table of his curves given by Brewster in the "Edinburgh Encyclopædia," and published in the Correspondence column of this journal.

STEAM AND THE STEAM-ENGINE.—CURVES OF EFFICIENCY.

On p. 197, last volume, we gave a short account of the views of Prof. R. H. Thurston on the ratio of expansion at maximum efficiency, in which he showed that the actual working engine, in all that affects that ratio, is vastly different to the hypothetical or theoretical engine. Prof. Thurston has determined what is the best ratio of expansion experimentally for several standard types of American engines, and in a paper recently read before the New York Academy of Sciences, he has described a method of charting curves of efficiency which will be found worthy of notice by the student of steam-engines. In spite of all that has been said and written on the subject, the question of the steam-jacket cannot be said to be settled, for every now and then we get some figures obtained during a trial of this or that engine, which, as put and utilised for the purposes of argument, appear to show that the steam-jacket is of little if any practical utility. But it is clear that if the jacket fails in its work that is not because the theory is incorrect, but because the conditions—perhaps of construction—are such as to negative any advantage gained by heating the cylinder with steam. Prof. Thurston, who has examined the subject in a thorough manner, concludes that the necessity of following the direction of improvement indicated more than a century ago, viz., the protection of the working fluid from losses of heat by surrounding it with non-conducting surfaces, constitute the most imperative of all demands to-day made upon the mechanical engineer engaged in designing steam-engines. Herein it will be seen that the principle which the steam-jacket is supposed to represent is clearly enunciated, but all that is asserted is just what James Watt stated years ago, that it is essential to keep the cylinder hot to prevent loss of heat from the steam. Prof. Thurston has shown that first friction and then cylinder condensation, due to expansion of a heated fluid in a cylinder constructed of material of high-conducting power modify the methods of expansion and of expenditure of heat so much that the ratio of expansion for maximum efficiency in unjacketed cylinders rarely exceeds $\frac{1}{2}\sqrt{P}$; P being the gauge-pressure. The modifying conditions differently affect various kinds of engines and also individual engines according to pressure and piston speed. It is obvious that in no case can the curve of mean pressures be such as would be obtained in a non-conducting cylinder, for steam must be more or less condensed at the beginning, and must always carry away heat by being re-vaporised at the end of the stroke. The steam-jacket checks the first operation, but accelerates the latter, and with wet steam may possibly do very little indeed to decrease the evil it is designed to prevent. That is especially the case with long-stroke slow-speed engines, as will be readily understood. Thus, to take the actual words of Prof. Thurston:—Consider a steam cylinder unjacketed and worked at some extremely low speed of piston. At the instant before the steam enters either end, that end is exposed to the chilling action of vapors forming on its warm surfaces at the pressure of the exhaust, while the opposite end is just releasing a charge of steam which has been expanded down to some pressure considerably below that of prime steam; the expansion of which charge and the re-evaporation of moisture present, chills the surface of the cylinder on that side of the piston also. Now, the steam entering from the boiler meets the cooled metal surfaces of piston and cylinder head and condenses upon them until they attain boiler temperature, or until the closure of the steam valve checks this operation, and the charge then expands as the piston moves forward with its very slow motion, uncovering, gradually, surfaces which had been cooled by the exhaust on the other side of the piston. The expanding steam, meeting these cold surfaces, surrenders a part of its heat until they are brought fully up to the temperature of the steam, by flow of heat into the interior of the metal, after which time they, in turn, give up heat again to the steam, producing re-evaporation of the water present and giving a pressure exceeding that which would be due the same volume of expanding dry steam. The total effect is evidently determined by the varying temperature of the cylinder walls, the temperature of exhaust and the dryness of the steam supplied. As the piston moves forward, all parts of the cylinder hotter than the mean temperature of exposed surfaces, and all the water present, surrender heat which causes the production of steam and a tendency to increase the normal pressure. The colder surfaces constantly uncovered by the piston absorb heat, produce condensation of steam and tend to reduce pressure below the normal. As the one or the other of these effects predominates, the expansion line rises above or falls below that obtained by adiabatic expansion. These effects are sometimes modified and rendered less observable by the occurrence of leakage—usually and principally through the steam valves—but where, as is frequently the case, the actual expansion line first falls below and then rises above the adiabatic or hyperbolic curve it may be probably safely assumed that leakage does not occur to any important extent.

In the paper, Prof. Thurston goes on to show how by Zeuner's formula the engineer can construct curves of efficiency with a satisfactory degree of accuracy, and the diagrams of curves constructed by him are given in the *Journal* of the Franklin Institute for February; but we have not space to give them, and must content ourselves with reproducing his conclusions. Prof. Thurston also promises another paper on the subject, in which working figures will be given, and we may hope that he will publish his results in book form. He finds: (1) That the work done in a non-conducting cylinder, the fluid expanding adiabatically, varies so little with the proportion of water present that this variation may be neglected by the engineer, and he may assume the performance of work to be such as would come of nearly hyperbolic expansion, while the heat expended may be exactly calculated from the quantity of work, when the latter is known. (2) That, in metal cylinders, the work done at any given point of cut-off is nearly the same as in the non-conducting cylinder, but that the quantity of heat and of steam expended in doing it are increased, and usually very greatly increased, by cylinder-condensation if saturated or wet steam is used, or by other methods of transfer of heat to the exhaust and by consequent waste, if superheated steam or other gaseous working fluid is employed. (3) That the ratio of expansion at maximum efficiency would be practically unchanged by ordinary variations in the proportion of water entrained with the steam, if it were worked in a non-conducting cylinder. (4) That the ratio of expansion at maximum efficiency, when steam or other fluid expands in a metallic cylinder, is more seriously affected by the introduction of water entrained by the steam, and this difference is increased, and usually is made very serious, by the occurrence of cylinder-condensation, or other method of transfer of heat to the exhaust, when a metal cylinder is used. (5) That the quantity of fluid used per stroke in the non-conducting cylinder is in direct and exact proportion with the volume of the cylinder open to the supply-pipe at the instant of closing the expansion-valves, and is measured by $1 / r$, the reciprocal of the ratio of expansion. (6) That the volume of boiler-steam worked per stroke in the metal cylinder is *not* in direct proportion to volume of cylinder open to steam at the point of cut-off, but that it is often very greatly in excess of the latter quantity, and that it becomes greater as the ratio of expansion is increased indefinitely. (7) That the ratio of expansion is not a gauge of the volume of steam demanded from the boiler, and paid for by the proprietor of the apparatus when the metal cylinder is employed; but that the volume of steam used or quantity of heat demanded must very greatly exceed the proportion $1 / r$ in nearly all actual engines. (8) The curve of variation of efficiency above traced, of which the abscissæ measure varying quantities of steam used in a given steam-cylinder, while the ordinates are proportional to the quantities of work done by those amounts of steam, is a curve of entirely different character and form, and often widely different in location, from the curve of adiabatic mean pressures or other curve of mean pressures exhibiting the work done by various quantities of steam expending under given fixed conditions in a non-conducting vessel. (9) That no predetermination of the efficiency of any proposed engine, whether of fluid, of machine, or of capital, can be made unless the true curve of efficiency can be obtained for the assumed case. (10) That the most certain and the most satisfactory solution of any problem of efficiency will be that obtained by first securing the elements of the curve of efficiency from actual engines operated in the manner proposed for the case taken. (11) That, having obtained by experiment upon any engine, the "curve of efficiency," as defined by the writer, the efficiency of fluid, of engine and of capital expended to do a given amount of work, and the quantity of work to be obtained most cheaply from a given engine, may all be obtained for any given set of conditions, and the ratio of expansion, at maximum efficiency, of fluid, of engine and of capital and the ratio of expansion which, with a given plant, gives most work for a dollar of expense of operation, may all be determined with a degree of exactness only limited by the magnitude of the errors of observation.

THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURAL, AND LODGMENT.*

By John Watson Warman,

Associate of the College of Organists, London.

(*Continued from p.* 607, *Vol. XXXIV.*)

x. INSTANCES of all three of these forms of Regulating Tail are to be met with. The *Button* model is constantly used by *Hill* in cases where the presence of a Detached Buffet, or some other reason, renders it inconvenient to apply the coupler to the *Action* connected with the Keys: his fine Organ in All Saints', Margaret-street, London, may be cited; the precise Treatment is that of the Sloped-Block. Of the Button Regulator with the Under-Sinking instead of the Block, no Example is at present known to the writer: it is his own design, and was called into existence solely or chiefly to accompany his Contracted-Level (2in.) Keys—for which see more fully at 92, *q*—, as used with 4-Manual Instruments. The *Split-Key* Regulator is or was constantly employed by various Builders; *H. Jones*' Instrument in the Wesleyan Chapel, Canterbury, may be mentioned. The *Spring* Form is much less common; a specimen, however, occurs in the Rebuild, by *Gern*, of the Organ in St. James', Addison-road, North, London.

y. *Selection* demands a rather more extended notice:—

The *Button* form is a really good one, and is by no means costly. It is, of course, essential that the proper relative *levels* of the Button and the Block-face (see *u*, ante) be observed in the first adjustment of the parts, and retained—approximately—at all subsequent times. For an additional advantage of the Button Form of Regulator, see what is said directly on as to the *Split-Key* Form. As regards the relative values of the Block and the Under-sunk *Varieties*, it is to be observed that the latter is the simpler, and that it also avoids the possibility of detachment at a glue-joint, eases the working of the Screw-eye, allows such Screw to be shorter, keeps the Keys lighter, and creates more room for the mechanism between the Manuals. This last point, however, is of no advantage (but rather the reverse) except in cases where either the Coupler [between Manuals] is of some *Sticker* form, or the vertical distance apart of such Manuals is *very* contracted. And as all such Sticker forms between Keys are inferior to the Drumstick (see Coupling-Actions), and very contracted Manual Levels are of comparatively rare requirement (see proper Head, at 92, *n*), it becomes obvious that the Block Variety is of the palpably greater utility. On the whole, we may safely lay down that the Under-Sunk treatment should be employed *only* when the Manual Levels are *less* than 2½ inches apart, the Key-tails, at the same time, being *not* Forked; but that the *Block* variety of the Button Form is to be regarded as the *regular* treatment for all ordinarily designed Organs of medium quality in which the Nose of the Action Backfall, Lever, or Square lies in or directly on the Key-tails.

The *Split-Key* form is the cheapest and simplest of the three, and if properly made and adjusted will answer quite satisfactorily, especially if the Key-body be made of some springy kind of wood (see at 87, *x*). But it is imperative that the Tongue be never forced too far from its natural straight position; for if it be, it will very possibly refuse to return tight against the screw on any after slackening of the latter, and so a chattering then result. There exists another disadvantage of the Split-Key treatment which it is well to mention here, and this is that it compels the Cutting for the Off-Clearing (see *u*, ante) to be made in the *Lowermost* of the two Keys (see *v*, ante). It is quite true that this last is considered an actually good point by some Builders, because it permits the Drumsticks to be so *Stoppered up* that they will not drop into said Clearing on the pushing off of the Coupler, and so the Lower Keys can rise without touching the Drumsticks, and all chance of their then causing a rattling of the latter be prevented. But the writer does not agree with this view, for when the weight of the Drumstick is taken off the Key-tail the "balance" of the entire Key (only *slightly* heavier forward, see *h*, next) is obviously interfered with, and the Key rendered more liable to "dance": it is likewise quite true that such Stoppering of the Drumsticks also does away with the *friction* of their contacts in travelling up the Slope; but such friction, though of course better avoided, is never, with the Drumstick Coupler, ficient to be of practical importance. The Cuttings, being made in the Lowermost Manual also gives the advantage of slightly lightening the *longer* and consequently the *heavier* Key; but the amount of decrease is too trifling to be palpable. Cetainly, therefore, the Off-Clearing's having to be in the Lower Manual remains as an objection to the Split-Key Regulator,—because the Drumsticks ought to be allowed to descend into such Clearing, and this may not always be quite convenient in the construction, and will, at any rate, involve the slight friction of the travelling up the Slope. [It is for the foregoing reasons that it is the Upper Key which is directed to receive the Clearing with the *Button* form of Regulator,—see *u*, ante.] On the whole, we may confidently say that the Split-Key Regulator may be freely employed with the *low-priced* Organ, and with all, of whatever quality, where the Key-tail has a Sticker or a Tracker running from it. But the Split-Key form must obviously be never used when such Key-tail is also Forked.

The *Spring* form will have had its *general* value defined by what has been given for the Split-Key. To this, however, it is necessary to add that the Spring allows of a larger extent or variation of Adjustment than does either of the remaining forms; but that, on the other hand, the cost of the Springs is a palpable item. We may therefore lay down that the Spring Regulator should be preferred only in cases where *one* of the two Manuals which it is the object to Couple [together] is liable to *vary* in its Touch-depth, and the *other* of such two is *not* liable to so vary. A suitable Instance of this might be presented in an Organ which possesses a Coupler between its Solo and Swell Manuals, the said Solo having an *Electric* Key-action, and the Swell a *Long Mechanical* one. A similar case might be afforded where the Actions of both of two Unitable Manuals are Mechanical, but one of them Short in length and the other Long. (See on these points in *Pro-Department* Entire Organ.)

[It is to be borne in mind that the foregoing assessments apply solely to the so stated Forms of Regulating Tail as compared with *each other*, and do not at all affect the question of the abstract desirability of such Coupler Regulation as compared with the performing of it at some point along the *Action* itself. Such abstract comparison is obviously simply that of the relative merits of two broad Types of Coupling-Action, and cannot, therefore, be fully gone into except in the *Department* of latter. In the mean time, however, the reader may be again referred to what is said under *S.-S.-Div.* of Design Precise (at Sub. *s*, next), where it will be seen that a Coupler between Manuals possesses some very important advantages, especially as respects the presence of a Detached Buffet, and the provision of a Clear Coupler Great to Pedale.]

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yy. *Tail-Slot.*—This is the small Mortise or Slot required to be cut through the *Key-Tail* whenever the Sticker leading from another Manual is made to pass through such Tail. The Mortise should always be as wide in the direction of right-to-left as is possible without unduly weakening the Key in which it is made,—the object of such wideness being the prevention of the Sticker foot's ever slipping off the Key-Tail on which it is to rest. In the other direction the Mortise may, of course, be extended as much as desired,—within reasonable limits; and if the Sticker be a Sliding one (see *Depart.* of COUPLING-ACTIONS) such extension —either backwards or forwards—, to a considerable and corresponding distance, becomes an obvious necessity. The Mortise or Slot must always be accurately and cleanly cut, and should, by rights, be slightly larger at its bottom than at its top. See here further at *w*, next.

Instances of the Tail-Slot occur in the Leominster Organ (see at *x*, next), and in that of St. James, London (see *y*, next). It will be noted that in the first of these the treatment was almost compulsory.

As regards *Adoption*, the writer would never recommend or employ the passing of the Sticker through the Key-tail unless under quite exceptional circumstances,—such as those just indicated; and, when so rendered inevitable, care should be taken to avoid the fetter—which fetter will be seen existent in the St. James' Instrument—of the retention of the *foot-wire*. Under even the most favourable Treatment, the Tail-Slot always involves a chance of undue friction, and consequent unbidden sounding; and, in addition, there is the risk of derangement through the Key's warping.

See further in *Department* KEY-ACTION.

yyy. *Tile.*—This will be found given in connection with the Head of *Mortise* and *Boring* (comm. *h*, ante).

z. *Wedge.*—This is the distinctive term applied to the Sloped *Block* or (as the alternative) the *Cutting* which is required to be attached to or made in the Key in all cases where an Action which comes into and out of Contact by a Sliding motion is in connection with such Key. The uses of this Wedge are (1) the securing of the necessary Off-Clearing for the actuator to pass into when the Coupler is not in use, and (2) the provision of a proper [sliding] surface for the Drumstick-head or the Sticker-head to travel smoothly into contact by. The Wedge, both of the Block and the Cutting Forms will therefore have necessarily been (at *u*, ante) described, in connection with the Regulating Tail. A more common employment of the Wedge is or was afforded in its application beneath the Key-tail for the contact of the Sliding-Head Sticker form of Coupler Manuale to Pedale: no additional information will, however, be required in connection with this particular Treatment. As regards the actual *Angle* adopted, it may be considered that such should not be more steep than 40 deg.; and that it needs never ordinarily be less steep than 30 deg. The first named will do very well for all Couplers Manuale to Pedale; the last named will be preferable for all Couplers Manuale to Manuale,—on account of the then larger number of Contacts involving greater Friction. In special cases, an Angle as low as 35 deg. may be used for a Coupler Man. to Ped., and 25 deg. for one of Man. to Man. Under all circumstances, where the Action is that of a Sticker (this will include all Man. to *Ped.* Couplers) the entire Stope and Crown of the Block or of the Cutting must be "Buffed," that is, clothed with a suitable soft substance to prevent noise (see here at 87, *y*); but in all cases where the Action is placed between the Keys no Buffing needs be applied to the latter, for the Head of the *Drumstick*—which has already been stated as the *best* Coupler for such location—can itself more simply and properly receive such Clothing. (See here further at *mm*, next.)

[89, a.] The *Material* of the Wedge (assuming it to be a distinct Block) will be preferably either Pine, Lime, or soft Mahogany.

aa. *Instances* of the Wedge in connection with Couplers Manuale to Pedale were at one time quite common, though they are less so at present. The Canterbury chapel Organ already cited (at *x*, ante), had both of its Man. to Ped. Couplers made with the Wedge and Sliding Sticker-Head. This Instrument also possessed two other Couplers—*Super Oct. to Great*, and *Pedal Pipes to Keys*—constructed in the same way. All these four Coupling-Actions were correctly designed, and worked quite satisfactorily.

aaa. As respects the *Adoption* of the Wedge, its abstract merits are of course involved in the question of the relative values of the Sliding and the Dropping methods of Coupler Contact: such appraisement must therefore be left to the *Department* COUPLING-ACTIONS,—with a third glance at *s*, next, and 90, *r* as a preparation therefor. A comparison between the *Block* and the *Cutting* varieties has already been made (at *y*, ante).

FITTING AND AFFIXURE OF KEY FRAMES.

b. First see that which is given under Head of POSIT,—at 92, *l* and on; and 93, *a* and on.

Having decided upon the actual placing of the Manual or Manuals turn to *Depart.* BUILDING-FRAME, where (at 43, *f*; and 44, *v*) a general indication of the best Treatments in Fitting will be found.

The Key-Frame of the Lowermost Manual will be fitted in its position by means of Wooden *Dowels*, and these will be preferably fixed into the proper parts of the *Building-Frame* or the *Key-Bench*, and *not* into the *Key-Cheeks*. When the Manual is fitted in *between* the Bui.-Frame *Middle-Rails* (see 43, *g*) there should be a Dowel projecting from the inner face of each such Rail; and the outer face of each Key-Cheek of such Manual must then receive a short horizontal Slot or Sinking, terminating at the extreme [tail] end of the Cheek, and corresponding with the Dowel. Two other Dowels will be fixed vertically in the Building-Frame or the Key-Bench; they will be set so as to be as near to Front-end of Manual as is practicable, and will enter the bottom edge of each Cheek of latter. A couple of *Screws* may be added, if desired.

The Key-Frame of the Second Manual will be fitted to the Lowest one *solely* by Four Dowels like the last, fixed, two in each Cheek, into the *upper* edges of the Lowest Key-Frame. The Third Manual, if present, will be fitted in the same way to the Second Manual: and if there be yet a Fourth Manual it will be so fitted to the Third.

Where the Vertical distance from the Keys of any Manual to those of one next to it is less than 3in. (see 92, *n* & on) it will usually be advisable to so cut away to a given point all the plain portion of the upper edge of the Cheeks of the Lower Manual as to leave the Finishes (see 86, *t*) of the latter standing *higher* than such edge. The Cheeks of the Higher Manual will thus have their bottom edges set at a *lower* level than the upper line of such Lower Finishes, and the front bottom corners of the Higher Key-Cheeks will lie just behind these Finishes.

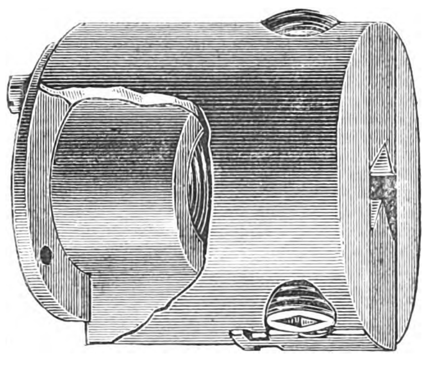
bb. An *Instance* of this last Treatment occurs in the Leominster Organ already mentioned, and sufficiently described at *x*, next.

(*To be continued.*)

IMPROVED DRILL-CHUCK.*

THE accompanying engraving represents an improved form of lathe chuck, made by Chas. H. Reid, Danbury, Conn. This chuck is very simple in the arrangement of its parts (which are few in number), and holds either flat or round drills, small material for turning, &c., as in making screws from long stock, or may be used for any of the purposes for which a small chuck is desirable; and especially where a strong grip is necessary. As will be seen, it consists essentially of a cast-iron body into which are fitted two steel jaws. One of these jaws has a V-shaped groove on its face, while the other is fashioned to a V-shaped projection corresponding with this groove. These are moved by the operation of a single screw turned by the means of a socket wrench. The angle of the groove in the jaw, as above referred to, is such that in combination with the different pitch of the ends of the screw which operate the two jaws, they are opened and closed at such respective velocities as to provide for any piece from the smallest to the largest which the chuck will take, being held exactly central.

Instead of threading the chuck to fit the lathe (as is commonly done) it is provided with a taper bush which is accurately fitted into a corresponding recess in the back of the chuck, this bush being threaded to the lathe spindle. It will be observed that this bush projects into the body of the chuck by which a long bearing surface is provided for keeping the two true, the one with the other; but what is of more importance still, by this means the overhang of the chuck beyond the end of the lathe spindle is not increased. An important object gained by the use of this bush is the practicability of using one chuck on several lathes in which the spindle screws are of different diameters or pitch; all that is necessary being to shift the bushes, of which as many as required may be provided at a trifling expense. In this way, if advisable, one chuck may be used on a half dozen different lathes, drill presses, &c. The jaws are made deep to provide a long clamping surface, and are arranged with a view to hold equally well the entire length of this surface.



ELECTRIC RAILWAYS.

A LECTURE on the utilisation of electricity for working railways was recently delivered before the Birmingham and Midland Institute, by Prof. Ayrton, F.R.S., who, in conjunction with Prof. Perry, has been making a special study of the subject. Engineers, said Prof. Ayrton, had been turning their attention to the consideration whether electricity might not supplant steam or compressed air for trains and for tramcars. The question was mainly one of expense, and what they had to consider was whether electric transmission of power would lead to greater economy than was possible to be obtained with an ordinary locomotive. The weight of a railway carriage filled with people was about seven tons, while the weight of a locomotive engine varied from twenty to sixty tons. Therefore the average weight of every engine might be taken as being equal to six carriages full of people. Ten carriages usually formed a train; therefore, the presence of the locomotive necessitated the expenditure of at least fifty per cent. more power than would be necessary merely to pull the train along. A still more serious objection to the use of the locomotive was that every bridge must be made many times stronger than would be necessary to carry railway carriages; and the repairs were many times as expensive. Compressed air had enabled the railway companies very successfully to apply brake-power to every wheel of a train; but it was to electricity that they must look to drive the train, by power applied to every pair of wheels. The electrical energy, however, must be produced either from the burning of coal, from the energy of the mountain stream, the forced stored up in chemicals, or the energy of the wind. At the present time it was the first of these—namely, the potential energy of coal, which was applied to railway propulsion; and it was that form which would still be employed even when they had electric railways, as it was found that the driving of a dynamo-electric machine by a stationary steam-engine would produce electricity more economically than it could be produced by the burning of zinc in a galvanic battery. By means of a small gas-engine, driving a Gramme machine, the lecturer showed how power was produced, which could be transmitted by wires, and made to work a lathe, a drill, or other apparatus at a distant point, and he explained that this method of producing electricity was the more economical by the fact that a pound of zinc only contained about one-seventh of the energy contained in a pound of coal, while the former was about twenty-five times as expensive. In employing electricity to drive a drill, flexible wires could be used to convey the current; but to drive a carriage along a railway, the simplest plan was to use the rails as the two wires, the one rail acting as the going wire, and the other as the returning wire—the electricity being taken into the electro-motor by the wheels on one side and sent back by the wheels on the other. The rails, however, must be insulated from one another, or the electricity would pass from the one to the other instead of going through the motor. It had been found hitherto impossible to insulate a long line of rails sufficiently to prevent excessive waste from leakage, and his colleague, Professor Perry, and himself had spent considerable time in devising methods to overcome this difficulty without adopting the method, which, however, had been successfully used for tramway purposes, or taking a supply of electricity with the conveyance by means of a Faure's accumulator. Instead of supplying electricity to a very long and badly-insulated rail, their plan was to place by the side of the line a well-insulated cable, by means of which the electricity was supplied to a comparatively small section of the railway over which the train was at the time running. As the train left one section and passed on to the next, a brush attached to it came in contact with a mechanical contrivance which transferred the electric current to the next section, and so on throughout the number of sections of which the line might be composed. Dr. Siemens had shown practically that an electric railway would answer over short distances, and the lecturer submitted that by making up the line of short lengths, each of which was automatically rendered electrical in its turn, the difficulty arising from leakage over an extended line was overcome. He showed the working of the system by means of a model circular railway about 10ft. in diameter, divided into four sections; and he pointed out that its arrangement afforded means by which an apparatus in a signal-box would show over what section a train was moving. Means could also be provided by which a train upon one section would effectually block the section behind it, so as to prevent all risk of collision by a following train.

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* From the *American Machinist.*

WHALES.

ON the 3rd of November, 1827, an enormous whale was observed floating on the surface between Belgium and England. It was captured and brought to shore near Ostend, where it awakened lively interest. The skeleton of this animal—which was 85ft. long—was mounted and exhibited in many of the capitals of Europe, London included. It was afterwards taken to the United States, and European *savants* appear to have lost sight of it. Some ten years ago, however, the fact transpired that this once famous whale had turned up at in Kazan in Russia, was there bought by some magnate, and presented to the Imperial Academy of Sciences of St. Petersburg. It is now lodged in a corner of the Zoological Gardens in that metropolis, under a shed which affords but scanty protection from the elements. The ground is littered with bones that have fallen from it, and can be taken away by any who may desire some souvenir of their visit.

Such is the account of M. Van Beneden, the well-known Belgian naturalist, who has made the history of this whale, and the observations to which it gave occasion, the basis of an interesting lecture on the progress of cetology, lately delivered at a public séance of the Belgian Academy. We propose to give here an account of what he states regarding the zoological position of this animal.

The Ostend whale is a Balænoptera, this being the genus which comprises the so-called Rorquals or Piked whales. Here let it be said that the Family of Balænidæ or Toothless whales, comprises the genera Balæna, to which the Greenland or "Right" whale belongs, Balænoptera, Megaptera (the hump-backed whales), and Physalus, the Finner whales proper. What, then, is the exact position of the animal in question?

In 1827, when it was captured, and later, when its skeleton was shown throughout Europe, the most eminent naturalists were unable to determine this point. While the whale was in Paris, Cuvier had a plaster cast taken of the cavity of the cranium, and this, recently found by Gervais, contains no indication on the subject. Cuvier supposed that there was one species proper to the Mediterranean, and the differences of size observed in skeletons from the North Sea, were to him the result of mere differences of age. He really had not sufficient data for a precise opinion.

Now that skeletons of most of these animals are known, it can be affirmed that there are four distinct species (of Balænoptera), quite different in size, character, and mode of life, and that these species are no less known to whalers than to naturalists.

The first is the small Balænoptera, skeletons of which are to be found in most of our museums. It is the Balænoptera rostrata of Fabricius. It does not exceed 30ft., and one could not confound it with any other animal. It has yellow fins, and the vertebræ do not exceed 48.

The second species is much more rare; only a few skeletons have been obtained, one of which is in Berlin, another in Brussels. It has the name of Balænoptera laticeps, or, better, Borealis (the name given by Lesson before Gray), attains 30ft. to 40ft., and has more than 48 vertebræ.

The third species is the most common: it is the Balænoptera musculus. This is the animal which Cuvier believed peculiar to the Mediterranean. It does, in fact, sometimes penetrate into this sea, and is the only species the ancients knew. It attains some 60ft., and its fins are always striated.

The Ostend skeleton belongs to the fourth species, which attains 80ft., and the fin of which, dark and shiny, cannot be mistaken for those of other species. It is generally known as the Balænoptera Sibbaldii; M. Van Beneden considers it should be called the Balænoptera d'Ostende (as the much earlier name). In Greenland it is called the Tunnolik, in Iceland the Steypieydre.

The skeleton of Ostend was long the only one of its species; but this is no longer the case. There are others in London, Hull, Edinburgh, Gottenborg, Stockholm, and a couple, male and female, will shortly be possessed by Paris, obtained by Professor Pouchet last year in the Varanger Fjord, at Vadsö, where they are fished during the summer months.

Considering the observations recorded of their passage in Baffin's Bay, in the waters of Iceland, and of the Loffoden Islands, and their periodical appearance in the North of Norway, it may be said that this species is an animal of the North Atlantic. As for the individuals that have been captured on the coasts of Belgium, England, Scotland, or Sweden, they are probably vagabonds, repudiated perhaps by their kind, or sick and wounded individuals that have left their usual haunts.

Are these animals, which live on the Greenland Coasts, and pass from Baffin's Bay to the entrance of the White Sea, confined to the Atlantic?

Captain Scammon, who may be called the Scoresby of the Pacific, has carefully studied the marine animals of that Ocean; he has occupied himself with Balænæ, Megapteræ, and Balanopteræ, and one cannot but be struck on comparing the species he describes with those known in the Atlantic. There is in the Pacific a small Balænoptera not attaining 30ft., and another which exceeds 80ft., and the special characters of the skeletons and the fins recall so completely two of our species that one cannot refuse to recognise affinity.

Between the large and the small, there is another of middle size, Balænoptera velifera, which also recalls our intermediate species. We cannot doubt that the large Balænoptera sulphurea or "sulphur bottom" of the Americans, corresponds to our Ostend animal, and the Balænoptera Davidsonii to our small Rostrata. The intermediate species Balænoptera velifera appears to be our Balænoptera musculus.

Prof. Turner relates that an experienced whaler had said to him when he was dissecting a large Balænoptera, that he had often seen this animal in the Northern Seas, and that it was called silver bottom on account of the silvery appearance of part of its body. The word "silver bottom" seems to have become in the sailor's mouth "sulphur bottom." This same opinion is, moreover, expressed by Prof. Cope, of Philadelphia. The sulphur bottom is the largest species (he says), and it is the same animal that haunts the North of the Pacific and the North of the Atlantic. It is found on the coasts of California from May to September.

If we consider that it is the same free whale that haunts both the Sea of Ochotsk, Baffin's Bay, and the waters of Spitzbergen, the same species of Megaptera, of Cachalot, of Meluga, of Grindewal, and many other Cetaceans, we need not be surprised to find also the same Balænoptera.

The same forms are reproduced in the waters of our Antipodes. The British Museum received not long ago, a skeleton from New Zealand, quite similar to our small Balænoptera, and by the side of these lives a species which attains 80ft., and whose fins, vertebræ, and ribs correspond, both in number and form, to those of our large species.

A like observation may be made with regard to the South Atlantic. A son of M. Van Beneden, in a recent visit to Brazil, found in the species called Balænoptera bonnaesis, all the distinctive features of our Rostrata.

The *exposé* given by M. Van Benedon, in this lecture, proves clearly that our knowledge of cetaceans has undergone large extension within the last fifty years, though from the nature of the case great difficulties are encountered. We conclude with an anecdote in the lecture, which illustrates this, and also the activity and energy of Holböll, a governor of Greenland, now dead. One day Eschricht wrote to him, asking for the brain of a whale, as this organ in cetaceans was not well known. The letter was hardly gone when Eschricht bethought himself: "My friend Holböll will think me crazed, to ask such a thing. Even if he were an anatomist, how would he take it?" And he regretted not being able to send another letter retracting the foolish request. (There was only one courier to Greenland, leaving in spring.) What was the astonishment of the Copenhagen Professor to receive, by return of the courier, a cask of spirits, in which he found a complete brain of a hump-backed whale of ordinary size, perfectly preserved in its bony case.

DOMESTIC ELECTRIC LIGHTING.

A LECTURE on electric incandescent lamps suitable for domestic lighting was delivered in the concert-room of the Crystal Palace last week by Professor Silvanus P. Thompson, of the University College, Bristol. So far back as 1841 the attempt had been made to construct little electric lamps by enclosing in glass bulbs thin wires of platinum or thin strips of carbon, which on the passage of an electric current grew white hot. This method of procuring light from electric currents was revived in 1878 by Mr. Edison, who at first attempted to construct platinum lamps, which, however, in spite of many ingenious contrivances to protect them from over-heating, could not be kept from fusing up. Eventually Edison settled upon a filament of carbon, but not before a similar suggestion had been made by Mr. Swan, of Newcastle. Edison prepared his filaments from bamboo fibre, Swan from cotton thread. In each case the carbonised fibre was fixed in a small pear-shaped globe, and exhausted as perfectly as possible of air by a mercurial air-pump. A filament of carbon thus treated became as elastic as steel. Similar lamps had been constructed by Lane-Fox and by Maxim, with slight differences of detail in the manufacture These little lamps gave a light of about equal brightness to one bright gas-jet. They were destined to work a revolution in domestic lighting, since, when supplied by currents from a central station, they would not only be cheaper than gas, but would be far more readily managed and kept in order. There was no unhealthy smoke or products of combustion produced, very little heat, no smell, and no risk of explosion. The incandescent lamps lent themselves with extraordinary facility to the purpose of decoration, and would doubtless rapidly become the fashionable mode of lighting. The experience of the Savoy Theatre showed that it was practicable to apply them to a large building. The public safety demanded that no time be lost in making electric lighting imperative in all public buildings. It ought also to be made compulsory to use electric lamps in coal mines. In a few days the experiment would be tried of lighting the Holborn-viaduct and surrounding houses by Edison's lamps from a central station. This would be but a small sample of the method in which domestic electric lighting could be carried out on a large scale. The lecturer predicted for this method of lighting results far more important and wide-reaching than those which any other kind of electric lighting could possibly attain.

ELEMENTARY LESSONS IN DRY PLATE PHOTOGRAPHY.—III.*

The Dark Room.

OUR young friends will understand that the plates which they are about to work with are of the most "exalted sensitiveness;" that is to say, a very small amount of light allowed to act on them will produce a change which may be made visible. We must explain, however, that it is only certain rays of light which have the power of making the change which we mention. All our readers who have a little knowledge of physical science, know that white light is in reality a combination of light of all the beautiful colours which we see in the rainbow, and that if we pass a ray of white light through a prism, it will be broken up into all these colours. The order of them is—violet, indigo, blue, green, yellow, orange, and red. Those at the beginning of the list are called rays of high refrangibility, those at the end, rays of low refrangibility. Now, it is a curious fact that the photographic change which is worked in a sensitive plate is worked entirely by the rays of high refrangibility, principally by the violet and the blue, which are said to be "actinic"; whilst the red, which is said to be "non-actinic," has no effect at all. Were it not for this peculiar fact, photography would be almost impossible, because we could find no light in which we could manipulate our plates without their being affected and consequently destroyed. As it is, however, we only require to secure some place illuminated by those rays which do not have any photographic action, and we can work quite freely. In other words, we want a room lighted with only red light in which to work. Photographers give such an apartment the name of "dark-room," although the term is a misnomer.

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* Condensed from the *Photographic News.*

In the dark-room, then, we propose to give what hints we consider necessary for the beginner. Any room or closet from which all the outer rays of light can be shut off may be converted into a dark-room in which plates may be changed and developed. If a room having a sink and water tap—say the pantry—can be "annexed," the trouble will be greatly reduced; but it is quite possibly to make shift with a pail for a sink, and a water jug instead of the tap. We have said that it is necessary to shut out entirely all outer light. This pre-supposes the use of artificial light for illuminating the apartment with the necessary red or non-actinic light. We consider that until such time as the student sees his way to fitting up a permanent dark-room, he will find it best to work with artificial light. There are lamps constructed especially for the purpose of giving "safe" light sold by all dealers in photographic apparatus. These use either gas, oil, or candles, and all consist of an arrangement whereby the air necessary to support combustion is introduced by passages which will not allow white light to find its way out, the colour of the light being modified by funnels of ruby glass, or shades ruby paper or cloth. The gas and oil-lamps are much to be referred to the candle arrangements, as with the former it is possible to raise or lower the light at will.

All, then, that the photographer has to do, is to find some small room or closet, which he can make quite dark, in which he can have a plain deal table to work upon, and to purchase a "dark-room lamp" from a photographic apparatus dealer. Our description of dark rooms would not, however, be complete, unless we say something about the fitting up of a permanent photographic room in which all the operations, including the manufacture of the plates, may be conducted.

A window is needed whereby the necessary light is introduced. It should be about two feet long, by one foot six inches high, and should be glazed with one thickness of ruby, and one thickness of orange glass. On the inside there should be a blind of red Turkey cloth, which can be raised and lowered at will. This is to reduced the amount of light when the sun shines direct on the window, or when the process of plate manufacture goes on. A sink made of glazed stoneware should have the top edge about two feet six inches, or two feet eight inches along the floor. The operating table should be covered with sheet lead, with a very narrow and low ridge round all the sides except that next to the sink, it should have a very slight incline in that direction, and should have the sheet lead "dressed" over the edge of the sink, so that all spillings may find their way into it. There should be a narrow shelf about four inches above the level of the table and sink, and extending along the whole length of both of them. On it is placed the lamp when artificial light is used, as when working at night, and the bottles of solutions actually used for development. The lower edge of the window should be an inch or two above this shelf. There should be a shelf about six inches below the operating table, on which the flat developing dishes may be kept. There should also be a table on which the levelling slab may be placed when the manufacture of plates is commenced. Above it—or, in fact, along all available space of the walls—shelves may be fixed for carrying bottles, &c.

A space is reserved for the drying cupboard, used in manufacturing plates. Above it, and with its lowest edge about three feet higher than the floor, should be fixed an ordinary cupboard, with a door closing light-tight. In this may be placed plates or anything sensitive to light, which would be destroyed if left about, for it must be understood that even light of the deepest ruby red will in time act upon a sensitive plate.

Double doors, whereby the photographer may go out or in without letting any light enter, are advisable.

Provision must be made for ventilating the room without letting in light. There should be at least one common gas jet for lighting up the room when no sensitive plates are about, so that solutions, &c., may be mixed with comfort, and there should be provision made for attaching several rubber tubes with the gas pipes for connecting with Bunsen burners, &c.

NOTE ON THE PHOTOGRAPHIC SPECTRUM OF THE GREAT NEBULA IN ORION.*

By William Huggins, D.C.L., LL.D., F.R.S.

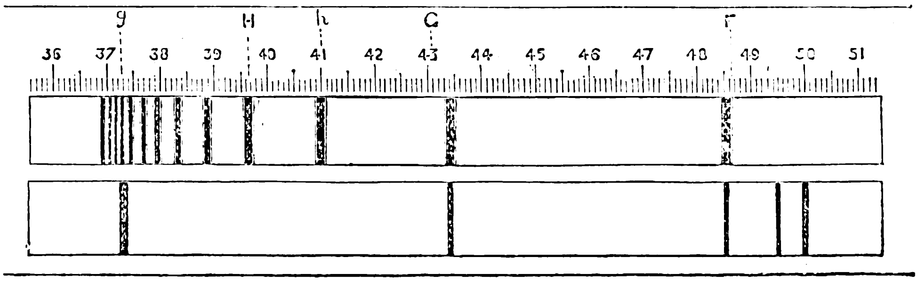
Last evening (March 7) I succeeded in obtaining a photograph of the spectrum of the great nebula in Orion, extending from a little below F to beyond M in the ultra-violet.

The same spectroscope and special arrangements, attached to the 18in. Cassegrain telescope with metallic speculum belonging to the Royal Society, were employed which have been described in my paper on "The Photographic Spectra of Stars" (*Phil. Trans.* 1880). The exposure was limited by the coming up of clouds to forty-five minutes. The opening of the slit was made wider than during my work on the stars. The photographic plate shows a spectrum of bright lines, and also a narrower continuous spectrum which I think must be due to stellar light. The bright stars forming the trapezium in the "fish's mouth" of the nebula were kept close to the side of the slit, so that the light from the adjacent brightest part of the nebula might enter the slit.

Outside this stronger continuous spectrum I suspect an exceedingly faint trace of a continuous spectrum. In the diagram which accompanies this paper the spectrum of bright lines only is shown, which is certainly due to the light of the nebula. In my papers on the visible spectrum of the nebula in Orion, and other nebulæ (*Phil. Trans.* 1864, and 1868), I found four bright lines. The brightest line, wave-length 5,005, is coincident with the less refrangible component of the double line which is strongest in the spectrum of nitrogen. The second line has a wave-length of 4,957 on Ångström's scale. The other two lines are coincident with two lines of hydrogen, $H\beta$ or F, and $H\gamma$ near G.

In the photograph these lines which had been observed in the visible spectrum are faint, but can be satisfactorily recognised and measured. In addition to these known lines the photograph shows a relatively strong line in the ultra-violet, which has a wave-length 3,730 or nearly so. The wide slit does not permit of quite the same accuracy of determination of position as was possible in the case of the spectra of stars. For the same reason I cannot be certain whether this new line is really single, or is double or multiple.

This line appears to correspond to ζ of the typical spectrum of white stars. In these stars this line is less strong than the hydrogen line near G; but in the nebula it is much more intense than $H\gamma$. In the nebula the hydrogen lines F and $H\gamma$ are thin and defined, while in the white stars they are broad and winged at the edges. The typical spectrum has been added, for the sake of comparison, to the diagram.



I cannot say positively that the lines of hydrogen between $H\gamma$ and the line at 3,730 are absent. If they exist in the spectrum of the nebula, they must be relatively very feeble. I suspect, indeed, some very faint lines at this part of the spectrum, and possibly beyond λ 3,730, but I am not certain of their presence. I hope by longer exposures and with more sensitive plates, to obtain information on this and other points. It is, perhaps, not too much to hope that the further knowledge of the spectrum of the nebulæ afforded us by photography, may lead by the help of terrestrial experiments to more definite information as to the state of things existing in those bodies.

P.S.—In the woodcut the new line is made broader to indicate its great relative intensity, and not to show its exact breadth.

EXPANSION OF WATER THROUGH ABSORPTION OF GASES.

Past researches on the absorption of gases by liquids have been limited mainly to determining the coefficients of absorption, that is, to ascertaining the quantities of the gases that are absorbed under special conditions. The changes of volume and density due to absorption have been but little investigated, and such investigation, when it has occurred, has been confined to a few gases that are strongly absorbed. The expansion of liquids in consequence of weak absorption has recently been made a subject of inquiry by Herr Knut Angström, who has a paper on the general subject in the February number of the *Annalen der Physik*. This includes the description of the somewhat simple apparatus he used, and the results furnished in absorption of various gases by water.

With regard to the method of exact determination of the volume-change in weak absorption, it was seen to be desirable, that each determination of volume should be made at constant temperature, that the gases used for absorption should be introducible without the liquid being exposed to evaporation, and that the absorbed quantity of gas should be capable of ascertainment with accuracy. These conditions were fulfilled in a somewhat modified dilatometer, for particulars of which, and its mode of use, we must refer to the original. The gases employed were atmospheric air, nitrogen, carbonic oxide, oxygen, hydrogen, and carbonic acid.

The results of experiment, collected in a table, prove that the increase of volume of water is proportional to the quantity of gas absorbed: a law previously arrived at by Messrs. Mackenzie and Nichols, also by Nichols and Wheeler, for carbonic acid and ammonia. It may therefore be concluded (the author says) to have general validity, at least within the limits of accuracy of the investigation.

Calling the increase of volume of the liquid through absorption of unit volume of gas δ, and the coefficients of absorption β, Herr Angström's experiments with distilled water yield the following values:—

Gas.	δ	β
Nitrogen	0·00145	0·0203
Atmospheric Air..	0·00140	0·0247
Carbonic Oxide ..	0·00127	0·0329
Oxygen..........	0·00119	0·0193
Hydrogen........	0·00106	0·0411
Carbonic Acid....	0·00125	1·7967

It would, perhaps, be premature, Herr Angström remarks, to draw from the values arrived at any conclusions as to the nature of absorption. One fact, however, may here be specially noted—viz., the small difference of the values of the expansion for gases which have otherwise very different physical and chemical properties. This is, doubtless, because we have not here to do with a chemical phenomenon, and that the molecules of the gases in absorption enter the liquid in a free state.

A calculation of the co-efficients of expansion, through absorption, for some easily condensable gases from older and less exact determinations, gave for muriatic-acid gas, δ = 0·00097; for ammonia, = 0·00077; and for sulphurous acid, = 0·00091. These values are pretty near those found above, so that a qualitative distinction between the absorption of easily-condensable gases and permanent gases does not seem to be warranted. This is still more clear on comparison of nitrogen, hydrogen, and carbonic acid; the first two are, at 0° C., and the pressure required to compress them to a volume corresponding to the volume-increase of the liquid in absorption, still permanent, while the last has passed into liquid condition. Yet the coefficient of expansion through absorption for the last gas lies between those for the first two. "For the rest," says Herr Angström, "the gas, in absorption, loses the properties belonging to it as a gas, especially the great mobility of the molecules, since this is opposed by that of the molecules of liquid."

Finally, Herr Angström compared the coefficients of expansion through absorption with the compressibility of the gases, and found that the series is the same for both properties.

LECTURE EXPERIMENTS.

An experiment for exhibiting the change in weight that attends oxidation or reduction, without the aid of a chemical balance, is given by Max Rosenfeld. A modified form of hydrometer takes the place of a balance. The ordinary saccharometer has attached to its upper end, by means of sealing-wax, a piece of strong wire, about 4in. long, and to the other end of the wire is fastened a glass cup, made by cutting the end off a test-tube. On the cup is placed a piece of platinum foil to hold the substance to be burned or reduced. The instrument is so adjusted that a weight of 0·8 to 1 gram on the foil will cause it to sink until the wire is a little way under water. It now resembles a Nicholson's hydrometer, and is very sensitive. To perform an experiment in oxidation, enough finely-divided iron is put on the foil to cause it to sink until the end of the wire is in the water. The foil, with its load, is carefully removed, and held over a flame until the iron is converted into oxide. When cold it is replaced on the glass cup, and causes the instrument to sink until the cup almost touches the water. To show the loss of weight by reduction, the foil is loaded with copper oxide until the cup nearly touches the water. After it is reduced to metal, of course, the apparatus sinks to a much less depth. A cylinder made of copper oxide and gum water, and well dried, can be used to show both oxidation and reduction.

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* A paper read before the Royal Society

Brössler, of Vienna, has recently described several methods of making phosphoretted hydrogen for lecture experiments. He places some granulated zinc in a glass dish, and adds dilute sulphuric acid until bubbles of hydrogen gas are given off regularly, but not too rapidly. He then throws in a few pieces of ordinary phosphorus. In a short time the bubbles of gas begin to ignite at the surface of the liquid with a slight explosion. To hasten the operation, the dish and its contents may be warmed to 112° Fahr. on a sand-bath, or the necessary heat can be generated by putting the zinc in cold water, and pouring concentrated sulphuric acid upon it. If a solution of caustic potash and granulated zinc is heated to 140° Fahr., and a few pieces of phosphorus thrown into it, bubbles of the spontaneously inflammable gas will also be given off. The hydrogen generated by the action of concentrated hydrochloric acid upon zinc is not adapted to the generation of this inflammable gas, but the addition of a few drops of concentrated nitric acid produces the desired effect.

USEFUL AND SCIENTIFIC NOTES.

Prof. Boyd Dawkins on the Ancient World.—Last Monday Prof. Boyd Dawkins gave the fifth of a course of lectures on "The Ancient World at the Time of the Appearance of Man," at the Owens College. He said that it might be gathered from the association of living with extinct mammals that man made his appearance in India at the same hour, so to speak, of the geological clock as he appeared in Europe. The present order of things in India was shadowed forth at that time by the presence of the living species of mammalia. Europe, in the pleistocene age, was connected with Asia, so that animals at that time could freely wander from one to the other. The musk sheep, for example, had been traced from the Pyrenees right through Siberia by the remains which lay buried in the frozen morasses, and the mammoth of pleistocene Europe was found perfectly preserved in the frozen mud of the Siberian rivers. Indeed, almost the whole pleistocene mammalia, with the exception of the African species, were to be found also in Siberia, either living or frozen. Nor was their range bounded by Behring's Straits. The musk sheep, horse, bison, elk, reindeer, and the mammoth had been discovered in the frozen mud forming the cliff in Eschscholtz Bay, and had been traced over a large portion of North America. It was, therefore, evident that then Asia and America were united more closely than they are now, and the direction of their continuity was shown by the small depth of sea in Behring's Straits—some thirty fathoms. An elevation to that extent would unite the two continents together and form an isthmus. This group of animals was found as far to the south as the State of Kentucky, and there they were associated with gigantic extinct sloths and armadilloes, which belonged to the South American mammalia of the pleistocene age. Indeed, in North America, as in Europe, northern and southern animals were found mingled together, and there were three climatal zones implied by their distribution.

Ink for Rubber Stamps.—The following is said to be a good ink for use with rubber stamps. Aniline violet 90 grains, boiling rainwater 1oz., to which is added a little glycerine, and a small quantity of treacle. The quantities of the last two ingredients will vary with the season, but half a teaspoonful will be ample for the quantities of violet and water specified.

When an alloy of lead, tin, or other metal with sodium, is made in a melting-pot, great care must be used in subsequently freeing that melting-pot of all trace of sodium before using it for melting tin in it with a view to tinning copper or bronze articles; otherwise these articles, when placed in the melted tin, will be rapidly eaten away. This has been recently accidentally proved; but it might have been expected from known facts concerning sodium alloys as very long since pointed out by Mallet, who showed, among other things, that if a strip of iron be coated with sodium amalgam, and dipped into a pot of, say, molten tin, the iron will disappear faster than it can be put to the bottom of the pot.

SCIENTIFIC NEWS.

The following grants to learned Societies, &c., for the purposes of scientific investigation, appear in the estimates for the financial year:—The Meteorological Council, £15,300, which includes £800 for the gratis supply of forecasts to newspapers; the Royal Society, £4,000; the Royal Geographical Society £500, apart from the special grant for the Leigh-Smith relief; the Royal Society of Edinburgh, £300; the Royal Academy of Music, £500; the Irish Academy of Music, £300. The reports of the *Challenger* expedition will cost about £4,100 during the year, and the amount required for the expeditions in connection with the transit of Venus is nearly £15,000.

The death is announced of Herr J. J. Sievers, the astronomer, in his 78th year.

Differences of opinion appear to prevail as to the economy of the electric light; for while "professors" assert that it is cheaper, and prove their statements on paper, we find that it is being given up in places where it has been tried, notably at the Victoria Railway Station, Manchester. Last week, at the Society of Arts, Mr. Wigham read a paper on "Gas for Lighthouses," in which he had no difficulty in showing that gas was superior to oil, but also helped to prove that it was better, all things considered, than the electric light. Prof. Tyndall was in the chair, and had not a word to say for the electric light; but referring to Galley Head light, which is fitted up with Mr. Wigham's improved gas-burning arrangement, he said there could not be two opinions that the light was the finest of its kind in the world. The objections to the electric lights are that they are obscured by fogs and mists, and give false ideas of distance to the mariner. Steamships are, however, being fitted with electric lamps, and the "new" light is to be tried in the Law Courts.

An experimental train has been fitted up by the Eastern Railway of France with electric communication throughout, with brakes worked by electricity, and with electric lamps. The experiments with arc head-lights for engines are stated to be unsuccessful, the majority of drivers complaining that they cannot see so well on account of the dazzling effect.

Colonel Webber's paper "On Telephonic Communication," which was announced for the 22nd inst. at the Society of Arts, has been postponed until after Easter.

F. W. Webb, J. Reddrop, and M. H. Foye, of Crewe, have patented improvements on Lake's patent of 1879—Ancelin's acetate of soda warmer for railway carriages. The object of their patent is to insure the solidification in a crystalline form of the acetate of soda when allowed to cool after having been liquefied by heat.

Schmoele and Mols, of Antwerp, have patented a means of automatically playing musical instruments by pneumatic and electro-magnetic appliances. The pneumatic arrangements are for sounding reeds, and a sheet of card, perforated according to the tune, makes and breaks electric contact as it travels.

At the meeting of the Scottish Society of Arts last week, Mr. Lang read the report of a committee on Mr. Frazer's paper "On the Graduation of Thermometers." Mr. Frazer contends that thermometers graduated on the same scale for all parts of the instrument do not give correct indications of low temperatures, especially those below zero. We thought that fact was well known. At a meeting of the Engineering Section, Dr. Ferguson gave a lecture on dynamo-electric machines. After illustrating the conversion of mechanical energy into electricity, the lecturer proceeded to explain the distinction between magneto-electric and dynamo-electric machines, showing that the latter, in which the magnet was itself produced by an electric current, were capable of yielding, horse-power for horse-power, the better results of the two. The principle of the electric machine was stated to be magnetisation and demagnetisation. A detailed explanation was given of the respective modes of working of the Gramme, the Siemens, and the Brush dynamo machines; the lecturer concluding with the remark that the mode of testing their respective merits by candles per horse-power was rather unsatisfactory, from the circumstance that the number of candles set down for a given lamp might vary according to the position from which its light was gauged.

At a meeting of the Liverpool Science Students' Association last Saturday, Mr. Norman Tate, the president, suggested a subject for examination by the botanical section—the causes that lead to non-development of fruit in shrubs and trees near towns, notwithstanding profusion of bloom. An instance was given in the hazel, on the pistils of which one observer had found so much soot as to absolutely prevent pollenisation. A paper was read by Mr. C. E. Miles, on "Precious Gems," and Mr. J. Edwards described the process of diamond-cutting as carried on at Amsterdam.

The Eames locomotive was tried last week on the Lancashire and Yorkshire Railway, having been altered to suit the conditions required in passing another train. The firebox is 7ft. wide and 8ft. long; the tender carries 4,000 gallons of water, and 10 tons of coal. The engine has the cowcatcher, bell, and lamp, which are conspicuous appendages of the American type. We understand that it has been introduced to show the capabilities of the Eames vacuum brake, and also to prove that it can run without stopping for a longer distance than any English locomotive. Not much difficulty is experienced in replenishing the tender-tanks without stopping on the North-Western line, and possibly an arrangement could be devised for picking up bags of coal if it were necessary.

The Society of Arts Bill for the Amendment of the Patent Law has been brought in by Sir John Lubbock, Mr. W. H. Smith, and Mr. J. C. Lawrence, Q C. The second reading of the Bill is set down for Wednesday, April 5.

It having been stated that Mr. C. L. Wragge was about to resume his observations on Ben Nevis, that gentleman has written to say that they will probably be continued during the summer, but no definite arrangements have yet been made.

A new pump for gas-compression, which appears likely to be serviceable in the laboratory and in industrial operations, has been described to the French Academy by M. Cailletet. A distinguishing feature is the use of a mercury column above a plunger-piston, the two working up and down in a vertical cylinder. The gas to be compressed enters by a lateral tube, in which is a stopcock worked by cams. At each revolution of the flywheel about 1 litre of gas is compressed; so that, with an hour's work, one may obtain 400 or 500 grammes, e.g., of liquid carbonic acid or protoxide of nitrogen. When the compressed gas acquires sufficient tension, it raises an ebonite valve at the top of a narrow passage, and passes through a tube to the receiver, which is formed of metallic tubes arranged in bundles, and communicating with each other. In these, gas compressed to several hundred atmospheres may be kept safely. Glycerine or vaseline is used to lubricate the working parts of the pump. The apparatus requires but a small motor force; there is no admixture of air, and heating is avoided, as the heat liberated in compression is spread, by movement of the mercury, through the mass of the cylinder, which cools quickly, without a circulating current of cold water being required.

A central laboratory of electricity is to be instituted in Paris, under the supreme direction of the Ministry of Posts and Telegraphs. The sum of 325,000 francs from the profits of the recent Exposition will be devoted to its organisation and maintenance.

The objectionable dark coating which most bronze statues soon acquire, with the look of cast-iron, does not consist (according to Herr Brühl) of sulphuret of copper, as commonly supposed; but of a mixture of coal-dust, sand, &c., with oxides of the bronze-metals. It is not removable, either mechanically, or by treatment with dilute sulphuric acid; but, on the other hand, it may be very quickly and completely washed off by means of a concentrated solution of carbonate of ammonia, applied with brushes. Thereupon a layer of patina is formed, which guards the statue against fresh formation of the dark coat. The work should, of course, only be intrusted to skilled and intelligent men. Another method is to paint the statue, at intervals of a few weeks, repeatedly with a solution of 20 parts anhydrous vinegar in 100 parts bone oil. The acetate and oleate of copper salts thus produced, form first a thin green layer, which hinders the attachment of dirt and dust, and occasions further patina-formation.

Some interesting results concerning the penetrability of porous bodies by air have been recently obtained by Herr Christiani, using what he calls a *poroscope*, which consists of a brass cylinder, closed by two capsules, and having, at about the middle, an annular partition, in which cylinders of the bodies to be tried are inserted air-tight. The first substance he used was red beech-wood, and with this the motion of one capsule induced a corresponding motion of the other. A building-stone of the densest kind (clinker) behaved similarly, only a difference of phase was noticed in the motions. Old, dry oak, ivory, cork, and (what is specially noteworthy) a disc of a new earthenware cylinder of a galvanic element, proved quite impermeable by atmospheric air. In a later series of experiments, different kinds of wood were compared in the fresh and in the old dry state. Fresh oakwood was here found permeable; and this is botanically instructive, because moistening the end-surface of a permeable boxwood cylinder rendered it impermeable. Herr Christiani has devised another apparatus for measurement of the phenomena, consisting of two mercury manometers, communicating by means of caoutchouc tubes through the poroscope, and he will ere long publish observations made with this.

The well-known works of Krupp are now under contract with Brazil to supply 18 batteries, or 108 complete field-guns, within the present year. Roumania has lately ordered 100 of Krupp's guns, and Sweden and Norway 30. Since 1873 more than 10,000 guns have been sent out from these works.

The telephone-cells or chambers in the Berlin Exchange have double walls, with ashes, clay, or sawdust in the interval. Under the wall-papers is cotton-covered felt stretched on a framework, beyond which is a lining of thin pasteboard. This is quite successful, and the cells are much frequented. There are at present in Berlin two public telephone-rooms, and in Hamburg one, into which a person may go and, on payment of about 5d., converse with any one who is in the telephone system of the city.

An instructive series of experiments on the Faure secondary battery has been described to the French Academy by M. Allard and four other physicists. Thirty-five elements (new model) were employed, a Siemens machine was used in charging, and the discharge was through a series of Maxim incandescent lamps. It appears that a work of 6,382,100 kilogrammetres was stored in the battery (being 66 per cent. of the work expended). Of this 60 per cent. was recovered during discharge. Thus, the use of the accumulator involved a loss of 40 per cent. of the electric work disposable without it. It is pointed out that there are many cases in which this loss would be fully counterbalanced by the advantage of having at hand, and quite at disposal, an abundant source of electricity.

The general proportion of carbonic acid in the air has now been sufficiently determined (in M. Dumas' opinion), by M. Reiset's experiments, as about 3 volumes in 10,000. M. Dumas suggests the importance of now studying the variations to which it is subject through great movements of the atmosphere; and for this purpose the approaching transit of Venus expeditions, to various portions of the globe far apart, afford a valuable opportunity.

It has been lately observed by Prof. Detmer, that various substances do not act in the same way on living plant cells and on ferments. Thus, while (not too) dilute common salt solutions and oil of cumin are very poisonous to plant cells, they do not arrest the action of diastase on starch. This is adverse to the view that life is to be conceived as a kind of ferment action.

The subject of injury to health from tinned meat has been engaging some attention in France. A Nantes chemist, M. Bobierre, found that in many cases the soldering, hastily done, had been such as to bring a considerable surface of the solder (containing sometimes as much as 45 per cent. of lead) in contact with the meat. M. Bobierre calls attention to the inequality of legislation with regard to these imported meats, and the national products of like nature, the latter being now under strict regulations as to the mode of soldering (which were issued in August last after revelations by MM. Schutzenberger and Boutmy). A rapid and sure means of detecting impurity in the tins employed in tinning having become a desideratum, such a means has been lately submitted to the French Society for Encouragement of National Industry, by M. Maistrasse. It is based on the different aspects presented by the *moires* (or wavy combinations) obtained with alloys containing a greater or less quantity of tin, when the metallic surface is washed with pure hydrochloric acid mixed with a little nitric acid. By patient and methodical researches, M. Maistrasse has succeeded in forming a series of *moire* types, tin and lead, in which the proportion of lead increases from 1 to 30 per cent.; the difference, in this respect, between pure tin and an alloy begins to be very sensible whenever the amount of lead exceeds 5 per cent.

At the Paris Exhibition, an instrument which excited much curiosity was the *fan-fare* of M. Aden, a trumpet-arrangement which amplified to the strength of a hunting-horn airs sung lightly into the transmitter of a singing condenser. The mechanism by which this was accomplished is now made known in *La Lumière Electrique*. It consists of a horseshoe magnet, having at its polar extremities two flat bars of soft iron turned towards each other (so as nearly to meet), with flattened coils not reaching the extremities. In front of these ends is a small, very light armature, supported on a small wooden knob, which is attached to a very thin slice of pine, which forms the vibrating diaphragm. It is in front of this diaphragm that the resonance-case is placed, into which the trumpet is inserted. The distance of the small armature from the magnetic poles is so regulated that at the moment of action of the current a shock occurs, and the repetitions of these shocks gives the resultant notes. It has been attempted to apply the system to reproduction of speech, but the few words obtained were so indistinct that the idea was given up.

Prof. Tyndall on Light, Sound, and Heat.—On Thursday week Prof. Tyndall, D.C.L., LL.D., F.R.S., delivered before a crowded audience in the theatre of the Royal Institution, the first of a course of three popular lectures on "The Resemblances of Sound, Light, and Heat." He began by reminding those before him how science had been slowly built up from the beginning by the constant interaction of two factors—the phenomena of nature and the human mind. At first observation by means of the outward senses was deemed sufficient. But by degrees the root of things was asked for, and this could only be seen by the eye of the mind. He had to speak to them of wave motion, such as that of the ocean, on whose undulations every drop of rain exerted an influence. The formation of ripples on large or small bodies of water was illustrated and explained. From the discussion of the propagation of the waves in water the lecturer passed to speak of like movements in the atmosphere. In an illustrative experiment sound was passed along a series of balls, each hung on a metallic spring, to render visible what the Hon. Robert Boyle had called "the spring of the air." It was thought that the idea of the pulsations of sound had suggested to the Huygens the explanation of the phenomena of vision by his undulatory theory of light. Newton and he had wrestled like two giants on this question, our own great countryman insisting that light was produced by the impact of particles, while his antagonist thought it was caused by waves of luminous ether impinging on one another. The controversy was critically reviewed at some length, the chief experiments and illustrations being repeated with all the modern improvements. The laws of the reflection of sound and light alike were deduced logically from wave motion. A parallel explanation of the nature and laws of refraction, applicable severally to optical and acoustic science, was given, and reference was made to the merits of Snell, who developed the law of refraction before the days of Newton and Huygens, and of the Californian investigator, Leconte, Professor Barrett, and Lord Rayleigh. The lecturer concluded with the repetition, amid much applause, of the photographic illustrations of animal life in motion given recently at the Royal Academy by Mr. Muybridge, of San Francisco.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

ICI ON PARLE FRANCAIS—PRECESSION OF THE EQUINOX—GREGORIAN AND CASSEGRAINIAN TELESCOPES—COMITES TO ALDEBARAN—BARLOW LENS—FINDING THE—MOON'S POSITION—THE CALCULATION OF A SOLAR ECLIPSE—ARAGO'S "POPULAR ASTRONOMY."

[19826.]—The receipt of the first part of "L'Astronomie," by Camille Flammarion, certainly suggests the idea to me that among things which "they order better in France" is the production of Monthly Astronomical Reviews. Beautifully printed, with its 40 large octavo pages illustrated by nine wood engravings, this new magazine, which only costs a franc to subscribers, presents a remarkable contrast to its skimping little predecessors for which we are charged a shilling a number in England. Let us hope that their Editors will take a hint from M. Flammarion's example.

In reply to "Astrologos" (query 46299, p. 19), the vernal intersection of the Equator and Ecliptic, the "First Point of Aries," or ♈ of the Almanacs, quitted the extreme S.W. of the Constellation Aries about 259 B.C. It then crossed the little bit of Cetus, which runs in between Aries and Pisces at this point, and 104 B.C. entered the N.E. portion of Pisces, across which, as your correspondent knows, it continues to travel. By the year 2720, or thereabouts, the Vernal Equinox will be found in the confines of Aquarius.

"G. L. E." (query 46333, p. 20) will simply waste his time and money, should he attempt to construct either a Gregorian or Cassegrainian telescope with its mirror ground to *spherical* curves. Notably in the case of the Gregorian, it is essential that the large mirror should be a segment of a paraboloid, and the small one a segment of an ellipsoid of revolution, if aberration is to be destroyed. If we grind both these mirrors to spherical curves, not only will their aberrations unite, but that of the large mirror will be extremely intensified by the action of the smaller one. In the case of the Cassegrainian form, the small mirror should be of a convex hyperbolic form, instead of a concave elliptic one. In one sense, its convexity would be less likely to exaggerate the aberration of the large mirror (assuming this to be spherical) than would the concavity of its counterpart in the Gregorian form; in fact, it would have a tendency to correct it. Of course "G. L. E." knows that the Cassegrainian telescope inverts objects. The distortion in a Gregorian with spherical mirrors would be monstrously greater than that in a Newtonian of equivalent focal length.

I am afraid the "Zenas" (query 45836, Vol. XXXIV., p. 483), will begin to think that I have forgotten the promise I made in letter 19741 (p. 589 of the same volume) to look at his *comites* to Aldebaran. This, however, is not the case. I first tried what I could do with the ordinary position micrometer, but the illumination of the field rendered the Southern *comes* exceedingly difficult to see at all, and absolutely obliterated the one preceding Aldebaran. After this, the weather was very bad, and, moreover, moonlight intervened. We have, though, at last had two or three brilliant moonless nights, and I have availed myself of them to make the best estimate I could of the measures for which "Zenas" asked. His first *comes*, then, the one at an angle of about 185° with Aldebaran, is a 11—12th magnitude star, and is about 340″ from its primary. This is rather brighter than the well-known companion. Then the one at an angle ± 250° is a 12—13th magnitude, and is approximately 308″ from α Tauri. I trust by this time that "Zenas" has picked up the recognised *comes*. He will see it plainly enough if he will hide Aldebaran behind a bar for a few seconds: and, once caught, it will be visible enough even in the glare of the large star.

In answer to query 46371 (p. 43), the crown glass lens in the Barlow combination is the concave one, and is placed next to the object-glass, the convex flint lens being obviously next the eye-end of the telescope.

The arrangement of "W. L. O," as described in query 46389 (p. 43), seems quite sufficiently accurate for his purpose. It is not rigidly so; because, for example, the Moon would be vertically over the Eastern part of New Guinea when she was new on February 17, and not over its centre; but, as I have said, this appears near enough for obtaining a general notion of her position with reference to the Earth's surface at any given time. With regard to the beginning and end of a Solar Eclipse, my querist seems to be confusing two different things: the time occupied from its beginning to its end *on the Earth generally*, and those at any given station. If we suppose an observer to be situated at the centre of the Sun, the instant that the Moon's preceding limb touched that of the Earth would be that of the commencement of the Eclipse on the Earth generally: as that of the contact of her following limb with the opposite one of the earth, would mark its termination. On the other hand, at any particular place where the eclipse was total, its duration would amount roughly to the time occupied by the Moon in travelling over two of her own diameters in the sky + the apparent increase in longitude of the Sun during the interval. The greatest, and least, possible duration of an Eclipse varies, moreover, with the latitude. Now, supposing even that "W. L. O." gave the specific stations for which he wishes to know the greatest and least times a Solar Eclipse can take; to furnish a reply would involve an amount of most operose calculation which I have neither the time nor the inclination to face. So difficult is the computation of any given phase for a given place, that it can only be performed by successive approximations. I may add that, on the Equator, the longest possible duration of an Eclipse of the Sun from the instant of first to that of last contact is 4h. 29m. 44s. As for the lines on the map, perhaps I may just say this much: Supposing the observer to be on the Sun, then the line marked "Eclipse begins at Sunrise," passes through all those places where the Moon is entering on that terrestrial limb just being brought into view by the Earth's rotation. "Northern line of simple Contact" and "Southern line of simple Contact" are drawn at the extremities of a Lunar diameter. Every place on the Earth's surface situated between these lines must, ex necessitate, see more or less of the Sun's disc obscured. Those on the Northern line will see the Moon's Northern limb tangent to the Southern one of the Sun, and *vice versâ*. This may give your correspondent some notion of the principle on which the maps in the *Nautical Almanac* are drawn. For details I must refer him to Chauvenet's *Spherical and Practical Astronomy*, Vol. I., pp. 436 to 517.

I question exceedingly if the maps at the end of Smith and Grant's translation of Arago's "Popular Astronomy" (concerning which "S. M. B. G." puts, query 46401, p. 44) were ever intended to give anything more than a general idea of the face of the Heavens. Assuredly small differences of stellar magnitude are unnoticed in them. Bayer and Flamsteed are both quoted on two of the maps at the end of Vol. I. as authorities, as are Lacaille, Bode, and Piazzi. Probably Flamsteed's Atlas formed the basis of the maps, and the objects wanting in it were supplemented, with their magnitudes, from the catalogues of the observers named. Doubtless, though every star between, say, the second and third magnitudes, but nearer to the former, was called a second mag., while, perhaps, a very small 4th would figure as a 5th. In my copy of Arago, Castor and Pollux are not reversed, Castor being quite properly the Northern Star. Finally, there is no *Constellation* of "Duo Asini"; albeit these words are engraved in capital letters. They refer to γ and δ Cancri, which (according to Smyth) the Romans called Aselli, the Greeks ὄνοι, and the Arabians (following Ptolemy) Al-himâraïn—all signifying the same thing, the two asses. The origin of this term I have been unable to trace.

A Fellow of the Royal Astronomical Society.

COMPARISON OF STAR MAGNITUDES.

[19827.]—SOME little time ago I compared the magnitudes of every star in the "Bedford Catalogue" with those of Σ. in the *Mens. Micr.*, and I have thought that a brief collation of the results (which are in gratifying accordance with those given by Mr. Knott), might be of interest to some of the readers of the ENGLISH MECHANIC. I have restricted the comparisons to the objects measured with the Dorpat refractor in the *M.M.*, because the magnitudes in that work are far more carefully estimated by Σ. than those in the *Cat. Novus*, and I have omitted any reference to the *Pos. Med.* because of the difference in the size of the telescope employed; moreover, the mean epoch of the observations of the *M.M.* more clearly approximates to that of Smyth than either of the others. The following little table explains itself.

Sm.	Σ.	No. of comparisons.	Extremes.
9·5	8·78	18	ε Drac. 7·6; 67 P. x Leonis 9·7.
10	9·18	25	46 Herc., 59 Cygni 9·0; 20 Persei 10·0, α Aquilæ 10·2.
11	10·10	26	39 Erid. 80 H viii. Persei 9·2; α Androm. 11·2, 81 P. viii. Mon. 11·5.
12	10·17	17	136 P. xvi. Herc., 88 P. xvi. Oph. 9·0; β Delph. 11·0, α Tauri 11·2.
13	10·65	21	φ Virginis 9·7, 307 P. xix. Aquil. 10·0; 72 Virg. 11·5, η Serpent. 12·0.
14	10·36	(6)	84 Ceti 9·2; 54 Oph. 11·3.
15	11·15	(8)	ν Ceti 9·6; ξ Pegasi, 16 Lacertæ 12·0.
16	10·83	(3)	

Smyth's 10th mag. includes 4 stars rated 10½m. by him; his 11th two 11½ mags., his 12th one 12½m., and his 13th one 13½ mag. star. It is unadvisable to carry the comparison above Smyth's 9½ mag., because many of his 9 mag. stars are assumed from Piazzi. It does not seem to be generally known that where both components of a double star observed by Smyth are to be found in Piazzi, Sm. has usually assumed Piazzi's mass for *both* components, as in the case of γ Delphini, 38 P. II. Triang., 1 Camelop, &c.

The following comparison by O.Σ. of the magnitudes assigned by himself at Pulkowa with those of his father at Dorpat, may be of use:—

Σ.	O.Σ.	No. of Comparisons.
12·0	11·35	10
11·0	10·38	20
10 0	9·64	59
9·0	8·80	165
8·0	7·90	159

It will be remembered that the *min. vis.* in the Dorpat refractor was placed by Σ. at the 13th mag. of his scale in the *M. M.*, and at 12·4 in the *P. M.*, the smallest *measurable* object being called 12·0m. There is only one 13m. star, as far as I remember, in the whole of the *M. M.* O.Σ. has said of the magnitudes assigned by him to objects seen in the Pulkowa refractor, "I estimate a star to be of the 14th magnitude if it is more suspected than distinctly seen on a dark night." This would be about the fifteenth mag. in his father's scale extended, agreeing excellently with the theoretical value.

H. S.

COMETS AND METEORS.

[19828.]—IN the interesting lecture by Dr. Huggins, given in the "E. M.," it is stated, as the result of experiments with several meteorites, that their spectra were similar to that of comets apparently in all the cases tried, and this notwithstanding the disadvantage of examining the meteorites necessarily "after superficial ignition in passing through the air." I presume other lines could be made to appear which would differ probably in different meteorites, the cometic lines being preponderant. This being so, I do not quite comprehend the lecturer's objection to the suggestion of Professor Tait that the luminosity of the parts about the nucleus might be due to the mutual impact of the fragments,—namely, that the spectra would be more complicated, and not the same in each comet. Now, the cometic spectra are not all absolutely identical, though similar, and all we have to suppose is that in each comet, as in the meteorites experimented upon, there is some volatile mattor, very similar in all, whose lines are predominant.

As to the suggestion of Prof. Stokes, that in the vacuum of the planetary space the loss of heat by radiation would be very small, and that we should consequently have a high temperature, this, I think, extremely doubtful. Some comets manifest the characteristic tails at distances from the sun equal to that of the earth, and whatever be the nature of the vacuum or luminous fog which surrounds a comet, the moon must be practically surrounded by something similar in density. Now, at the lunar surface at all events, we see nothing analogous to the comet lines or electrical action sufficient to produce bright-banded spectrum, notwithstanding the circumstance that we are so many times nearer that body than we are to comets.

W. C. E.

TO ALFRED H. ALLEN—ANALYSIS OF REFINED COPPER — HARDNESS OF WATER — TANNIN — IMPURITIES IN ACIDS—BLEACHED BEESWAX—GLYCERIN—PRECIPITATING ALCOHOLIC SOLUTIONS—ANÆSTHETICS.

[19829.]—IN reply to query 46068, page 578 of last volume, addressed "To Alfred H. Allen," I fancy "Cupric" would find Volhard's method the best for estimating the actual amount of copper in the commercial metal. Some time since I obtained exceedingly accurate results by means of it, and it has the advantage of being unaffected in its indications by the presence of any metals except mercury and silver. It consists in adding sulphite of sodium to the slightly acidulated solution of the metal, warming, and then adding a moderate excess of a standard solution of ammonium sulphocyanide. The liquid is made up to a definite volume, passed through a dry filter, and an aliquot portion of it titrated with decinormal nitrate of silver, using a few drops of ferric sulphate as an indicator. As soon as the whole of the sulphocyanide is precipitated, the reddish tinge disappears, owing to the destruction of the ferric sulphocyanide. It is well to add the silver solution in slight excess, and then to titrate back with sulphocyanide. Of course the amount of copper is calculated from the amount of sulphocyanide which was removed from the solution in the form of CuCNS. Chlorides must be absent.

For the detection and estimation of sulphur in commercial copper I should recommend the querist to dissolve the metal in nitric acid, evaporate to a low bulk, dilute, filter, and precipitate the liquid with barium chloride. He must take care that the insoluble residue does not retain sulphate of lead. I don't know Hampe's method of determining suboxide—at least, I don't know it by that name.

"Dyer" (query 46109, page 579) will find full descriptions of the method of ascertaining the "Hardness of Water" in any book on Chemical Analysis—e.g., Frankland's "Water Analysis," Wanklyn's "Water Analysis," Sutton's "Volumetric Analysis," Thorpe's "Quantitive Analysis," &c.

Probably the querist ("Tannin," No. 46110, page 579) could prevent his gelatine solution from spoiling by adding to it a little salicylic acid. It would be worth trying at any rate.

In reply to "Impurities in Acids" (query 46199, page 624), "W. Duff, Analytical Chemist," gives some curious information. Has he *tried* whether he can get a "blue" ppt. by adding potassic ferrocyanide to a sample of oxalic acid? Fancy, too, adding ammonium oxalate to a solution of oxalic acid, in order to detect lime! Again, he distinguishes lime from alumina by adding ammonium carbonate. But perhaps the grossest error is the direction to test for sulphurous acid in hydrochloric acid by adding "a few drops of strong sulphuric acid," and noting if there is a smell of burning sulphur.

"Bleached Beeswax" (query 46291, page 627) is liable to a number of sophistications. The following is a simple and apparently a fairly good method of qualitatively examining suspected samples. Dissolve a portion of the wax in turpentine, when any mineral or starchy impurities will remain undissolved. Sulphur may be recognised by the smell of sulphur dioxide, produced by burning the wax previously made into a taper. Rosin gives wax a terebinthinate odour, and makes it adhere to the teeth if chewed. Paraffin makes the wax brittle. Lard is indicated by the fatty odour and feel of the sample. Other and more reliable methods will be found in "Commercial Organic Analysis," Vol. II.

"Inquisitive" (query 46298, p. 19), asks me to tell him the best method of recovering "glycerine" from soap lyes on a large scale, as its value has lately advanced so enormously that its extraction has become a desideratum. There are several patented methods of effecting this purpose. These the querist could not use without payment; secret processes I cannot describe; and "Inquisitive" will scarcely expect me to give him the benefit of any private ideas I may have on such a matter. However, the querist will find some information in a reply by Mr. F. Barker Cooke, on p. 40, and some more on p. 29. I see Mr. Cooke falls into the old error of supposing glycerine to be soluble in chloroform, whereas it is in reality wholly insoluble, and consequently his method of separating glycerine and sugar is absolutely unworkable. Palin appears to have been originally responsible for the statement as to the miscibility of glycerine with chloroform, and the persistency with which various authors have copied a statement which is improbable on the face of it, is a striking example of the recklessness of the bookmakers. Glycerine is often very impure. That intended for medicinal use should leave no sensible ash on ignition, should be neutral on reaction, and unaffected by strong sulphuric acid, nitrate of silver, sulphuretted hydrogen, oxalate of ammonium, or exposure to sunlight.

For "Precipitating Alcoholic Solutions" of resins (query 46416, page 44), a good plan is to add a few drops of a solution of alum or chloride of calcium, and then add a little phosphate of sodium. The flocculent precipitate entangles the finely-divided resinous particles, and filtration becomes easy. Whether this method would be applicable to the case of the querist depends on whether a salt of calcium or aluminium would be injurious to his solution. But it is not difficult to produce a flocculent precipitate of some sort without removing any of the active constituents of the liquid.

"Anæsthetics" (query 46391, page 44) vary much in their effects, according to their purity. The objectionable symptoms sometimes attending the inhalation of chloroform are most probably due to the presence of other bodies. Ethylidene, or ethydene dichloride, is prepared by the action of chlorine on ethyl chloride, or by distilling aldehyde with pentachloride of phosphorus. When pure it boils at 60° C., and has a density of 1·186 at 12° C.

Alfred H. Allen.

Sheffield, March 18.

ORNAMENTAL LATHE-THREADS.

[19830.]—We have to thank "Scorpio" for his valuable letter. Of course, all these data may be got by trigonometry; but the mathematical formulæ are not sufficient for practical readers. Should Mr. Holtzapffel not favour us by comcompleting his explanations, perhaps "Scorpio" will kindly work out the actual sizes of the screw-shafts at bottom of thread, and publish them in "E. M."

As thousands of the present ornamental lathes are in circulation, a complete summary of the data will be of practical value in the pages of the English Mechanic, so that its readers in any part of the world may be able to understand these "ornamental screw-threads." I propose, therefore, to collate our present fragmentary data in the form of a convenient table, and ask the Editor to favour us by publishing it. Meanwhile, I shall be grateful to anyone who will make accurate measurements from his own apparatus for the data which I have requested, and who will kindly forward them to me by a private note.

We want the sizes—outside the thread, and the screw-rates of all ornamental mandrel-noses; also the diameters of their lathe-bits. Sizes should be measured in thousandths of an inch; or a template of card, tin, or thin copper may be cut so as to slide accurately over the nose, outside the thread, which will give its diameter. Sealing-wax impressions of screw-threads will give their screw-rate accurately. Such measurements, templates or impressions, with descriptions of the apparatus from which they are taken, may be forwarded by post.

James Edmunds, M.D.

Grafton-street, Bond-street.

[19831.]—I quite agree with "Orderic Vital" in that Mr. Evans made a mistake in taking offence at Dr. Edmunds' letter. Dr. Edmunds goes at once to the root of a question which is of great importance to amateur turners, and he calls a spade a spade. He is quite right in saying that the present ornamental screws are "a barbarous survival of rule-of-thumb mechanics," and that amateur turners are "victimised" by unwittingly purchasing costly apparatus constructed with obsolete and incommensurable screw-threads. Charles Holtzapffel, a whole generation ago, said that these threads ought to be superseded by making all new screws to aliquot parts of the inch. As a client of Mr. Evans, I trust he will allow me to ask him whether these old screws should not now be superseded by aliquot threads? Is there any reason why Dr. Edmunds' suggestion to screw new 5in. mandrel-noses ten threads to the inch, and 6in. mandrel-noses nine to the inch, should not be adopted? Will Mr. Evans favour us with the sizes and threads of his present ornamental mandrels? Infinite simplicity, and comfort, and saving would accrue, by getting rid of mandrel-noses screwed 9·45 to the inch, and while some may look to Mr. Holtzapffel, others will look to Mr. Evans, for help in the matter. If a maker will go on repeating the undeveloped nomenclature, and reproducing the obsolete models of his grandfather, the end is clear—he will be superseded by newer men, who do not insist upon using up old patterns and selling off obsolete screw-tools, and who have the freshness and capacity to advance with the progress of science.

I note that Mr. Holtzapffel does not give us the remaining data for which Dr. Edmunds has asked, and which are necessary to enable us to understand these screw-tools. Probably, Dr. Edmunds does not yet realise the fact that these data are not given, simply because they do not exist. The size of the drills for boring out holes to be tapped for those screws are taken by "rule of thumb." The gauge-plates, as they are called, do not contain any second hole for sizing the drills or testing the screw shafts at bottom of thread, as all properly-arranged *systems of screws* do. The only way is to put the drill into the screw-hole, and see if it is about the size inside the thread. Of course, this leads to a rapid deterioration of the screw-holes, which ought to be preserved intact, in order to gauge the finished screws. I think we shall find that, after all Mr. Holtzapffel's professions of not making an enigma of anything, and of willingness to answer Dr. Edmunds's questions about these screw-tools, he is reluctant to make a clean breast of the facts, and that he still wishes to make a property of these screws. If he can do this, future generations of purchasers must still pay for sets of screw-tools, and for repairs which can be done nowhere but in his shop. But the progress of science cannot be stopped for any man's private profit, and amateurs will certainly look to other markets for their apparatus if these screws are still forced upon them. I trust that Dr. Edmunds will not leave this question where it is.

A Member of the Amateur Mechanical Society.

SCREW THREADS.

[19832.]—Referring to "Scorpio's" letter, No. 19819, it is all very well calculating the depth of a thread by some trigonometrical formula with a view to ascertaining the size of the hole that has to be tapped; but practically I can assure him that such a formula would be of little or no use in the shop. Individually, I may say that his notation as, *e.g.*, $\frac{1}{2}p : d =$ tan. $\theta / 2$ is as incomprehensible to me as a poem by Longfellow or anybody else would be if I read it.

The difference in diameter between the outside of a bolt and that of the hole to be tapped depends first on the theoretical depth of thread; secondly, on the degree of rounding off of that thread at top and bottom, and, thirdly, on the nature of the material to be tapped. Now, taking Whitworth's threads first, I am sorry to see from year to year a big blunder continued in each annual issue of the *Engineering Trades Almanack* by the Nottingham Malleable Iron Company—viz., that the depth of the Whitworth thread is equal to its pitch. The fact being that the thread is rounded off both at top and bottom to an extent equal to 1-6th of the pitch (one-sixth), leaving the total depth of the thread only two-thirds, instead of the whole of the pitch. Mem.: Whitworth's angle of thread is 55°.

Next as to material The copper alloys, such as brass and gunmetal (now fashionably called bronze), and perhaps aluminium bronze, and some others, about which I cannot speak, as I do not know, will admit of tapping with a nearly full thread, as will also wrought iron, if the taps in this last case are in really first-rate order, which means that they have good keen edges to cut with. But cast iron is a very different substance to deal with, and at the same time it varies very materially in quality at different places, or according to mixture at any one foundry.

I hold that no attempt should ever be made to produce in cast iron an internal or "female" thread of full section, or what the workmen call a "full thread," unless it is to be done by cutting out the material entirely in a screw-cutting lathe by means of proper screw tools, commencing, say, with an internal side single pointed tool, and finishing with a female chaser of usual form. And even then I think it is better (as it is much easier, and therefore, if carefully done, is much more likely to be satisfactorily done) to leave the rounded part of 1-6 the depth of the thread totally out of the question, and therefore in cast iron to bore the tapping hole very considerably larger than the theoretical size. If you do not do this, you will find the metal crumble away during the process of tapping, and the hole will not only be as large as it should in the first instance have been bored, but all the inner part of the thread will be ragged, with plenty of lodgment for dirt; and the difficulty of removing that dirt, when you have not a tap of right size at hand, becomes a source of grief when you have scrupulously to clean in order to finally adjust a job.

As to taps of other makers, such as Clements, succeeded by his nephew, Joseph Wilkinson, who, by the bye, actually cut and made all Clements's hobs for him while working as an apprentice, and now in the possession of Elliott Brothers, of Charing-cross, as far as I have gone in examining these, of which I have a great number, including taps, hobs, dies, &c., &c., I think I may say that Clements' angle of thread, which is much less than Whitworth's (already stated as 55°) is, as a rule, 40°; but in different taps, made specially for certain purposes, the amount of rounding off varies considerably. I have specimens of Clements's threads or tools from his hobs, or copies of them, in which the angle is only 35°, or even as low as 30°.

Now, if anybody who has "Holtzapffel's," Vol. II. (and that is just the book that no amateur worthy of the name should be without), he will find it thus written on page 673, viz.: "For a long series of years I. I. Holtzapffel . . . . made, as occasion required, a large or small screw, a coarse or fine, a shallow or deep thread, and so forth . . . . not less than one hundred varieties of all kinds."

Now, anybody who wants these "hundred varieties of all kinds," tabulated with depths of threads, &c., &c., makes about the mildest sort of request, and the least likely to be granted, that ever came under my notice. I have about a hundred sorts and varieties myself, and can pretty well appreciate what would be the labour of making such a table.

By the bye, "mild," when I was at school, meant unlikely to be complied with, or even *absurd*, but is, perhaps, not vernacular, so I give the explanation of what I mean by the term.

Just a word on slides. Many amateurs have a fancy for gunmetal loose sides to slide-rest, and gunmetal nuts to the same, believing, no doubt, that workmen thrust upon them cast-iron ones because they cost less. Now, I believe, I could fit five gunmetal side-pieces in less time than I could two cast-iron ones.

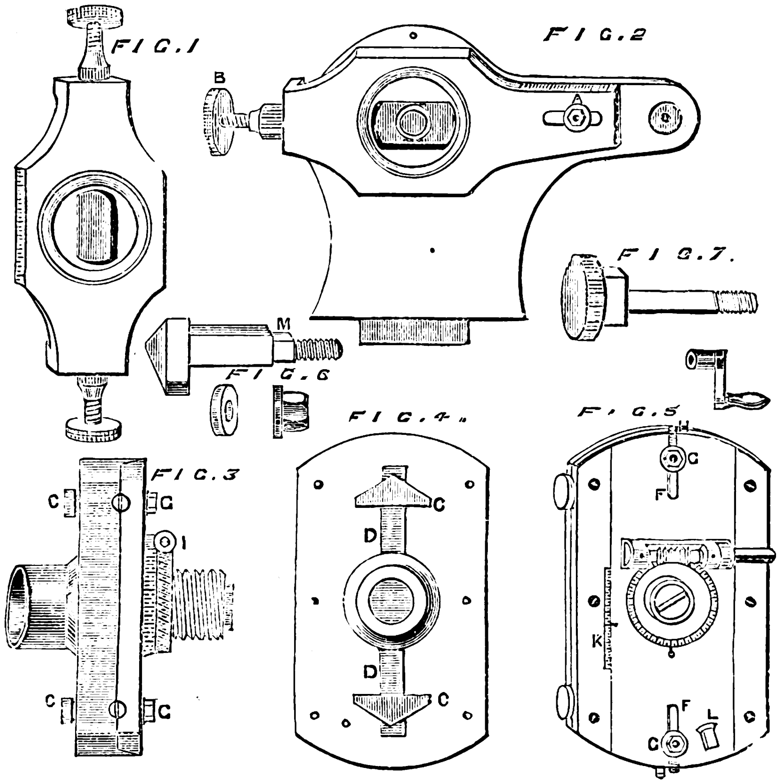
Also, I estimate that every set-screw, or binding-screw, in a 5in. slide-rest costs 1s. 6d. by the time it is fitted into its place, if the work is done as it should be.

Cast-iron nuts are out and out the best for use with cast-steel leading screws, but I should use gunmetal nuts with Bessemer steel screws in second-class rests. Of course, cast-steel screws for best rests run into a good deal more money.

J. K. P.

COMBINED OVAL AND ECCENTRIC CHUCK.

[19833.]—I wish to give a description of how a chuck can be made, which may be used for either oval or eccentric work; and in doing so, I may state that it is only for the use of those who, not being skilful enough to make the separate chucks themselves, and who cannot afford to buy more than one, by getting an oval chuck made after this pattern, can, at the cost of a few pence, use it as an eccentric chuck for all purposes, except for what is called straight-line work, which requires the slide to be moved by a leading screw. The pattern of this chuck is the one given in all books on turning, and I suppose I may call it old-fashioned, as the one described by Mr. Evans in the Mechanic for July 8th, 1881, is a newer pattern, and if I were making another for oval work alone, I should certainly adopt it. I think it would be easier made, as it would avoid having to cut slots; and also there is less strain on the arms which embrace the ring, and which arms would be more readily made parallel, on which parallelism greatly depends the smooth working and truth of the chuck. However, I have made two of the pattern now described, one for myself and one for a friend, and they both work extremely well. The one I made for my friend is not a combination one, I having previously made him an orthodox eccentric chuck. In writing this description, I do not give the minutiæ of the different operations required in the construction, as Mr. Evans has already done so in the number of the Mechanic referred to; at least, as far as the two chucks correspond, and I could not improve on his lesson. Fig. 1 is a view of what is called the eccentric ring, as applied to an ordinary plain lathe-head. Fig. 2 is the pattern which I have adopted in fitting it to my own and friend's back-geared lathes, and the drawing speaks for itself, A, Fig. 2, being a bolt, tapped into lathe-head, which passes through a slot in the ring casting, and when the ring is drawn across the desired amount of eccentricity by the screw B, the conical point of which enters a small hole in the side of lathe-head, A is tightened and secures the ring immovably. Fig. 3 is a side view of chuck, Fig. 4 a back, and Fig. 5 a front one. C C, Figs. 3 and 4, are the jaws which embrace the ring; they slide freely in the slots D D, Fig. 4; they have a shoulder, M, Fig. 6, to bed against the back of slide, and passing through the short slots FF, Fig. 5, are secured by nuts as shown at G G, Figs. 3 and 5; the object of these short slots, which are narrower than the long ones, is that the arms may be adjusted to embrace the ring tightly or not, as may be desired, and they are prevented getting slack during use by the two set-screws shown by the dotted lines at H H, Fig. 5; these are tapped through holes in the ends of the slide, and are nicked for a screwdriver. I, Figs. 3 and 5, shows the division-wheel and tangent-screw worked by the winch-handle J. In making the wheel, as well as all other similar division-wheels which I have fitted to either oval or eccentric chucks, I have adopted 120 divisions as being a better number than 96, generally recommended in books, as in doing double counting the patterns look better when finer than 96 would make them. K, Fig. 5, shows the position of a scale of 1-20in., which is necessary when using the chuck as an eccentric one. When doing so, the eccentric ring is removed from lathe-head, and also the arms which embrace it, shown separate (Fig. 6), with nut and washer. In place of these arms, two bolts, with round flat heads and square shoulders (Fig. 7), fitted nicely to the slots D D, are substituted, and by means of these the slide can be clamped to the body of chuck at any desired degree of eccentricity. These bolts moving in the slots D D allow the slide to be moved as far as necessary. L, Fig. 5, is a steady-pin passing through both slide and back of chuck when "all is at centre," a term which all ornamental turners will understand. This pin, of course, must be removed when the chuck is running as an oval one, or when the slide is thrown out eccentric.



This plan of clamping the slide by the bolts, instead of fixing it by a leading screw as in the usual pattern of eccentric chuck, is sufficiently handy when using it for the only work it is likely to be wanted for—viz., doing geometric figures by double counting, using the eccentric cutter to cut the circles, and in using it this way most beautiful figures, consisting of patterns composed of loops and cusps, may be produced, which can hardly be distinguished from those done by the epicycloidal or geometric chucks. There is, as I have mentioned before, one use of the chuck only which cannot be availed of without a leading screw to move slide, and that is some forms of straight line work which require the slide to be traversed vertically while a drill is cutting the lines. For all plain eccentric patterns can be done much more readily by the eccentric cutter alone, combined with the movements of division-plate of lathe pulley, and the figures now produced by double with eccentric chuck, division-plate of lathe, and eccentric cutter, are what used to be produced by the cumbersome and costly double eccentric chuck now, I believe, obsolete. There is one other use which Mr. Evans says the eccentric chuck is necessary for, and that is the geometric staircase, as shown in his ivory vase in the MECHANIC of March 3rd; but this can be much more easily done, and with far less danger of spoiling either work or chuck, by the universal cutter combined with the movements of division-plate of lathe and slide-rest; and I have done many of them in this way for such purposes as stems of vases and candlesticks. There is an excellent chapter on patterns done by double-counting in Northcott's "Lathes and Turning," and it is the only book I know which treats of this particular branch. I believe it was first introduced by Capt. Ashe, and perhaps he may have written on the subject. In treating of this combination chuck, let it not be imagined that I think it is as good or a better plan than having two separate chucks each for its own use, and I have, as I have said before, made separate ones; but it having struck me how easily they could be combined, I experimented on my oval chuck, and found the combination quite satisfactory.

F. W. G.

HUXLEY'S CALCULATING-MACHINE

[19834.]—In the ENGLISH MECHANIC, Vol. III., No. 59, page 131, will be found a drawing and description of a calculating-machine of my invention. In referring to this, my object is to show the important improvements in the working of the present invention, accomplished by the substitution of motion from centres, instead of a sliding motion as formerly.

The main feature of the machine is, that one scale of divisions being made to cross another, it is contrived that in working the same angle is maintained in the final operation to obtain the answer; so it is evident the readings on the two scales at any point formed by an angle are always in the same proportion to each other. Here, then, is an instrument which answers questions in the rule of three, multiplication, division, &c., and also involution and evolution (by means of a special scale), limited of course by its extent.

It may now be explained that in order to substitute a motion from centres, it is necessary to transfer the former scale, placed on right lines, to the arc of 60° as seen at F and G, Fig. 1, the said right line forming the chord of such arc, and such transfer being made by placing one leg of the compasses in the point A, Fig. 1, and producing the scale on the arc. The points D and E are the two centres from which are produced the arcs A H and A I, on the forearms of which are the scales. Fig. 1 is shown in this position in order that the principles involved in the construction of the machine may be understood. The joints D and E are made in the same manner as the sector or 2ft. rule. At the joint A one arm rotates above the other, thus allowing the forearm G to slide upon the forearm F. Fig. 2 shows the scale produced on an arc from a logarithmic scale on the chord thereof. This scale, if required, might be engraved also under each of the forearms, leaving out the words thereon, being necessary on one side only.

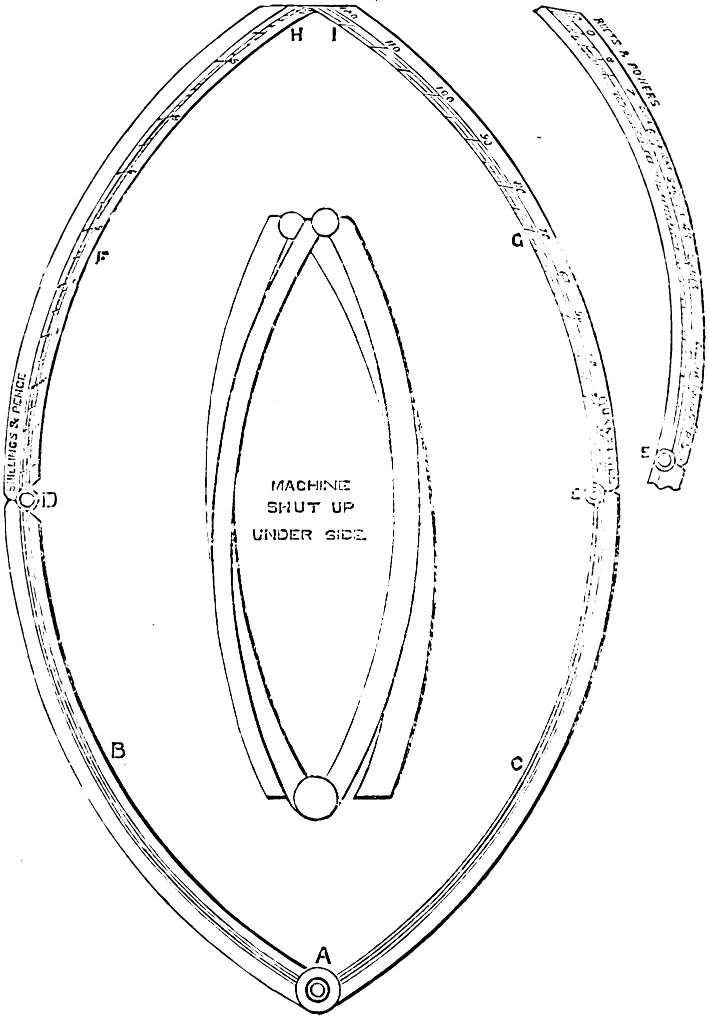


FIG. 1.
FIG. 2

There are two views which may be taken respecting machines of this class; one is theory, the other practice. In theory, that which will work correctly with tens or hundreds, would be equally correct with millions. But practically, our resources are limited by the dimensions which we may deem it convenient to have such a machine for use, and the amount of subdivision of the scales, which we may think advisable to crowd within such space.

Fig. 1 (space being limited) has only half the scales of a machine intended to be made of double that size, namely, 20 shillings in pence, and 240 divisions, portioned into cwts., qrs., and third parts of qrs. (this last amounting to always less than 1d.), total one ton. This is designed specially for use for calculating the workmen's wages in "ironworks," where many calculations have to be made of cwts., qrs., and lbs., at s. d. per ton, and requires a considerable time, if done by slate; but the answers worked out by the machine could be found as fast as they could be written down.

Directions for use.—Any division of any part of either scale may be put in contact with any other, by moving either or both the arms, F and G, on the centres D and E; and now having adjusted a certain quantity to a certain price, and wishing to know the value of some other quantity at such price, we press together or open the arms B, C, till the quantity sought touches upon the opposite scale, where the answer is then seen. The reverse, or new quantities, may be found for given prices. Many other uses could be explained, but space warns me to close.

Barry-road, S.E. J. H. Huxley.

GRINDING AND POLISHING GLASS SPECULA.

[19835.]—IN treating of the Foucault's test. I shall pursue the same plan as I have before—viz., explain the principles, then go to the practical application of them. I shall, as before, suppose we are testing a 6in. speculum of 60in. focus, and that the amateur uses his right eye. This, like the right hand, is, I suppose, mostly used. I shall, therefore, arrange the diagrams and apparatus as most convenient for this mode of applying the test; at the same time, should the amateur be obliged to use his left eye, he can study the principles from the diagrams, and afterwards arrange the apparatus for use in his left-eyed way. I must further observe that the amateur must be able to see distinctly at the distance the speculum is from him when testing; and if he cannot, he must wear spectacles that will enable him, for it is all important that the shadings on the speculum should be within the range of his most distinct vision, or the delicacy of the test will be impaired; as for myself, for instance, I am shortsighted, and I have to wear concave spectacles, or I could not test at all. As I find many amateurs know nothing at all about the Foucault test, I shall, therefore, have to treat of the very rudiments of the process; and I must confess to a feeling of great difficulty in attempting to describe the shadings as appearing in the old way of testing; but, happily for the amateur, the way I now test is free from this difficulty, and, therefore, much easier to describe and to carry out; and as it does not depend on our judgment got by long experience in the use of the test, it can be used at once by the amateur, and in his hands is far more accurate than the old way. But I must first describe the old way as briefly as I can.

In Fig. 1 is given a horizontal section of the important parts of the testing apparatus necessary to the understanding of the principles involved. S is the speculum, which, to save valuable space, I have drawn about one-third its proper focal length as compared with its diameter; but this in no way alters the principles—in fact, the exaggeration rather aids the ocular demonstration of the laws we have to study. C is the chimney of a paraffin-lamp: in my case it is a common ½in. burner or wick; the chimney is a brass tube the same length as the ordinary glass chimney; the flame is seen to be placed obliquely to the speculum so as to have more light than from the flat side of the flame. We must suppose that through the brass chimney there is a very small hole, say about 1-300in. in diameter. How to get this I shall explain when I come to the practical details. This hole must be opposite the brightest part of the flame; the light from the flame will pass through the hole and diverge on to the speculum, which must be at a distance of 120in., i.e., the radius of its curvature, which curvature we will suppose is perfectly spherical. From the speculum the light is reflected back to a point the same distance as the hole in the chimney: this is the focus for the speculum so arranged; but to be able to view this focus, we have to alter the speculum a little, so that the focus is thrown about 1½in. to the left of the hole, and about opposite the middle of the chimney; here we can view it with the right eye at R, the nose will then be at N, and the left eye at L. Now it is evident, if we put the eye close up to the focus, the pupil of the eye will take in all the rays coming from the speculum, as these are all concentrated into the 1-300in., the pupil being ⅛in. or more; now, with the eye thus close, the whole of the face of the speculum will appear equally illuminated (I suppose now it is perfectly spherical); 1, 2, 3 represent the three positions of a piece of sheet-metal seen in section, the right-hand edge of which is a straight edge; this sheet-metal is bent as shown to allow the nose to fall into the curved part without touching it, thus the eye can be got conveniently close to the straight edge. This straight edge we will call, in the future, the shutter, for it has to shut off the light in various positions of the cone of light. Now, it is evident that with the shutter at position 1, if we make it gradually pass from left to right, it will, to the eye close up to it, appear to shut off the light from the left-hand side of the speculum; then the shadow will gradually cross over to the right, while the right-hand edge of the speculum will be the last to disappear. This is easily understood by observing the way the shutter cuts the cone of rays as it passes from left to right. Now, suppose the shutter to be brought back beyond the focus, to position 3: here it is evident that the cone of rays is reversed, and that the shutter, in passing from left to right, will first cut off the rays coming from the right-hand edge of the speculum, and as the shutter advances, it will appear to move on the speculum from right to left—just the opposite direction of position 1; so by this means, and this is the first lesson the amateur has to learn, he can tell whether the shutter is before or behind the focus. If it shuts the light off from the left—*i.e.*, the point from which the shutter is moving, then the shutter is before the focus; but if the light is shut off from right to left—*i.e.*, in the opposite direction to which the shutter is moving, then the shutter is behind the focus. Now let the shutter be placed as in position 2—that is, right opposite the focus; here it is evident that the shutter will cut off all the rays at the same time—*i.e.*, right and left, and middle rays, and the shutter will not appear to pass over the speculum, either from the right or the left-hand side; but a shade, or decrease of light, will come on equally well all over the face of the speculum. Now, in all cases, we can find this exact point by a little experimenting. If the shade is darker on the left side than on the right side, it is evident the shutter is a little in front of the focus; move it back a little, say the 1-50in., and now pass it gently from left to right as before. But now we will suppose the amateur sees the shading on the right is a little darker than that on the left, as the shutter is moved from left to right. This tells him that it is a little behind the focus, and that, therefore, he has moved it too far back: he puts its forward about 1-100in., and again passes it from left to right. Now he cannot tell which side is darkening the most, the right or left of the speculum; and now he knows he has got the exact focus, because the whole of the face of the speculum darkened equally until the light went out as the shutter finally cut off the last ray. Now, if the amateur puts this speculum in a telescope, and finds out the focus of the various zones from observation on a celestial object, he will find that the centre rays, say of 2in. diameter, are longer than the outside rays, and in reality that there is no focus for the whole of the speculum, each zone having its own focus at a different distance from the speculum to every other zone, and that, therefore, perfect definition is not to be expected from a spherical speculum. The rule by which he can calculate this spherical aberration, *i.e.*, the aberration of a spherical surface for parallel rays is: Divide the square of the semidiameter of the speculum by four times the radius of curvature. In our supposed case the aberration would be ·019 nearly, *i.e.*, the centre rays would be ·019 (nearly 1-50in.) longer than the outside ray. From this it is evident that to bring parallel rays to a focus, the centre of the speculum needs to be deepened so as to shorten the focus of the centre rays, or the focus of the outside rays may be lengthened by the outside of the speculum being flattened. In other words, it must be made parabolical. I may just observe that in thus shortening the centre rays, or lengthening the outside rays, we first pass from the spherical surface to the elliptical, and from that to the parabolical; and, if carried further, we get the hyperbola. And I must further observe that these shade out of one into the other quite imperceptibly, and it is the most difficult point to decide when the parabola is just reached, not falling short of it, and being only an elongated ellipse, nor going beyond it, and being an hyperbola, it is impossible to tell as exactly, by the old mode of judging by the shadings (and it requires a vast amount of experience to tell), when the parabola is reached as by the mode I hope to describe in my next letter. Of course, I am supposing that the general truth of each figure we are supposed to be testing is kept—i.e., that the zones between the outside and centre are truly part of the curve supposed, as well as the outside and centre. This is of no less importance to good definition than the centre and outside rays coinciding in their foci. As the centre rays of a spherical surface require to be shortened to bring them to the same focus for parallel rays, it follows that when an elliptical or parabolic, or hyperbolical surface is tested by the Foucault's test, that the centre ray is shorter than the outside ray in its focus. Now it is impossible to tell by the mere shadings when the perfect parabola has been reached, or when the perfect parabola has been lost, and the hyperbola begins; by long practice an approach to certainty may be attained; but it is utterly impossible to describe to an amateur the appearance of the parabola, so that he can be certain, without a deal of practice, the very thing he has not got for his first speculum, and wood engravings are far too coarse to give any proper idea of the very delicate shadings that indicate the true figure; it would not do to tell an amateur that he must wait till he has got as much practice as a With or a Calver before he can judge correctly of the figure of his speculum. This made me desire to find out some easy and yet certain mode of testing for the amateur's use. Now, just to show the difficulty of the old mode, let the amateur remember that in the spherical surface there are but three possible positions for the shutter, therefore the testing for the sphere is most simple; but when we come to the parabola, where there are no two zones with the same focus, when tested by the Foucault's test, the variety of shadings is immense, and is according to the position of the shutter. To show this let the amateur study Fig. 2, where he will see that there are at least eight different places where the passage of the shutter would give different shadings, even though we only divide the speculum into two zones, but it may be divided into four or five zones; the shutter passing over the focus of each would give a different shading for the whole face; now Fig. 2 will help us to study this with two zones taken into consideration (I omit the lamp and diverging rays); now with the shutter at position 1, passing over the cone, it is evident that because it is within the focus of the centre rays B C, that it would appear to pass over from left to right without any shading, since the shutter would first cut off the A, then B, then C, and finally D in the order they occur, *i.e.*, from left to right; at position 2 the left edge of the speculum would be darkened first, then, when the shutter got to the focus of the ray B C, these together would be suddenly cut off, *i.e.*, left and right side at once, and the shadow would then advance to the right side of the speculum; at position 3 the left side of the speculum would be darkened first, then, when the shutter reached the ray C, the place C on the speculum would be darkened, leaving the spaces B and D still light, the shade would creep from C to B, and from C to D, till last the right-hand of the speculum would be darkened; in position 4 the light would be cut off from the space A and C together, then the shading would creep from C towards B and D, and from A towards B, while B and D would be the last to be cut off; in position 5, *i.e.*, at the focus of the outside zone, the ray and space C would be first to be shaded, then the outside A and D would follow, and be shaded together, and the last part, where the light would linger, would be at B, because this is the ray that is furthest from the shutter when it started to move from left to right, and therefore the last to be cut off. I need not go through the other positions, 6, 7, and 8, of the shutter, as my object is not to recommend the amateur to attempt to master this almost hopeless mode of testing, by observing the shadings in the many positions of the shutter that it is capable of being put in, to give variable shadings, even with a parabolical speculum, and then he ought to have a perfect speculum to learn from. His own may be, and probably will be at first, anything but a perfect parabola: how then can he learn with the means at his hands? At one time I thought it was almost hopeless to attempt to teach amateurs the use of the test by description only; but my first step in this direction was when it struck me that if the amateur could always start his testings of his speculum from one point in the cone, and always compare the indications with one another at this point, he would do away with seven of the positions that the shutter may assume, and thus his perplexity would be greatly reduced. I should, therefore, recommend him always to put his shutter at the focus of the outer zone, because the rays crossing here at the greatest angle, this point could be more certainly determined than the focus of any smaller zone. Now, to find this focus let him put, by suspending by a string, a circular disc of cardboard 5in. diameter on the centre of his speculum, thus leaving a zone ½in. all round. He must then find, by experiment, the position of the shutter where the left and right-hand part of the zone are shaded in exactly the same degree, as the shutter is passing over the rays. He can then take away the cardboard disc and pass the shutter over the rays coming from all parts of the speculum. He must be careful not to shift the shutter backwards or forwards, only from left to right. He must now observe how the face of the speculum is shaded, and see if it is as described when the shutter is at position 5; but how to enable him to distinguish an ellipse from a parabola, or the hyperbola from a parabola, I know not by mere description—the

FIG. 1.

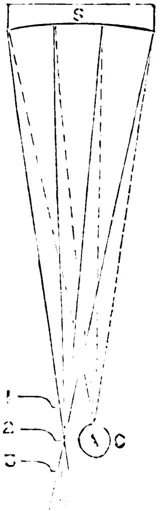
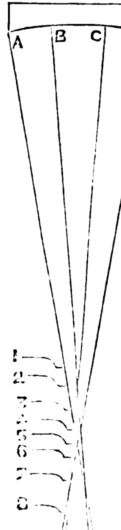


FIG. 2



shadings are so delicate that distinguish the one from the other. Now, the only direction I could give the amateur for a long time was, that he must test by zones in his telescope on a celestial object, and when he has thus got all his zones to give the same focus for parallel rays, he is not far out. He can then observe how the shadings come on under the Foucault's test, and this test could then only give him an idea of the general truth of the figure he had got, and not when it was the exact parabola; only after long practice he may aproximately judge from the shadings. I was not satisfied with this evidently-imperfect state of things, and one requiring a great deal of trouble to the amateur in having to go through two testings, and often having to wait long for a fine night. I know there is another way used by Mr. Calver, if I rightly understand his description in his new edition of "Hints," 1877, page 8, and the way he corrected his 37in. speculum for Mr. Common. I hope I shall be corrected if I misunderstood Mr. Calver's description, but this way is as much trouble as the one I have above described. Mr. Calver's mode seems to be this: he evidently gets the speculum, by his extensive knowledge of the practical working and the shading of specula, as near as he can to a sphere, by testing at the centre of curvature (co-called) or beyond that to the ellipse; he then removes his artificial star, say, to 50 yards distance, and then he works the speculum so that the shading comes on all over alike, and in this way forming an ellipse, which is an approach to the parobola from the sphere; he then puts his artificial star, say, 500 yards distance, and works again in the same direction as before, until he gets again the whole of the shadings to come on all over the face of the speculum alike. This, then, is an ellipse of greater eccentricity than the former, and nearer to the parabola; he then, perhaps, removes his artificial star to a still greater distance, if convenient, and again works his speculum to this test, which is a still nearer approach to the parabola; but, of course, rays proceeding, say, from 1,000 yards are not parallel. He has now to judge how much more working in the same direction and manner will convert this elliptical speculum into a parabolical one. Here, of course, his extensive experience aids him; but where is the poor amateur in his attempts without all this experience? Why, it is almost as good as impossible to him for his first speculum, for this mode demands a great deal of practice and means; and I felt dissatisfied with the state the Foucault's test came into the hands of the amateur, and I could not rest till I discovered an easier mode, and yet a strictly accurate one, for the amateur's use; but as my letter has reached its usual length, and as I think I have given the amateur enough to master at once, I must defer till my next my mode of ascertaining what the figure is of his speculum, and whether it is a true parabola or only an ellipse or hyperbola. I hope to give the description of the apparatus necessary to the practical carrying it out also in my next. There may need even a third letter on the subject, a gathering up the scraps, and giving warnings against sources of error or failures in the practical carrying out of the test. It may be that someone else has before used this form of the test, but I have never heard of it or seen it described.

A mistake has crept into my last letter, page 569, second paragraph, line 33, the word "polisher" ought to be "speculum."

Will Mr. Brashear, to whom I tender my most sincere thanks for his excellent letter, page 592, Vol. XXXIV., explain to me and others what he means in the second paragraph, lines 5 and 6, by "If the tint, which should be of the first or second order," what is "the first or second order"?

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OSSIFEROUS OR BONE-CAVES—PART II.

[19836.]—In a previous paper on this subject we dwelt on historic and pre-historic caves; it will therefore be necessary to confine our remarks to-day to Pleistocene caves, or those belonging to the Palæolithic or age of Unpolished Stone. The European fauna of this age is found to differ from that of the pre-historic, and to include the cave-bear (Ursus spelæus), cave-hyæna (Hyæna spelæa), cave-lion (Felis spelæa), mammoth (Elephas primigenius), glutton, musk-sheep, bison, lynx, reindeer, wild horse, hairy rhinoceros (R. tichorhinus), R. leptorhinus, R. hemitæchus, Irish elk (Megaceros Hibernicus), &c., whilst in no single instance have the remains of any domestic animal been found. There are a great number of caves belonging to this age. Some of the most celebrated are Wookey hole, Kent's cavern, Brixham cave, Kirkdale cave, the cave of Kühlock, the caves of Périgord, Dream cave, and the caves of Belgium.

At a very early date Dr. Schmerling pursued his explorations in the neighbourhood of Liége, where there are numerous caverns, the floors of many of which were composed of unbroken stalagmite. In the cave earth below he not only found the bones of animals both extinct and recent, but also traces of man in the form of rude flint implements, and in the cave of Chokier of a polished and jointed needle-shaped bone with a hole pierced obliquely through its base. In a few cases he also found skulls, teeth, and other human bones. Careful explorations of these Belgian caves were further pursued by Mons. E. Dupont, and as many as 30,000 unpolished flint implements have been found in the cavern of Chaleux and 1,200 in those of Furfooz.

The celebrated Kent's cavern was first scientifically explored by the Rev. J. McEnery, a Roman Catholic clergyman. He commenced his researches in 1824; but when he announced the result in 1825 he found it received with scepticism and incredulity. Later, in the year 1865, the investigation of this cave was pursued under the auspices of a committee appointed by the British Association. Very numerous and most interesting are the fossils and relics which have been discovered. They vary considerably, according to the different strata in which they lay embedded. On the surface was found a miscellaneous collection of articles which would suggest its having been frequented during the historic period. They consisted of pebbles of various kinds, Roman pottery, bronze articles, spindle whorls, bone awls, chisels, combs, &c. In the modern stalagmite the objects included chiefly charred wood, remains of extinct mammalia, flint implements, &c., whilst the antiquity of man received fresh corroboration from the fact of a human jaw being found at the base, whilst the bones of extinct mammals were found in the upper part. Below this stalagmite was the cave-earth, which yielded upwards of 350 flint implements and flakes, besides a quantity of charred bones and charred wood, indicating the places of the hearths; remains of cave-hyæna, Machairodus latidens, mammoth, rhinoceros, Irish elk, and other animals. Also bone tools, consisting of harpoons, some barbed on one side and others on both, and part of a needle, the eye still distinctly visible and capable of admitting fine twine, also a bone pin, &c. The bone needle closely resembles one that was found in one of the French caves. The breccia below contained even more bones than the cave-earth, and without exception they belong to the cave-bear (Ursus spelæus). Mingled with them were four flint implements, one being perfectly angular and sharp, thus proving man to have co-existed with these carnivora. It is besides evident, from the presence of the charred bones and wood in the cave-earth that man must have made the cave his home, where he cooked and ate his meals; the fires being also necessary in order to chase away wild animals. That this cave was also the dwelling-place of hyænas is proved by its possessing those characteristics which are common to all hyæna dens, viz., by the bones which are always gnawed and split for their marrow, by the corners of the entrances being rounded by the friction of the passage of these animals, and by the bones on the floor being worn smooth by the feet of the hyænas. As it was not possible that man shared the occupation of this cave *with* the hyæna, we are led to infer they occupied it *alternately*, the hyæna taking possession while man went on his migrations to other caves, to be disloged on his return. Even in the present day, the same thing is related by the Rev. Dr. Tristram to take place in the caves of Tunis and Syria.

It was in Nov., 1857, that Brixham Cave, in the little fishing-village of the same name, near Torquay, was accidentally discovered by the loss of one of the men's implements whilst quarrying the limestone rocks. The tool was seen a few days later at the bottom of a hole large enough to admit a man. Mr. Philp, who had recently purchased the property, at once descended in order to recover the lost implement, and found that it led into a large cavern, with a stalagmitic floor, from which numerous bones were seen projecting. In May, 1858, the Geological Society appointed Dr. Falconer, Sir Chas. Lyell, Sir A. C. Ramsay, and others, to make a thorough investigation, and decide the question which had been raised by the researches in Kent's Hole, as to the contemporaneousness of man with the extinct mammalia Grants of money were obtained from the Baroness Burdett Coutts and the Royal Society. The result of this exploration proved the cave to have been the dwelling-place of reindeer, mammoth, and other extinct mammals, their bones being discovered in the various deposits. Although no human bones have as yet been found, still, beneath the stalagmitic floor and in the gravel below, were obtained 30 stone implements and flakes, whence it is inferred that man was in Devonshire a contemporary of those animals whose remains are found commingled with these traces of human industry. Thus the alleged discoveries in Kent's Hole received a full confirmation; and it was decisively proved that man not only lived prior to the extinction of these cave animals, but also at a time so remote that the valleys of the district were at least one hundred feet less deep than they are at present.

Wookey Hole, near Wells, in the Mendips, is an instance of a watery cavern, and affords a passage for the course of the R. Axe. It was discovered accidentally by some workmen. Numerous fossil remains of hyenas and their prey, amongst which are to be found even the lion and bear, have been unburied. Dr. Buckland, remarking the peculiar method in which these bones are gnawed, and which is observable in all the caves which these bone-eating animals have made their dens, submitted various bones to hyenas in the Zoological Gardens, as well as to a Cape hyena in Wombwell's menagerie. On comparing the remains with the fossil bones, they were found to bear a remarkable similitude, even to the places of the tooth-marks. Thus, any doubt which might have existed as to this and other caves having been inhabited by hyenas, was at once dispelled. Implements of Palæolithic man have also been found in this cave. As the whole is confusedly mixed together, the cave must have been flooded.

Kirkdale Cave, in Yorkshire, is another instance of a celebrated hyæna den; Dr. Buckland estimating the remains as belonging to between 200 and 300 individuals of all ages.

The cave of Kühloch, in Germany, is supposed to have been inhabited by the cave-bear. It is very interesting, and differs much from other caves. Dr. Buckland, writing of it, remarks, "there are hundreds of cartloads of black animal dust entirely covering the whole floor, to a depth which must average at least ten feet... many hundred—I may say thousand—individuals must have contributed their remains to make up this appalling mass of the dust of death."

Some particularly interesting caves occur in the Dordogne, ten of which have been explored by MM. Lartet and Christy. Thousands of unpolished flint implements have been found, as well as remains of extinct mammals.

Additional evidence of the traces of man in Palæolithic times was furnished by Dr. Falconer, F.G.S., in 1859, by the results of his examination of some of the ossiferous caves of Sicily. The Grotto di Maccagnone was especially noteworthy, as it bore marks of having undergone several changes owing to various climatic influences. Also it gave grounds for inferring that the physical condition of the country was different then from now. For in the breccia, besides ashes and flint implements indicating the presence of man, he found also bones of hyæna and other animals, and especially a vast number of those belonging to the hippopotamus.

We have frequently had occasion to mention the unpolished flint implements; it would therefore, perhaps, be well to briefly describe some of them. They are of very various shapes, sometimes mere flint chips, at others of an ovoid, lanceolate, triangular form or canoe-shaped, and from two to eight inches in length. They consist chiefly of awls, hatchets, saws, round stones used as hammers, spears, javelins, arrow-heads, cutters, scrapers, and lance-heads. Some of them are devoid of handles, others have their ends chipped off for their insertion. The Palæolithic bone implements comprise bone needles, supposed to have been used for sewing skins together. There are also awls and various others to which it is difficult to assign any use. Many of these Palæolithic implements are rude and curious works of art. Thus in one instance a poniard was found cut out of a reindeer's horn, and it was ingeniously made to represent a reindeer, the hind legs being stretched out to form the blade, the back of the animal forming an even surface for a handle. On a piece of mammoth tusk was found a representation of that animal with its long hair. Various other designs have been met with—one of a reindeer, another of two horses' heads, a human figure and a snake, another the well-defined outlines of an ox, another of two outlines of fishes; also parts of an ibex, figures of horse, rhinoceros, Irish elk, &c. And, considering the tools with which these artists did their work, it is matter of no little surprise that these designs, which really display no small amount of artistic feeling, should have been so well executed. And this, moreover, as they are proved to belong to the Palæolithic age, when man was probably simply a hunter, and without the slightest knowledge of metallurgy or pottery.

Having briefly spoken of some of the chief of these Palæolithic caves, the only question which remains to be answered is—what have we learnt from them? In the first place, then, they prove very convincingly that man was coeval with the extinct mammalia, thus assigning to him an antiquity very much more remote than was believed previous to cave exploration, but which is now held by most of, if not all, our eminent scientific men, including Lyell, Ramsay, Huxley, Dawkins, Lubbock, Buckland, Murchison, and others. Then, helped by the data furnished by these caves, and aided by our imaginations, we can form a very vivid and accurate picture of the kind of life led by these distant ancestors of ours. We have seen how, in their uncivilised condition, they contrived to live without houses, making their homes in rude caves, the dens of wild animals

when vacated by man. We have been able to find out the amusements which helped to while away their leisure hours. How, when debarred by inclement weather or other causes from enjoying the pleasures of the hunting-field, they occupied themselves by exercising the artistic talent which lay dormant in them, by adorning their rudely-made implements with roughly carved designs. And, further, we are assisted in forming some conjectures as to what race of people these Palæolithic men were. From the similitude of their engravings on stone and wood, both in design and style of workmanship, to those of the Eskimos of North America of to-day, as well as the fact that, like Pleistocene man, the Eskimos disregard burial and live on the same kind of food as Palæolithic man, Mr. Dawkins holds that in these Americans the same ancient race still survives. He considers that the many points of ethnological resemblance which they have in common cannot be the result of mere accident, but that they are most probably blood-relations.

Again, we have gathered from the examination of these caves much knowledge concerning the European fauna. A comparison of the fossil remains in the caves of the Continent with those of Great Britain proves the fauna to have been similar. We have seen how numerous and varied have been the remains, which are estimated as having belonged to over forty different species, ten of which are believed now to be wholly extinct.

And besides all this, how much have we learnt respecting the climate of Europe and the alterations in its physical geography.

> "There rolls the deep where grew the tree,
> O, Earth, what changes hast thou seen!
> There where the long street roars, hath been
> The stillness of the central sea.
>
> "The hills are shadows, and they flow
> From form to form, and nothing stands;
> They melt like mist, the solid lands,
> Like clouds they shape themselves and go."

That the climate of Europe was very different in the Pleistocene age from what it is at present is judged more especially from the fauna then inhabiting Europe. Thus we find remains of animals accustomed to Arctic regions, such as the rein-deer, woolly rhinoceros, ibex, and mammoth. It is true that the last-mentioned is supposed to have possessed a somewhat elastic constitution; still, it is believed to have preferred cold climates because remains are found most abundantly in the extreme north, many skeletons, and in one instance an entire body preserved in the frozen soil, having been obtained in Siberia. At the same time, traces of animals which now only inhabit temperate zones have been found in these European caves, such as the lion, hippopotamus, and hyæna. This has led geologists to believe that the winter was more severe and the summer milder, and that these animals migrated from N. to S., and S. to N., according to the changing seasons.

This alteration in the climate of Europe is thought to be largely due to the changes which have taken place in its physical geography. From the evidence derived from the fossil remains, not only of these caves, but of those yielded by rivers, and by means of different soundings, geologists argue that in the Pleistocene age, Caldy Island must have been joined to the mainland, and that the Bristol Channel was a fertile plain. That Ireland was joined to Great Britain and Great Britain to the Continent. That the Mediterranean Sea was divided into two salt lakes by Gibraltar being connected to Spain and Africa, and Sicily and Malta to Italy and Africa. That Cyprus was united to Asia Minor; Corsica and Sardinia to Italy; Majorca and Minorca to Spain; that glaciers covered the peaks of the higher mountains of Asia Minor and North Africa; besides other changes. As these physical alterations presuppose an immense lapse of time, geologists are inclined to believe man to be pre-glacial.

In conclusion, whilst these bone-caves have told us so much concerning the climate, physical geography, and fauna of Europe, as well as the antiquity of man, yet they leave us still unenlighted as to his origin, and the truth or falsehood of the theory of evolution. There is no proof that the men whose fossil remains have been found in caves were intellectually inferior to the lowest savage races. No remains of apes, bordering on the human have as yet been met with. But there remains a large field for further exploration, and new discoveries in Greece, Palestine, and other parts of Asia. It will take years to complete, but it is a work which offers many attractions, combining, as it has been remarked, "The excitement of mountaineering with something of its dangers."

M. Sterndale Acworth.

AUTOMATIC MUSICAL INSTRUMENTS.

[19837.]—NOTICING on page 12 the letter of "Gray's Inn" on this subject, as well as one or two others that have recently appeared, I think I may as well make a few comments thereon. The first instrument in which the principle of producing a tune by the use of perforated paper was applied seems to have been patented in 1848. In this case, the notes were those of the ordinary organ-pipes. In 1851 there was standing in the corner of a room at the Society of Arts a fairly large instrument of this kind, and, for all I know, it may stand there still.

The great defect of this plan is that as the paper necessarily travels slowly, the holes open and close *gradually*, whereby a dismal, drawling, moaning effect is produced. I was informed by the late Mr. Croger that he knew of considerable sums having been spent in the endeavour to cure this, but in vain. Somewhere about 25 years ago I turned my attention to the subject, and made several attempts, which were likewise failures, till the idea struck me to employ *free reeds* instead of pipes. I made a model (still in existence) on this plan, using two octaves of concertina notes. This was a vast improvement on the pipes, and I, therefore, claim to have been the first to apply the combination of *reeds* with the perforated paper. The perforated paper was advanced by rollers with indiarubber rings to produce adhesion. A difficulty was, however, found to occur, which I have observed is also apt to occur with the orguinette—viz., the tendency of the band of paper to travel obliquely, and get crumpled and damaged at the edges. This led me to try a pair of toothed wheels, the teeth entering perforations at each side of the band of paper. Another plan which I commenced, but did not completely carry, out was the use of electro-magnets to open ordinary pallets, the paper passing over a metallic drum with a row of contact springs to drop through the perforated paper. A modification of this was the use of metal sheets instead of paper, with strokes and dots of a nonconducting varnish, or of conducting strokes on a non-conducting material. The nuisance of the battery, and the liability to failure at the contacts, are, however, serious drawbacks to this arrangement. The plan has since been employed on a large scale for a so-called electrical organ at the Polytechnic.

Another idea has been to use the perforated paper to admit air to small bellows whose inflation acted on the pallets in an organ windchest of the usual pattern. I found, however, on working it out, that the arrangement became complex and unsatisfactory. This method appears, from your columns, to have been recently applied to act on the notes of an ordinary keyboard, and from the description there is evidently much ingenuity shown in the details. Next we come to the plan of using springs or levers which, on the passage of the perforations, are set free to act on pallets. This I tried on a small pipe organ, but found it very difficult to avoid irregular action, as the adjustment has to be somewhat delicate. I believe, however, the organette (not orguinette) is thus constructed, but with reeds instead of pipes, and I hope any possessor of one of them will state whether the difficulty of adjustment is found to also exist in this instrument. Lastly we come to the orguinette, which is having such a success. In this the novelty consists entirely in the suction principle, and it has very great advantages in some ways. For instance, the paper being pressed down by the air, is kept in close contact with the perforated bar without any system of springs or upper bars. The friction is thus reduced, and the tendency to leakage is almost entirely avoided. There is, however, still the tendency of the paper before-mentioned to get slewed to one side or the other, a defect but partly remedied by the use of the "attachment." I hope this account of an apparatus to which the writer has given much attention, may prove of interest.

A. S. L.

THE ETHER LIMELIGHT.

[19838.]—MR. FISHER, of Tunbridge Wells, has lent me, for experimental trial, his "Ethoxo" apparatus, which has already been mentioned in these columns several times, and I think a short statement about it may not only be of interest, but, to some, of real importance, inasmuch as the apparatus places the very highest form of lime-light, with only one (oxygen) bag, within the reach of country operators, quite out of the way of gas.

I am not sure who was the original inventor of the process of using gas from ether in a lantern. A friend tells me he believes it was first done about three years ago, by Mr. Broughton, a dentist at Manchester, who simply bubbled the oxygen through the fluid, and used for the jet a long safety packing of granulated pumice-stone. The latter was said to give safety, but I should doubt this. The same was said of various packings with the oxy-hydrogen jet; but they all failed at one time or other, and ultimately it was found best to abandon them all, and to trust for safety to good pressure and avoidance of mixture. I should suspect it would, sooner or later, have proved the same here. But, however this may be, the object of the "Ethoxo" arrangement of generator is to greatly lengthen the course by which a small quantity of oxygen may pass through the ether. It is never less than 12in., which gives much hydrogen with so little oxygen as to be safe.

The arrangement is very simple. The oxygen under, say, 112lb. for a 36in. by 24in. by 24in. bag is connected by a T-joint, with a small copper generator. One other branch of the T goes to the ether in the generator, through which a few bubbles pass, carrying off copious ether vapour; the third branch of the T goes to the oxygen-tap of the lantern. The ether vapour goes to the hydrogen-tap, and when turned on alone burns like ordinary gas. The generator is filled with five-eighths of a pint of methylated ether, of which about one-quarter of a pint will be used in two hours. The residue is best poured back after use.

As to the results, the light is, at least, 15 to 20 per cent. better than I can get with the same pressure, with the same mixed jet, and house-gas in another bag. I can only attribute this to the ether vapour being a definite chemical compound, free from the inert and injurious substances which injure common gas. In some localities, the gas itself may do better than it does in London: but with me the difference was very marked, the light being more intense and white. With the polariscope a fine crystal of Brookite, which was a comparative failure with the mixed gases owing to its red colour and the wide angle and peculiar dispersion of its axes, came out very satisfactorily upon the screen when the hydrogen-bag was cut off and connection made with the ether-gas. Students will know what a difficult crystal this is to project, and it is a severe test for any light.

Of course, there is something to be said on both sides. I can see no danger with the apparatus with proper caution, and one is very necessary. Ether vapourises at such a low temperature that there is almost always some little pressure in the generator when filled. Now, if the oxygen-bag tap were turned on *first* when connection is made, a little liquid ether might be forced back into the oxygen tube, or even bag, and if so, a serious explosion might occur. This must be avoided by rigorously turning on the ether-gas tap to the lantern first to relieve the pressure. Again, ether is a ticklish thing to keep in store anyhow, unless one has a cool cellar, which I unfortunately have not, and equally ticklish to carry about. Lastly, ether is such a searching solvent that no grease can be kept upon any taps; hence, however well they are ground, it must be difficult to prevent more or less leakage ere long, when there must be a smell, which most people strongly object to. If I had the apparatus in use I should be inclined to keep it in a tub of water, which ought to stop any smell in the room. Otherwise, it is very difficult to stop it, and this seems to me the greatest drawback.

On the other hand, these objections will apply least just where the convenience of such apparatus will be greatest. To be able, in a country hall, where there is no gas, or in other halls where gas is difficult to get at to fill a bag, to set down anywhere the single oxygen-bag and pressure-board, and a copper vessel no larger than a small tea-kettle, and there and then have at command the most intense form of lime-light with the mixed jet, will be an advantage understood by many. This is what is afforded by the "Ethoxo" form of generator for the ether lime-light. People who have gas will probably not care to meddle needlessly with a highly volatile fluid; but those who have not will probably be exceedingly glad of the information.

Lewis Wright.

OUTDOOR PHOTOGRAPHY AND DRY PLATES.

[19839.]—WE are looking forward during the coming Easter time to employ the extra leisure we shall have in taking a few views direct from nature. Having little experience in such operations, or, in fact, but little experience at all with regard to photography, we are somewhat anxious as to the best manner of proceeding and what materials to employ. If some kind and, more particularly, experienced friend will give a few practical suggestions by which we may accomplish our end without being too lavish as regards expenditure of money, we shall be really grateful. We would like especially to know about dry plates, with some simple formula for developing.

P. and B.

CHEAP DARK SLIDES.

[19840.]—THOSE readers of the "E. M." who, by studying Mr. Stephens letter on page 10 may be tempted to try these cheap and easily-constructed photo-slides he recommends, are likely to be greatly disappointed in their efficiency if their plates be extra-sensitive gelatine, for these thin pine boards (1-10in. thick) are quite permeable to light. I tried them for the purpose recommended, and soon discovered their faultiness. Then I tried blacking them with ink, rubbing in black varnish, soaking in red or yellow dyestuff, but finally concluded that for the shutter we ought certainly use thin Spanish mahogany; the other portions of

the slide may be advantageously constructed as advised; still, as an amateur possessed of experience and not without constructive skill, I can advise my friends in the "E. M." to be content with making their cameras and tripods, but the dark slide, like the lens, ought to be left to the optician; it is a difficult job to make a double slide as it ought to be made, and the price is not so formidable. I got mine from Messrs. Lancaster, of Birmingham, for 5s.; it is extremely well made ¼ plate, and efficient with the most sensitive plates procurable.

E. B. Fennessy.

SCREW PROPELLERS.

[19841.]—To revert back to the subject of inclined propellers, I do not see the advantage of such mode of propulsion, inasmuch as I do not see how you are to reverse them, and go astern. As to "White Swallow's" propeller, I have seen it, and he has, in my presence, submitted it to authorities in London capable of giving an opinion upon its merits. They declare the motion quite novel. It enters and leaves the water in a perpendicular position, having given the water a back-thrust between whiles. My advice to him is "to put it into operation in a moderate-sized boat," and then let the world know its results. I am of opinion it will supersede both the screw and paddle. Its parts are easy of repair and adjustment at sea in moderate weather. It can be fitted on either side of the ship, or on either quarter or stern; it will do away with the long shaft, a deal of friction, and you will consequently get more of the engine-power developed.

To get an efficient scull propeller, you must have it forked like a fish's tail, and, I suspect, flexible; it could be worked with a crank-motion. I notice the swifter the fish, the more forked its tail. It is a mode of propulsion I thought of in 1860, but gave up the idea, as I imagined it would bring great stress on the vessel's stern, and, as I said before, you *cannot go astern with it.*

James D. Curtis,

Twickenham. Captain, R.N.

FUEL AND COMBUSTION.

[19842.]—There are two queries in our last volume relating to fuel and combustion which have passed into the column of "Unanswered," namely, 45349, p. 290, and 45892, p. 506. As these queries involve principles much required in the heating, lighting, and ventilating of rooms and public halls, as also in dealing with questions relating to fuel and combustion, regenerative furnaces, &c., I have constructed a few equations which will perhaps be found of use by your querists. I have not worked out either of the particular problems cited, but have given the general principles by which these and all such others may be calculated.

The temperature of a gaseous mixture is, as is well known, the excess of temperature which will be acquired by the gaseous products of combustion if they preserve the totality of heat disengaged in the reaction. Thus, let H equal the quantity of heat, and h the specific heat by weight of the products, and we have $T = H / h$, a valuating formula which is applicable in all cases where two gases burn in their respective atomic proportions, and based, of course, upon the assumption that the specific heat is not alterable, but constant at all temperatures.

Before proceeding with the calculations, it is necessary to tabulate the total calorific energy of the several combustibles with which we have to deal.

Name.	By weight.		Density (H = 1)		By volume.
Carbon	8,080 C.		——		——
Hydrogen	34,462 C.	×	1	=	34,462 C.
Carbonic oxide	2,403 C.	×	14	=	33,642 C.
Marsh-gas	13,063 C.	×	8	=	104,504 C.
Olefiant gas	11,858 C.	×	14	=	166,012 C.

And first, we shall investigate the calorific power of the elements, carbon and hydrogen, under various conditions, beginning with that of carbon burning in oxygen. Thus, 12 parts by weight of carbon unite with 32 parts of oxygen, and produce 44 parts of carbonic anhydride, with the development of 12×8080 units of heat. The specific heat of carbonic anhydride to water is in the ratio $\cdot 2164 : 1$, and we find, therefore, that the calorific *intensity* of carbon burning in *pure* oxygen to be equal to $12 \times 8080 / 44 \times \cdot 2164 = 10{,}175$ C. This equation may be condensed, and stated thus: the carbon consumed to the carbonic anhydride produced is as $1 : 3{\cdot}67$; therefore, the heat communicated to the carbonic anhydride at the moment of combustion is found by dividing the number of heat units by the quantity of heat necessary to raise the temperature of the carbonic anhydride one degree—$8080 / 3{\cdot}76 \times \cdot 2164 = 8080 / \cdot 794 = 10{,}175$ C.—and if the amount of heat energy were absorbed in a quantity of water equal to the weight of the carbonic anhydride produced, it would raise the temperature to about 2202° C., thus—

Temperature.		Weight of water.		Weight of water.	Temp.
2202°	×	3·67	=	8080	1.

In the foregoing calculation, we have assumed the combustion to have taken place in *pure oxygen*, and in just sufficient quantity to effect complete oxidation; but in ordinary circumstances, the combustion of fuel and gas is made in air: the composition of air being—

	By Weight.	Ratio.	By volume.	Ratio.
Oxygen ..	23·27	1	20·97	1
Nitrogen..	76·73	3·29	79·03	3·76

Now, when combustion takes place in air, an enormous amount of thermal effect is destroyed by the accompanying nitrogen, which plays no part in the generation of heat. This is due to heat being abstracted to expand the nitrogen uniformly with the products of combustion, which results in a lower mean temperature. Thus, with carbon $72 \times 8080 / (44 \times \cdot 2164) + (32 \times 3{\cdot}29 \times \cdot 2438) = 2755^\circ$ C., showing a degradation of thermal effect to the extent of 27 per cent.

We shall now investigate hydrogen in the same manner. 1 part by weight of hydrogen combines with 8 parts of oxygen, producing 9 parts of steam. The specific heat of steam being ·4805 heat units, the calorific *intensity* would be $34462 / 9 \times \cdot 4805 = 7969$ C., a number which represents the maximum amount of heat capable of being imparted by the total reaction of the primitive gases.

It has been shown that only a portion of combustible gases enter into combination, a fraction remaining in the region of highest temperature in presence of a corresponding proportion of oxygen, the heat in this part being sufficiently high to effect dissociation; but for ordinary purposes there is no advantage in discussing this matter in so exhaustive a manner, because the fundamental results will give relative figures for comparison, and will prove quite as serviceable as if we did.

The high degree of temperature shown in the last equation is, however, modified by the latent heat of the steam produced. Thus, if we assume that the combination be instantaneous and complete, and that the latent heat of the steam be 537 heat units, then the calorific intensity would be $34{,}462 - (9 \times 537) / 9 \times \cdot 4805 = 6857^\circ$ C.

Again, if the combustion takes place in air, a further degradation of thermal effect takes place. $34{,}462 - (9 \times 537) / (9 \times \cdot 4805) + (8 \times 3{\cdot}29 \times \cdot 2438) = 2{,}761^\circ$ C.

We are now in possession of all the data necessary, and the above equations render the calculation of the calorific effect of any gas or gaseous mixture a question of extreme simplicity. Applying these principles to that of marsh-gas burning in oxygen, we find that 8 parts by weight unite with 32 parts of oxygen, producing 22 parts of carbonic anhydride and 18 parts of steam. The density of marsh-gas to hydrogen is as 8 : 1, and as the total calorific power is 13,063, we have for temperatures above 100° C. in oxygen, $13{,}063 \times 8 / (\cdot 4805 \times 18) + (22 \times \cdot 2160) = 7{,}794^\circ$ C., and for temperatures below 100° C., $(13{,}063 \times 8) - (18 \times 537) / (\cdot 4805 \times 18) + (22 \times 2160)$. For temperature in air above 100° C., $(13063 \times 8) / (\cdot 4805 \times 18) + (22 \times \cdot 2160) + (32 \times 3{\cdot}29 + \cdot 2438) = 2{,}690^\circ$ C., and for temperatures in air below 100° C., $(13{,}063 \times 8) - (18 \times 537) / (\cdot 4805 \times 18) + (22 \times \cdot 2160) + (32 \times 3{\cdot}29 \times \cdot 2438) = 2{,}429^\circ$ C.

Again, with olefiant gas we have its total calorific power as being 11,858 heat units, and its density 14 : 1, which on combustion will unite with 48 parts by weight of oxygen, and produce 44 parts of carbonic anhydride plus 18 parts of steam. Therefore its calorific intensity burning in oxygen at temperature above 100° C., will be $(11858 \times 14) / (\cdot 4805 \times 18) + (44 \times \cdot 2160) = 9{,}152^\circ$ C., and for temperatures below 100° C., $(118{,}58 \times 14) - (18 \times 537) / (\cdot 4805 \times 18) + (44 \times \cdot 2136) = 8{,}619^\circ$ C., In air, for temperatures above 100° C., $(14 \times 11{,}858) / (\cdot 4{,}805 \times 18) + (44 \times \cdot 2160) + (48 \times 3{\cdot}29 \times \cdot 2438) = 3{,}106^\circ$ C., and for temperatures below 100°C., $(14 \times 11858) - (18 \times 537) / (\cdot 4850 \times 18) + (44 \times \cdot 2160) + (48 \times 3{\cdot}29 \times \cdot 2438) = 2{,}896^\circ$ C.

To make the citations complete, we shall now examine carbonic oxide, burning in oxygen and air. Of course, we have no latent heat of steam in this case. The calorific power of carbonic oxide is 2,403 C.; and its density is 14 = 1. On burning, 14 parts by weight combine with 8 of oxygen, producing 22 of carbonic anhydride. $2403 \times 14 / 2160 \times 22 = 7{,}069^\circ$ C., and burning in air, $2403 \times 14 / (\cdot 2163 \times 22) + (3{\cdot}29 \times 8 \times \cdot 2438) = 2{,}996^\circ$C.

Whatever difference of temperature may exist between the values given above and that actually obtained by experiment, is due to the excess of atmosphere which necessarily surrounds the flame, the specific heat of which becomes a divisory function in the calculations.

Robert Tervet.

Clippens Oil Works, March 16th.

COAL-TAR PRODUCTS.

(*Continued from page* 616, *Vol. XXXIV.*)

[19843.]—The figures in the first columns, under B.P.'s, are not the actual boiling points, but the temperature at which distillation commences. All the figures given refer to products from English coal tar; in the case of Scotch naphthas, the specific gravities are usually lower. Benzols made from Scotch naphthas are not so valuable for colour-making owing to the presence of non-nitrifiable bodies; hence the buyers of benzol usually insert in their contracts the condition "that it (the benzol) shall be a product of pure English coal-tar." The following is the usual method adopted for testing commercial benzols: "100 cubic centimetres of the sample, which shall fairly represent the bulk, are placed in an ordinary 6oz. retort connected with a Liebig's condenser. The thermometer should be so fixed by means of a perforated cork, that its point shall be ⅜in. from the bottom of the retort. Heat is applied to the retort by means of a Bunsen burner; when distillation has commenced, the heat is so regulated that the distillate shall come over in separate drops. When the required temperature is reached, the heat is withdrawn, and after a few minutes the number of cc. distillate is read off; the contents of the retort, after cooling, are added to distillate in burette, and the loss, if any, is added to the percentage as registered by distillate. Since it is often impossible to obtain fair ebullition in a new clean glass retort, in important tests of benzols, retorts which have been in use some time, and have a slight coating of carbon on the interior, should be used.

As the thermometer invariably rises from half to one degree after the heat has been withdrawn. The heat should therefore be withdrawn a little before the required temperature is reached.

This test may also be influenced to the extent of two or three per cent. by a rise or fall in the atmospheric pressure. According to a recent writer in the *Chemical News*, a sample of 30 per cent. benzol made from Scotch tars was influenced to the extent of 12° per cent., by a rise or fall of about one inch in the barometric column. The same writer afterwards admitted that a sample of 30 per cent. benzol made from English tars was influenced, under the same conditions, only to the extent of 4 per cent. It may be well, since the influence of varying atmospheric pressure on the testing of benzols, light oils, &c., has given rise to some discussion, to briefly comment on this phase of the subject.

Mr. A. H. Allen has stated that a difference of 1in. in the height of the barometric column makes a difference of one degree Centigrade in the boiling-point of benzol. Hence, if this be so, if we wish to obtain an approximate idea of the influence of atmospheric pressure upon the results of tests of coal-tar, naphthas, &c., it will be necessary to note the different percentages at the temperature specified by the test, and at a temperature one degree higher or lower. Let us first take one of the crude products—viz., light oil: the sp. gr. of this light oil varies from ·940 to 1·000. It will be seen from the percentage of distillates at every rise of 5° C., as given below:—

Sp. Gr., ·943; B.P., 100°.

C. 110	C. 115	C. 120	C. 125	C. 130	C. 135	C. 140	C. 145	C. 150	C. 155
5	8	10	16	20	23	26	30	34	37

C. 160	C. 165	C. 170	C. 175	C. 180	C.
41	44	47	50	54	percentage.

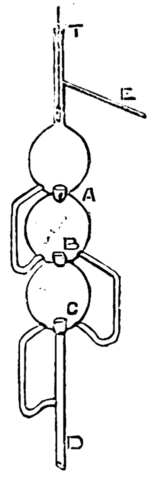
that a difference of one degree Centigrade can practically have but slight influence upon the testing of light oils. I have given the percentage of distillate at temps. from 100° C. to 180° C., because in the buying and selling of light oils there is no specified temperature at which the light oils shall yield a certain percentage of distillate, varying temps. being fixed by the various buyers and sellers. In the case of "once-run naphtha," a more valuable product, this is generally specified to yield a certain percentage at 120° C. A sample giving 41 per cent. at 120 C. gave 43 per cent. at 121 C., a sample giving 50 per cent. at 120 C. gave 53 per cent. at 121 C.; therefore, it is probable, though not certain, that a rise or fall of 1in. in the barometric column would affect the result of test two or three per cent. in these cases. I say it is probable, for it does not follow that because the boiling-point of pure benzol is influenced to the extent of one degree under certain conditions of atmospheric pressure, that the boiling-point of a mixture of several hydrocarbons will be affected under similar conditions to the same extent. When we come to the higher class of benzols we find that one degree temp. makes a greater difference, thus:—Benzol yielding 30 per cent. at 100C. yielded 40 at 101 C.; yielding 47 per cent. at 100 C. yielded 52 at 101 C.; yielding 51 per cent. at 100 C. yielded 58 at 101 C.

In the case of benzol yielding 90 per cent. at 100° C., 1° rise or fall of temperature can make but little difference, there being but 10 cubic centimetres of higher homologues of benzol left boiling in retort, the temperature rises very rapidly. Mr. B. Nickels has published the following method of estimating the percentage of carbon bisulphide present in 90 per cent. benzols:—100 cubic centimetres of the sample are agitated with one gram. of potassium hydrate dissolved in the smallest quantity of boiling absolute alcohol, occasionally during a period of 30 minutes; the mixture is then filtered, the filtrate washed in a glass stoppered separating funnel with its own volume of slightly warm water, the wash water run off, and washing with cold water repeated two or three times. The benzol is then run into a dry bottle, and agitated with a little plaster of Paris to dehydrate. Two samples of English 90 per cent. benzol were treated in the above manner and tested, before and after treatment, in Townson and Mercer's fractionnater.

	No. 1. Before Treatment.	No. 1. After Treatment.	No. 2. Before Treatment.	No. 2. After Treatment.	
Distillation commenced	81·4	83	81	83	C.
10 per cent off	83	84·1	82·5	83·8	C.
20 ,, ,,	84	84·9	83·2	84·4	C.
30 ,, ,,	85	85·4	84·0	85·1	C.
40 ,, ,,	85·5	86·2	85	85·5	C.
50 ,, ,,	86·5	87·1	86	86·2	C.
60 ,, ,,	87·7	88·2	87·1	87·5	C.
70 ,, ,,	89·5	90	89·2	89·3	C.
80 ,, ,,	93	94	92·5	92·5	C.
90 ,, ,,	100	102	100	100	C.
95 ,, ,,	113	119	117	116	C.
Specific gravity	·8819	·8798	·8832	·8812	

It was found that the addition of half per cent. by volume of carbon bisulphide to the treated benzols restored to them their original gravity. It was, therefore, concluded that the above samples contained half per cent. by volume, or 0·7 per cent. by weight, of carbon bisulphide.

Townson and Mercer's Fractionnater.—At A, B, and C are inserted small conical cups of fine copper gauze. D is inserted through a cork, fitting into the neck of an 8oz. flask. When distillation is going on, the distillate condenses on A, B, and C, and thus washes the ascending vapours, whilst the surplus liquids, condensed, pass, by means of the side tubes, back into the flask; the lighter vapours passing forward through E to the condensing apparatus. A thermometer is inserted at T.



200 cubic centimetres of 90 per cent. benzol, after extraction of carbon bisulphide, were distilled in the above apparatus. The first 100cc. distillate from this, which distilled off between 81° C. and 84·5° C., tested in the ordinary manner in 8oz. retort, with thermometer immersed in liquid:—

B.P.	81C.	82	83	84	85C.
80C.	5%	15%	38%	69%	82%

With thermometer in vapour;—

79	9	45	65	76	82%

Mr. B. Nickels gives the following as a proximate analysis of good 90 per cent. English bemzol.

Carbon bisulphide	1·5 per cent.
Light hydro-carbons, sp. gr. 872, not nitrifiable, probably chiefly amylene and acetonitrile......	3·5
Benzene, sp. gr. ·885 and distilling wholly within a range of 2°.	78·4
Toluene, sp. gr. ·8715, and distilling within 2°	16·6
	100·0

The following figures may serve to illustrate the efficacy of this apparatus as a fractionnater.

A sample of impure commercial toluene which tested in the ordinary manner showed:

BP.	110C.	115C.	120C.
107C.	20%	52%	74%

The first 25 per cent. distillate, obtained by distilling in ordinary retort; and retested, gave results as under A. The first 25 per cent. distillate, obtained by distilling in fractionnater, and retested, gave results as under B.

	BP.	100C.	110C.	115C.
A =	100	—	64	84
B =	96	42	90	—

Chemistiana.

(*To be continued.*)

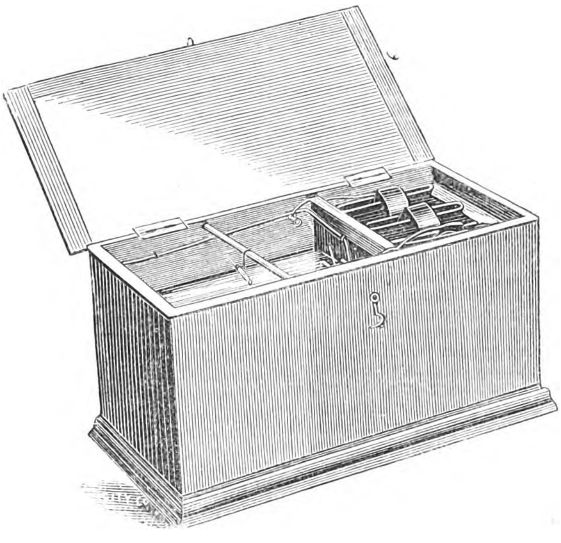
PATENT ELECTRO-PLATING APPARATUS.

[19844.]—I take the liberty of sending you a sketch of my new apparatus for plating either silver or nickel. Knowing how much nickel and silver plating are inquired after in your valuable paper, I thought the matter would be of general interest. The apparatus has been devised for the many and varied workers in metal who desire to put a superior finish on their work.

There are many small articles which appear too trifling to send to a professional plater, and to those working or dealing in such, this apparatus is of great value. It is of good service in technical colleges for class demonstration, and is particularly adapted for amateurs in the fascinating occupation of electro-plating.

The construction of the apparatus forms one of its several merits, bath and battery being in the same mahogany case. The electromotive force is under 4 volts, and the plates having great surface, a considerable quantity of current is obtained. In many cases, nickel-plating is done with too much electromotive force, the result being that the nickel is very easily chipped off. No acids are used in the battery, and the zincs do not require amalgamation, and the battery is *very constant*. The apparatus is on view at the Crystal Palace exhibition on the stands of Messrs. Dale and Co., also Messrs. J. Orme and Co.; they may also be seen at Messrs. Mayfield and Co.'s, 41, Queen Victoria-street; Messrs. Dale and Co., Little Britain; Messrs. Orme and Co., Barbican, and Mr. Paterson, Little Britain, where every information may be obtained. **John E. Chaster.**

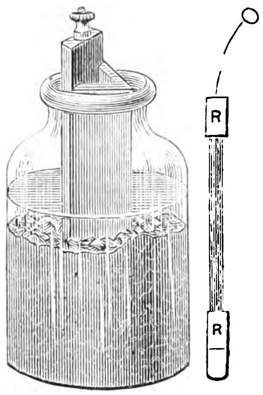
35, Ward's Buildings, Deansgate, Manchester.



TOLMAN'S SAL-AMMONIAC CELL.

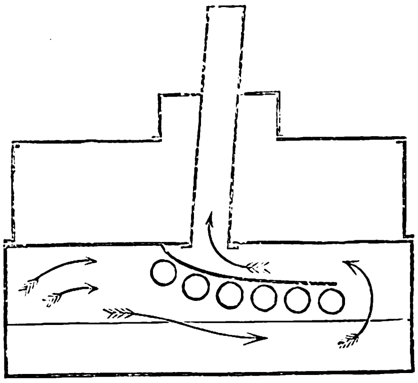
[19845.]—We well know the trouble of making up manganese cells, and when made, total failure in a few weeks. It is not generally known that a plate of carbon and zinc immersed in a solution of sal-ammoniac gives off a fair current, and rings an electric bell fairly well; it would surprise a great many who have not tried it. The fact of this led me to devise the present form of cell, which I have tested for 12 months; on one occasion it was in circuit for two days, with an electric bell and indicator of very little resistance. Of course it was soon exhausted; on disconnecting for less than five minutes, it recovered itself quite equal to its accompanying cell, a new-pattern Leclanché. It has never failed since; have repeatedly tested it; it works a large electric bell: resistance of coils 1·5 ohm.

The arrangement consists of three carbon plates placed to form a hollow prism, and fixing an india-rubber band on each end; one of the carbon plates, which has the terminal on, is 3in. longer than the other two, and is soaked in paraffin-wax for 4in.; the other two are dipped an inch in the wax. The one carbon being longer, the salts cannot creep to the connection. If ready, place the prism in the centre of a glass bottle, and half-fill with broken gas carbon, about the size of beans: on no account use any carbon dust; gently shake, to settle in the smallest compass; fill up within an inch and a half of the top with clean water. Then pour some (not very hot) melted paraffin on the top of the water by degrees, allowing it to set firm before any more is added, till it is level with the top of the jar or bottle; this forms a wax cork: and keeps the carbon prism in place, and prevents salts creeping. Now pour water out. Three parts charge with a saturated solution; also place in a tablespoonful of powdered sal-ammoniac. The zinc rod should be a little longer than the cell, with a piece of rubber tubing, R, on each end to prevent contact with carbon. Take care of any carbon getting loose in the prism, and do not use any greasy vessel. **George Tolman.**



MODEL STEAMBOAT AND BOILERS.

[19846.]—I have noticed a good many queries for dimensions of boilers and best form for driving model engines, and have expected to see some arrangement of tubes suggested in addition to the plain, flat piece of heating-surface which is given



by the ordinary form of boiler. Perhaps it will be said that anything beyond this entails more work and complication; but I think it is quite worth while to go to a little trouble to obtain a boiler which would give a larger and more effective heating-surface, the space available in model steamboats being generally limited.

How would it do to put a series of water-tubes running across the firebox from side to side, commencing at about the middle of its length, and ending within an inch of the end and about 1in. from the top, the chimney to be near the middle, so that the flames from lamp, after heating the first part of firebox, would have to pass under the water-tubes and turn up at the back, and then heat the other half of firebox and pass up the chimney? The sketch will show the arrangement clearly.

It would be very interesting if any reader who has a good model boiler which has any special arrangement of heating-surface, if he would send description, and what size engine it will drive.

E. L. P.

LENSES AND THEIR FOCI.—TO "ORDERIC VITAL" AND OTHERS.

[19847.]—THE next points on which information is wanted relates to lenses singly, and I will put it as briefly as possible. A plano-convex lens, receiving parallel rays on its convex surface, reflects them to a focus at the diameter of curvature; but if the rays falling on it are convergent or divergent at any given angle, how can the new focal points be determined?

If a periscopic lens have its concave surface of a radius equal to the distance from it of a radiant point, and its convex surface $1/n$ that of the concave, where will the focal point be situated?

As variations of the first query, how is the result affected when equi-convex or crossed lenses are used, and of the second query, when the convex surface has a radius greater than the concave?

If two lenses of different foci, but of the same diameter, and so arranged that their foci were on the screen of a photometer, were simultaneously used to transmit parallel rays, would the intensity of the light-spots on the screen be equal or inversely as the squares of the focal lengths? Solar rays are supposed to be used.

Lens.

REFLECTING TELESCOPE.

[19848.]—So much has been written on the adjustment of mirrors, and I must plead guilty to it myself, that those who have not instruments may perhaps suppose that it is beset with difficulties, and may be discouraged from procuring reflecting telescopes. But exactly the reverse is the case. When first I had one, thanks to Mr. Calver's instructions, I never had any difficulty in getting a good adjustment, but I saw very soon the perfection of which it was capable, and I resolved not to rest until the whole thing was accomplished with perfect accuracy and simplicity.

It clears the way, in the first place, to know what is necessary and what is not; and this, perhaps is best stated by saying that the observer has to do with nothing but the mirror, the flat, and the eye-tube—and the beginner should not meddle with the eye-tube until he is quite at home with the other adjustments. The eye-tube is set by the maker, and will most probably, from a good maker, not require altering. So that it is reduced to the two mirrors.

Perfect accuracy, with simplicity, is attained in the adjustment of the large mirror, as has already been described in the ENGLISH MECHANIC, by bringing the spot on the mirror central in the reflection of the flat. Nothing can be easier and simpler, and it is the cardinal adjustment, for unless this is right, nothing is right or can be made right, except by a balance of errors, by adjusting on a star, which I would warn all beginners against as vexation of spirit.

The simplest adjustment of the flat is, with the eye-tube drawn out to power of 200, to make it concentric with the mirror. This is all—and quite sufficient for the first six months, or until the observer wishes to try the inner pinhole. A simple form of this is to fit a piece of cardboard to the tube and make a hole quite central ¼in. diameter. The adjustment of the flat is made at 200, because if the eye-tube should be slightly out of truth, it will be right at the 200, and the change to other focusses will then be so small, that the error, if any, will be hardly appreciable.

Fordingbridge. **T. Westlake.**

P.S.—It may, perhaps, be thought rather unprofessional to make a spot on the mirror—but I do not hesitate to say, that no eye is correct enough to insure a perfect adjustment by only bringing the reflection of the flat central in the mirror, and the best observers will, if they try the spot, be the first to acknowledge that they have with it a simplicity and accuracy which is otherwise quite unattainable.—T. W.

ADJUSTMENT OF REFLECTORS.

[19849.]—A CORRESPONDENT, writing to me after the appearance of Mr. Haren's letter, remarks:—"Notwithstanding so much is said about the atmosphere of America, there seem to be fogs there, and Mr. Haren seems to be in one." Mr. Skelton and Mr. Westlake have been at the pains to describe methods they use, and by which they readily and easily adjust their telescopes accurately, and obtain perfect results. Yet Mr. H., after all, imagines their instruments "may be glaringly out of gear." Mr. H. is not the only one, perhaps, who rides his "hobby" to death, and makes troubles where none exist. It certainly is one of the easiest things to see when a mirror is leaning from axis of tube by its reflecting more of that part of tube towards which it is leaning. And Mr. Skelton has shown that the amateur needs no better plan to bring the mirror quite true than his spot in its centre. The simple plan of measuring with a rule will show whether the plane is in the axis of tube; guessing is not needed.

G. Calver.

VIOLIN SOUNDBOARD WOOD.

[19850.]—SWISS pine, commonly so called, is really a harsh, stiff wood, its principal requirement being a straight grain, some closer together than others. Now, this wood comes from America, that treasure house for timber of all kinds. Australia does not compare, and although the "Kauri" pine of New Zealand is a beautiful wood, yet is too wiry or split-like for a good resonance. For the violin proper we must have strength to resist the down-pressure of the strings, and where this cause is eliminated, as per Berliner's patent, yet a reaction is so necessary that a strong wood is still required. The piano here has no comparison, because the actional vibration is direct—that is, as the hammer moves the string, so the string moves the soundboard, but in the violin the bow pulls the string from side to side, causing a vibration that has to make its way (and does) through the bridge (which it ought to rock, but can't through the pressure), through the soundboard, which is at right angles to the bridge and string, and then through the soundpost to the back. The said soundpost is again at right angles to the soundboard and back, but the return action of the vibration, starting from the back, is turned in the right direction to move the soundboard bridge and string. Yes, though the bow still moves the string the contrary way, yet the reaction moves soundboard up and down, or the right way. Now, if this reaction was not required, much softer wood could be utilised, and indeed would be an absolute necessity; but what with the pressure, &c., a harsh, stiff wood is thus the thing; as we use enormously stiff strings for pianos, so I suppose that a stiff wood soundboard is right, the parties are agreed; but for violins where soft gut is used, soft wood should be the rule. The only way to have this is to place the string in relation to the soundboard as it is placed on a piano, and (shall I blush to say it?) on the new violin. I know many of "ours" will be improving on the idea, but I warn them off the Swiss pine; it's only a waste of time and money. I hereby return thanks to "ours" for their confidence and inquiries, but as I had an ugly rush of clients, I thought this one reply would do for all, and somewhat relieve a **Fiddler.**

MEDICAL REPLIES.

[19851.]—OPACITY OF CORNEA (46411).—This subject is fully dealt with in the article (page 542, No. 881) to which "J. W." refers. When once pustular ophthalmia has produced ulcers and left scars upon the front of the eye, the pupillary opening is obscured permanently, and the sufferer must select some employment which does not require keen or discriminating vision. Simple bathing with warm water or with cold, strong, perfectly-clear tea, is the best thing that can be done to such eyes when they become irritable and inflamed. "J. W." may have other complications, such as vascular cornea, or inflammation of the roots of eyelashes; but here, again, he can only be prescribed for by some one who can make an accurate diagnosis, and his own description is not clear.

"J. R.," who asks me to prescribe for convulsive attacks in his child, must consult a local medical practitioner, who can examine the child.

James Edmunds, M.D., &c.

Grafton-street, Bond-street.

HINTS TO EMIGRANTS.

[19852.]—DURING the last few months a large number of subscribers to the ENGLISH MECHANIC have written to me for advice as to emigrating to this country. I have answered their questions to the best of my ability, and now I have a letter before me from a young man living in co. Meath, Ireland. Some of his queries and my answers may be of interest, and I hope of value to others, who, like him, desire to gain information of a reliable nature concerning this country, and the inducements it offers to the intending immigrant. In a letter which this young man (whom I will call Charles B——) addressed me in October last, he stated that he had worked on a farm all his life, but was fairly well educated. He asked if it would be well for him to come out here as a clerk. I dissuaded him from this, assuring him that the clerk market was already overstocked, while there is always plenty of room for farmers.

In his letter of Feb. 23rd, he refers to the fact that all the vigorous men appear to be leaving Ireland for this country. He states "one man who left from about here last year has written home to say that he is earning 60 dols. per month in New York." I quote this remark for the purpose of pointing out that 60 dols. per month in New York is not worth more than 30 dols. in London, while a man could live very comfortably in the country in England for even less. If a man goes to New York city from an Irish farm and seeks work, the chances are that he could get only the meanest kind of labour at wages which would secure him only the most miserable accommodation. I have seen too much misery in New York city to advise anyone ever to go there to live. It is an excellent place to leave.

My correspondent says that he has been used to overlooking men, although at times he would turn his hand to hard work. He asks if, under those circumstances, it would not be better to "reside somewhere on a farm in America, and gain experience as to the ways of the people before investing any money." Most certainly, Yes. That is the only sensible way. Let me say that unless Charles B—— knows some friends who are farming, to whom he can go, a good way for him to do is to strike out himself into the Far West, take his fortune in his hands, and take the first work that turns up. This is by no means a dreadful or risky thing to do for a man of pluck. If he is going to farm it is of no use to stop in a city, and but little use to advertise promiscuously, although if he comes across a newspaper circulating in the neighbourhood where he would like to settle, he might do something in this line. But there are a variety of ways of getting the kind of work he wants. He might see an advertisement, or meet someone in the train who could help him.

Let me say a word here as to the kind of life my friend will find in the Western States. Very little of the land in some of these states is settled. He may find himself out of society, surrounded by people speaking all kinds of tongues, without schools or churches—that is in, say, Kansas, Iowa, Utah, Dakota, &c. If, however, my correspondent would not mind sacrificing a possible future chance of owning a large Western farm, if by so doing he could secure more comfort for the present, he should have little difficulty in securing work on a farm further east—say, in New England or a Middle State.

My correspondent asks me, "What amount of capital would give a man a fair start in Kansas or Missouri?" This is a question difficult to answer. Charles B—— had better do as he suggests, and go and live on a farm first as a hand; then he will be better able to judge for himself as to the capital required.

He also asks, "What are the extremes of heat and cold in these States, and are all immigrants likely to be attacked with the ague or any other disease?" The extremes of temperature are rather great in some parts of these States; but the atmosphere is dry, and 90 degrees is borne without much inconvenience. The thermometer rarely goes down to zero in Kansas in the winter. In Minnesota it goes down to 40 degrees below zero sometimes. The ague is very prevalent on marshy ground; but if an emigrant chooses a healthy location, which is easily done, he will be safe.

"Are there good markets for all you would produce on your farm?" Yes, if your farm is near a railroad.

"Are mosquitoes, flies, and snakes very prevalent in Kansas and Missouri?" In some parts, especially on low ground, mosquitoes are abundant. Snakes are found in some localities, but the trouble from them is not great.

I have answered all my correspondent's questions to the best of my ability. Let me say that the Mid States I have been referring to chiefly—Kansas and Missouri—are warmer than Ireland. It might suit Charles B—— better to go to Iowa, or Minnesota, or Wisconsin, where 30° below zero is not as difficult to bear as zero in the British Isles. In all of these States he would find an abundant opportunity to make his way, and act as the pioneer for his family. Or if he desired it, he might go to Canada, where the advantages are equal to those to be had in this country.

R. M. Tuttle.

Providence R.I., U.S.A., March 10th.

TO "FELLOW-WORKMAN."

[19853.]—EXCUSE a kindly criticism; but why recommend the amateur to open brass holes to fit pivots when fitting a new verge? If he can run the pivots to fit the jewel-holes, surely he can get them fine enough to fit brass holes, which will be much less trouble and not nearly so detrimental to the watch. I am aware some self-taught men do act upon this plan, and also open the hole in the balance so as to save the turning; but of course, in nine cases out of ten, this way of procedure will put the balance out of poise, and make the watch so that it can never be relied on as a time-keeper.

Perhaps "Fellow-Workman" will excuse me if I say here that he might have given a few more lessons on the cleaning and larger repairs before he gave instructions how to put in a new verge, for we cannot get the amateur to the apex of the horological hill all in one lesson. Tempus.

HOW TO MAKE A CHEAP AND ORNAMENTAL BOOKCASE.

[19854.]—THE reply to letter 19777 is not satisfactory; others than the querist require the same information. He who answers well will confer a public good. I admire Mr. King's ideas; but as I view his drawing I am seized with the idea of huge folios coming down with a crashing weight on my skull! Moreover, there is a difference between *jam* and *books*. The former, in large pots, occupies the top shelves, of course; but the man who makes use of books deals more frequently among his larger ones. For my own part, no book on my shelves remains untouched long. The red ink-stain is perfectly horrible. Why not use blood? Wood-stains can be had at 6d. per bottle, and what can be better? As I am also waiting for instructions to make a cheap and ornamental bookcase, will your readers help? Beta.

LATHES AND LATHE-MAKING—TO "C. H. D."

[19855.]—I HAVE not seen an account of Booth Bros. "Overhead," but have sent to the firm for description. The exact details of planer sent by you I have never quite made out. The drawing suggests a compact and good machine, which I believe it is. O. J. L.

A NEW BICYCLE BACK-WHEEL BEARING.

[19856.]—I SEND the accompanying sketches (drawn half-size) of a back-wheel bearing of my own design, which I have made and found to answer perfectly, thinking they may be useful to some of my fellow-readers. They may be found suitable for either bicycle or tricycle back wheels. I claim for them the following advantages:—They are dust-proof; the wheel cannot drop out; they are very strong, the pin being one size all through. All the wearing parts are of hardened steel, and are renewable. They can be adjusted in a moment.

No more tools are carried, as the key can be combined with the "tommy" for turning centre of head. They *are not patented.*

TO TIGHTEN THE BEARINGS.—Loosen the lock-nuts, turn the pin with the key till the wheel will turn freely but without side shake, then lock one nut, holding the pin in the key to prevent its turning, then lock the other. In practice it is best to allow a little shake when turning the pin, as the nuts tighten the wheel a little in locking.

TO TAKE THE WHEEL OUT (WITH BALLS).—Take out the three screws from each dust-cap, take off the lock-nuts, spread the forks by turning the pin the reverse way until wide enough and remove the balls (they will shake out)—first one side and then the other. Put a piece of wood between the forks, to keep them wide apart; then take out the screw that prevents the outside cone turning the side the key is not. Turn the pin as in tightening the bearing, but allowing the loose cone to turn with it. When tight, turn the reverse way, now keeping the loose cone from turning (a piece of wire may be thrust through the fork-end into small screwhole) until loose cone comes off pin. Remove it, and, with a small screwdriver, turn forwards until the pin is out of cone. Why the screwdriver is used is because the key would not turn inside cone (the tommy-end might be filed flat for this duty). Remove pin, then take out screw preventing key-end cone turning, and the wheel will come out.

TO PUT THE WHEEL IN (WITH BALLS.)—Place the wheel between forks; place one outside cone in position, with dust-cap over it, remembering the left-hand threaded cone goes the right-hand side of machine. Put pin through fork and hob the side the cone is not, turn pin until it is screwed far enough into cone to admit of the other outside cone being placed in position; place it so, with the dust-cap over it; turn the pin the reverse way from before, but allowing the cone first put in to turn with it, the last one, of course, remaining still. When the cones are tight in the hob, should the pin be too short one side and too long the other, turn the pin the way to loosen the wheel, allowing the cone the side the pin is too short to turn with the pin. When open enough, turn the reverse way, but now keeping the cone the short side still, and allowing the long-side cone to turn with the pin. When pin is properly in place, put in the screws that prevent cones turning, spread the forks by turning the pin, put the balls in one side, turn the wheel over, and put them in the other; close cones on then till tight by turning the pin, put in dust-cap screws, and put on lock-nuts.

These directions look very formidable on paper; but, in practice, they are very simple. The coned bearing is tightened, removed, and replaced in the same manner, but without balls, of course. If any reader wishes to make one I will give the method I used without a slide-rest being required.

Fig. 1 shows a combined key and "tommy" for turning centre in head.

Fig. 2 shows coned bearing; N, lock-nuts; F, fork ends; C, cones; P, pin; L, left-hand thread; R, right-hand ditto; K, key square for adjusting; E, eye to take screwdriver.

Fig. 3 ball-bearings; N, lock-nuts; F, fork end: S, screw to prevent cone turning; C, cones; D, dust-caps; B, balls; I, inner cones; H, hub; O, oil-hole; P, pin; L, left-hand thread; E, eye to take screwdriver; R, right-hand thread; K, key-square; S. P., small pin to prevent inner cone turning. Ixion.

FIG. 1

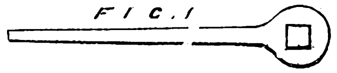


FIG. 2.

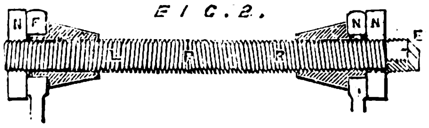
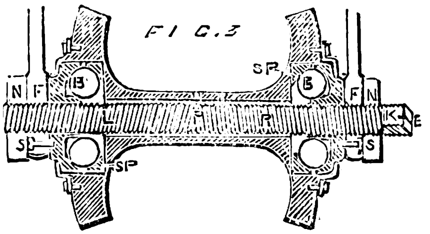


FIG. 3



A SCREWDRIVER IMPROVEMENT.

[19857.]—MOST people who use screwdrivers must be occasionally inclined to use strong language at their persistency in slipping out of the nick, and their refusal to go into it. I do not know how it has happened never to occur to me until the other day—nor to anybody else, so far as I know—how to prevent this, by a very simple addition, especially now that round screwdrivers have almost superseded flat ones, being so much nicer to handle.

All that is wanted is a short tube, big enough to inclose the screw-head somewhat tightly, but only spring-tight, so that it may rise as the screw-head comes near the wood. Also, we have to provide for heads of different sizes with the same driver. All this can be done by just turning up a strongish tin tube, 3in. or 4in. long, like a slate-pencil case, big enough to slide over the widened point of a round screwdriver, and then fitting spring-tight on the shank by means of a piece of leather wrapped round it; and for larger screws than usual, you might pull that socket off and put a larger on, with a thicker piece of leather. I find it answers perfectly. You need not even look at your screw, but just put the tubed screwdriver on, and turn. It will drop into the nick at the first half-turn, and stay there till the screw is screwed home. In unscrewing, of course, the tube must be slid back until the screw-head is clear of the wood, and then slid down during the rest of the unscrewing.

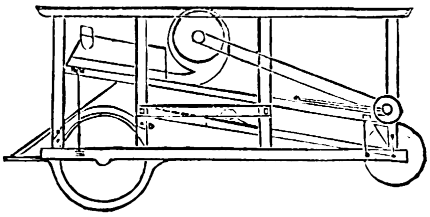
March 20. Edm. Beckett.

Preserving Meat.—A method of preserving meat by causing the heart of the animal to pump boracic acid into the tissues has been recently patented. A sheep, for instance, is stunned by a blow, and blood being withdrawn from the left jugular vein, a strong solution of boracic acid, kept at blood heat is injected. In a few minutes, the heart of the still living animal has pumped the antiseptic fluid into all parts of the body, and the sheep is then killed in the ordinary way by the butcher. The cost is said to be less than 6d. per sheep, and the meat will keep for five or six weeks in summer.

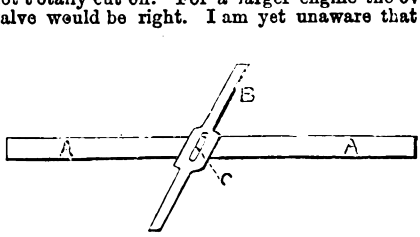
REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[45516.]—**Hand-Thresher.**—I have sent rough sketch of what I think "Strathtay" would require. The best thing I think he can do is to make the whole frame, as shown, and take drum and gearing, &c., out of old frame, and put it in the new, and then he would get the whole in one piece. It would not take him so long to shift it as it would to fit everything on to the old one. You omitted to mention the height of drum-centre from floor, but I have supposed it to be 3ft. 6in. The length of whole frame over posts would then be 8ft. 2in, 3in. sq. wood. The distance between the two posts at drum end is about 1ft. 9in. inside the posts, and then the other one just between the two. There are two shakers 6ft. long, the sides of them being 5in. broad, about $2\frac{1}{2}$ft. from back end, and then tapered to 3in. at point. They are $\frac{7}{8}$in. thick. The crank-shaft is placed about 2ft. from back end, and the points rest on rollers. The crank-shaft should be 1in. diam. and $2\frac{1}{2}$in. of a throw, that is from centre to centre. The journals are 3in. long by $\frac{5}{8}$in. diam., and the bushes made of beech, as brasses rattle terribly. The shakers are driven off small crank-shaft at the point, at the same speed as riddle. Next the riddle is 8ft. 4in. long, and is hung on four springs, and driven by a rod off small crank-shaft. The sides are $3\frac{1}{2}$in. broad, by $\frac{7}{8}$in. thick, and the bottom of it is all close until about 30in. from low end, and then the first riddle is put on. It will be seen from sketch that the riddle frame is deeper here; but you can determine that after you get shakers in, as you will require to keep the riddle as close to shakers as it will work freely. The second riddle is put beneath the first, and the blast blows in between the two. The size of holes in first riddle to be $\frac{7}{8}$ and in second $\frac{3}{8}$. It will be seen that from the rocking motion of the riddle the grain is gathered down to the spout in the corner and shaken out to the floor, the chaff passing out at the end. The fan will be 15in. diam., and the flights, three in number, about 3in. broad. The spindle would do $\frac{5}{8}$in. diam., journals $\frac{1}{2}$in. diam. by 1in. long. The shakers, riddle, and fan could be driven separately at the point about 18 to 5, and I think that a man should drive it easily. The blast would require to be driven about double the speed of riddle; but as I have no more time at present, if "Strathtay" thinks this would suit him, I would gladly give him any more minute information, either through the "E.M." (if the Editor does not object) or by letter.—WAS-HEIL.



[45687.—**Throttle Valve.**—"J. J. A." certainly can't have read the original query carefully. The throttle-valve over which so much valuable space is being wasted really was for a very small model engine, and for such it is not necessary to go to the extent of using an oval valve. Therefore, for a small model, the circular disc is quite sufficient, as from the small capacity of the steam-chest a little leakage is a benefit, as the steam is not totally cut off. For a larger engine the oval valve would be right. I am yet unaware that I used any terms that were incorrect, or that were not known to practical workers. It rests entirely with the Editor, in his discretion, as to whether it is worth while to engrave the sketch I have inclosed of the pattern of the valve showing the chucking spindles. A and A are the spindles, B the valve shown edgeways. C the flat passage through which the spindle goes that it turns on. I have yet to learn that it is needed to show a dia-



gram of a drill to bore a square hole, as, in the first instance, I did not use the words he assumes to have quoted, and further still, no amateur possessing even a superficial knowledge of engine construction would want to be told that the drilled (not cast) hole was for a steady-pin passing through the casting and the valve spindle, and that it did not refer to the spindle aperture itself.—Sunlight.

[45885.]—**Yellow Wash for Funnel.**—Yellow ochre mixed with water to the same consistency as for whitewash, and painted on with ordinary paintbrush. Do not use oil paint or varnish, unless you want it to turn brown with the heat. It will want renewing occasionally. — Marine Engineer.

[45894.]—**Acne.**—I have found it to be greatly relieved, almost cured practically, by abstaining as much as possible from butter. This may require some self-denial at first; but after a time a critical taste in bread will be developed, and butter will come to be regarded as spoiling the flavour.—Nonius.

[45918.]—**Grafting Fruit-Tress.**—I meant to have replied to this query before, but circumstances prevented me. There is one rule in grafting which is a *sine quâ non*, and that is, the bark of scion and stock must be brought into intimate connection; beyond that there is very little, as the exact shape of the cuts may be anything. Always choose for scions perfectly ripened shoots of the previous year; and as to season, the golden rule is that the stock must be further advanced in vegetation than the scion, because unless that is the case the latter will dry up for want of sufficient sap. Therefore, cut your scions as soon as the buds begin to swell, and bury them in the ground or in moist sand. As soon as the stock begins to push vigorously, insert, cover carefully with "wax," and leave the rest to nature. Take care always that the inner bark of both scion and stock are in contact. Plums can be grafted in the ordinary way, but, as a rule, they are budded in July, just the same as roses, because that operation is more certain than the ordinary grafting. Cherries should be shield-grafted — that is, budded in August; the peach the same, but gardeners have some little fancy for earlier or later grafting, according to the stock. The apple and pear can be grafted apparently at any time except winter. If "O. V." does not understand, and no skilled gardener comes forward, I will endeavour to explain further.—Nun. Dor.

[45933.]—**Soldering.**—I shall, before concluding my articles on "Plumbing," give a chapter or two upon this very important and almost unknown branch of the plumbing trade. Such a question as that put by "N. W. E." cannot be answered in Tom Hood's style of "Yes" or "No"; in fact, short answers would only mislead. Rest quiet for a short while until I can get rid of the sanitary work, and then shall come to lead-burning proper. I shall introduce it in cistern-lining.—P. J. Davies.

[45943.]—**Pressure of Water.**—If you alter the size of supply pipe to the motor you must alter the size of discharge pipe as well. You might get a little more power this way. The pressure would be slightly reduced in passing through a meter, but the stop-valve should be of the sluice-valve pattern —giving a straight thoroughfare. You ought certainly to get this, with 36lb. pres.—Labor Omnia Vincit.

[45962.]—**Glass Transparencies (U.Q.)**—As no one has replied to this query, I will endeavour to do so, as I have been giving a great deal of attention to the subject during the last three months. I use gelatine plates of the "quarter plate" size 4¼in. by 3¼in.; as magic-lantern slides are usually 3¼in. square, the plates have to be cut after they are printed; it would be a great convenience if some of the dealers would make the gelatine plates of that size. I have used several makers' plates: there does not seem to be much difference. Mawson and Swan's or Wratten and Wainwrights' are perfect, but I daresay others are as good. To proceed, then: My grocer furnished me with a biscuit-box, about 2ft. 6in. by 1ft. 6in. by 1ft. This box is set up on end, and a small hand-lamp (paraffin) placed inside; a little window, about 6in. square, is cut in the box opposite the flame of the lamp, and over this is placed one thickness of orange-coloured paper, previously varnished to make it transparent; the lamp is then lighted and the lid closed. In the same room (darkened, of course) is another lamp, with the flame turned down when not in use. The wick is about 1in., and it has a ground-glass globe. The negative to be copied is laid on a table face up, and the gelatine plate placed over it, face down; place a piece of black paper over these, and then turn up the lamp last mentioned so that the flame is about half its full height. Then place the thumbs on the black paper covering the plates, and with the tips of the fingers of both hands, raise the plates and black paper, and pressing the plates together, hold them facing the lamp at a distance of about 6ft., the time of exposure will be from 20 seconds to half a minute. Place the plates on the table as before, and turn down the lamp. The developer is made as follows: Put half a pound of sulphate of iron in a quart beer bottle and fill with water up to the top of the cylindrical portion, leaving the round shoulder and neck empty—this makes it easier to pour out of the bottle; then, in a large jug or ewer, place a pound of neutral oxalate of potash, and over this pour as much hot water as will fill three quart bottles to the same height as the sulphate of iron bottle; when dissolved, pour into the bottles. The strength of these solutions, when the salts are dissolved, will now be almost exactly that given in the printed formula. These solutions are to be mixed just before using in the proportion of three of oxalate of potash to one of sulphate of iron. About an ounce of the mixture will be sufficient, and a few drops of a saturated solution of bromide of ammonium should be added to each ounce. This keeps the light parts perfectly transparent; the mixture is poured into a square dish somewhat larger than the plate. The plate should be left in this for at least 10 minutes, but longer steeping does not do any harm. In looking at the orange light through the plate, it will be seen that the plate is almost black, and hardly a vestige of the picture is to be seen; but on steeping in the hyposulphite bath, the picture becomes beautifully clear with a clear glass for the lights, and the shades of a perfectly neutral tint. The usual washings must then be done, and the picture is complete. It will be seen that all depends on giving the right exposure; but this is soon learnt, and by using a weak light the time is more easily regulated. The appearance of the picture during the developing is no guide at all. The pyrogallic acid development is too troublesome for an amateur, and the tone is not so good. A few seconds too long in the developing-bath stains the picture yellow, whereas with the iron it may remain in for a quarter of an hour to twenty minutes, while you are printing another plate. While developing, the plate should be covered. The transparencies made in this way are admirably adapted for colouring; but this is a separate subject, and this reply is already too long. —M.I.C.E.

[45990.]—**Organ Pipes (U.Q.)**—State the scale—*i.e.*, the diameter—of your pipes, or your query will not be answered. To your last question: Yes, 2in.—J. W. W.

[46012.]—**Tile Moulds.**—The obvious answer to this query is, try whether brass strips will be better. Presumably leather is used for cheapness; but then brass, properly screwed on, might answer better. Zinc could be used instead, but probably the brass would be cheaper in the long run.— J. T. M.

[46018.]—**Turbine for Low Fall.**—If the querist will refer to "Molesworth's Pocket-book," he will find rules for calculating the power as applied through turbines, and a table of horse-power from actual practice. I quote one that meets his case: Head 2½ft., velocity of centre of buckets in ft. per sec. 9½, quantity of water 25ft. per sec., revolutions of turbine per minute 34, gave 5 horse-power. The head, it will be seen, is less than his, but the quantity is greater, so that it just about meets his case, and he may rely upon getting 4 h.-p.—S. Mayer.

[46082.]—**Driving Smith's Fan.**—"J. J. A." need not cross the Irish Channel to be convinced that a 6in. fan can easily be driven by hand at the rate of 3,000 revolutions per minute. Mr. John Hope, mechanician, of 14, Water-street, Liverpool, has been kind enough to say that rather than readers of the "E. M." should be misled by such an assertion, he is willing to afford him "ocular demonstration" of the fact at any working hour he may choose to call.—W. H. Davies.

[46089.]—**Muffle Furnaces.**—There is no reason why the furnace described should not be suitable for burning small plaques, &c. All that is necessary is the muffle should be of sufficiently large size to admit the articles requiring to be fired. Large things of the size mentioned you had better get done in a potter's kiln. Should you intend making the furnace, I will send dimensions of the larger muffles.—Arthur E. Morris.

[46109.]—**Hardness of Water.**—Standard solution of soap: 10 grams of pure Castile soap, in fine shavings, are to be dissolved to 1 litre with alcohol of 35 per cent. 1cc. corresponds to 1° of hardness, or ·001 of $CaCO_3$. Standard solution of hard water: Dissolve 1·11 grams of pure dry $CaCl_2$ to 1 litre, with water; or 1 gram of pure marble, or $CaCO_3$, may be dissolved in a slight excess of HCl, and that excess carefully neutralised by excess of NH_3. 1cc. contains lime equivalent to ·001 of $CaCO_3$. As, however, the soap solution is not always correct, it should be standardised by the method about to be described, using 10cc. of the standard hard water, and making up to 70cc. with distilled. Since, however, the distilled water possesses the property of decomposing 1cc., our standard soap solution, if correct, should use 11cc. Supposing, however, it uses 14·5, then, to find what 1cc. of the soap equals of hardness, is arrived at by the following proportion: If 14cc. of the soap solution equals 11° of hardness, what does 1cc. equal? Having obtained a correct standard solution of soap, we now proceed as follows: 70cc. of the water under examination is accurately measured, and introduced into a stoppered bottle of about 200cc. capacity, and agitated thoroughly; then suck out the air from the bottle through a glass tube, so that any CO_2 given off by the water may be thereby removed. Next add 1cc. of the standard solution of soap, shake the bottle vigorously, and repeat the process after each addition, decreasing the quantity of soap-test added from time to time, until, as the reaction is approaching completion, the soap solution must be added drop by drop. When a good froth has been obtained by shaking, the bottle is laid down on its side; and if the lather remains permanent for the space of five minutes, the operation is finished, and the quantity of soap-solution used must be accurately noted. If, however, the lather breaks up before the expiration of five minutes, more soap-solution must be added until the lather acquires the requisite stability. The reason that a lather cannot be produced until a certain quantity of the soap has been used is, that when soap comes in contact with waters containing salts of lime and magnesia, the soluble alkaline oleates, stearates, and palmitates composing the soap are decomposed with the formation of insoluble lime and magnesia salts of the fatty acids. Hence it is impossible to get a lather until the water has been softened at the expense of the soap. If the water is very hard and uses more than 16cc. of soap, an aliquot part of 70cc. must be taken and diluted to that volume with distilled water, since the results are not so accurate with a large quantity of soap. The process is gone through as described, but the number expressive of hardness will have to be multiplied by 2 if 35cc. be taken, or some other figure according to the degree of dilution of the sample. But when noting down the number of cc. used, 1cc. must be deducted from the distilled water used, for the reason above described. When the excessive hardness is caused by the presence of magnesia salts, indicated by a characteristic lightness of the curd, the water should be diluted with distilled water until less than 9cc. of soap are required for 70cc. of the diluted water. The quantity of soap thus consumed is called the "total hardness," but many waters become softer on boiling. This is due to $CaCO_3$, held in solution by the excess of CO_2, hence, when it is boiled the excess of CO_2 is driven off, and $CaCO_3$ precipitated. The decrease produced by boiling is called "temporary hardness," whilst the remaining hardness is termed "permanent." The permanent hardness, which is due almost entirely to $CaSO_4$ and $MgSO_4$, is ascertained by first boiling some of the water (about 200cc. or 300cc.), gently allowing the steam to escape freely, and then, after it has cooled and the loss by evaporation has been made up with recently-boiled distilled water, applying to it the soap-test as before. On no account must the steam from the flask be condensed and allowed to flow back into the boiling liquid, because the condensed water dissolves the escaping CO_2, which is thus continually returned to the contents of the flask in sufficient quantity to prevent the complete precipitation of the carbonate of lime. Hoping I have not made this too long for insertion, if the querist requires a table for the conversion of these degrees into Dr. Clark's, I shall be glad to let him have it.—J. C. Belcher.

[46118.]—**Slide Valve and Piston.**—If you have a good lathe or planing machine handy, take a light cut across the valve face—that is, at right angles to the direction of the valve's travel. Then, if the cylinder face is not badly cut, you can scrape the face to the valve, using a little thin red lead and oil to show the high parts If the cylinder face is badly cut, you must get it planed up by some firm who have a portable planing apparatus for such jobs. On no account attempt to grind the valve and face together. Anything I can tell you I will with pleasure.—Labor Omnia Vincit.

[46158.]—**Ginger Ale**—Is an aërated beverage made in the usual way, but flavoured with soluble essences of ginger and capsicum and essential oils. —R.

[46161.]—**Pumping to Pressure.**—Your idea of an escape valve to supply the reservoir is practical enough, but it is not economical as far as working expenses go. You would have the extra pressure on pumps and main, which would require more steam, and consequently more coal, to do the work. As the supply to 3in. main is but small compared to the other, why not put down a set of force pumps for the high level specially, and drive by a belt from the main engine?—Labor Omnia Vincit.

[46177.]—**Tinning Bicycle Spokes.**—I see no difficulty in doing this. Clean the spoke with number F emery cloth; have a Bunsen gas-burner (ordinary burner would not do, as it would smut the work, and the tin would not stick), with a rubber-tube to feed it. Heat the spoke with this, having previously wetted it with spirit of salts, with a little zinc in it; when hot enough to melt the tin, run a little along the spoke, smoothing it if rough in places with a hot soldering-copper. I have thought of doing this myself to prevent rusting, but have not done so as yet. Would "52in." say how it answers after a month or so's trial? It is very easy to take a wheel to pieces, but quite another thing to put it together again,—about the most difficult thing in making a machine.—Ixion.

[46199.]—**Impurities in Acids.**—Commercial sulphuric acid often contains lead sulphate, and not unfrequently arsenic (which is derived from the pyrites). The lead sulphate is owing to the action of the acid on the leaden chambers in which it is condensed during its manufacture. It also frequently contains nitrogen oxides and sulphur dioxide. The latter may be detected by shaking the acid in a bottle and testing the air with iodised starch-paper. If the paper is turned blue the lower oxides of nitrogen are present, and if sulphur dioxide be present the blue colour will gradually be destroyed owing to the bleaching properties of the dioxide. Sulphuric acid may be purified from lead sulphate and oxides of nitrogen by redistilling it with the addition of a small quantity of ammonium sulphate. The hydrochloric acid of commerce generally possesses a yellow colour, which is due to the presence of either chlorine or ferric chloride. Sometimes, too, it contains sulphurous, arsenious, and sulphuric acids got from impurities in the oil of vitriol used in its manufacture. Nitric acid has a yellow colour, owing to the presence of lower oxides of nitrogen, from which it may be freed by passing a current of air through the acid. Oxalic acid, being produced from nitric acid and various organic substances, often has impurities which are difficult to determine. Some of the oxides of nitrogen are frequently present.—Hugh Tunnadine.

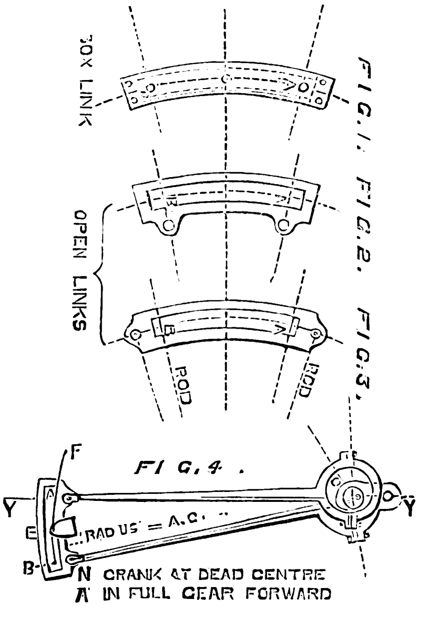
[46202.]—**Pattern Making and Casting.**—To "Cast Iron."—Many thanks for kind offer. A few hints on pattern making for tools and machinery for amateur engineer's workshop, and a little instruction in brass-casting, would be of great service to those who have not back vols. to refer to.—E. C.

[46213.]—**Measuring Steam.**—I have never heard of any kind of meter for this purpose. But it seems to me that the best and fairest way would be for the parties to get some independent engineer to come at stated times, and indicate the engine, and let the price be based on the horse-power exerted. The practice of supplying "room and turning" is common enough in the northern manufacturing towns, and this looks like a similar instance.—Labor Omnia Vincit.

[46217.]—**Model Electric Engine.**—In reply to Mr. Lancaster (p. 16) I would like to make one with power enough to work an American organ. Should like to hear from Mr. Lancaster. I thank "R. W." for his answer.—W. F. G.

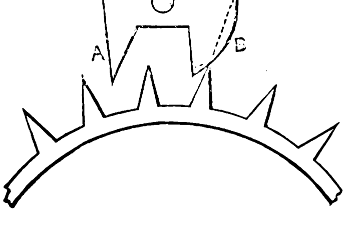
[46220 and 46222.]—**Link-Motion.**—To give "rules" for proportions of link-motion is not quite as easy as "A. B. C." and would require one to write a small book. Besides which, it is necessary to thoroughly understand the slide-valve as well. If, however, you simply wish to use the link as a reversing gear, and are not particular about equalising the admissions at each end of the stroke, the matter is not so very difficult. A small amount of lap will do for reversing; the link should be struck out with a radius equal to the length of the eccentric rods (not straight—that requires a different arrangement). The link may be four times the stroke of the valve in length, measuring from the centre of link-block at its two extreme positions, and it may be hung from one end, by hangers longer than itself, to arm of reversing shaft, which should be arranged in such a position that the link-block will travel up and down as little as possible in working. The eccentric rods should be so connected with the ends of the link that they will be crossed when the eccentrics are both towards it; the head of the slide-valve will then disappear at mid-gear and the reversing lever can be used to shut off steam. If you wish to use the link as expansion gear, you must have a good deal of lap on the valve—one port of lap is a good proportion. If this is not possible, owing to the space between your ports, have as much lap as you can get without throttling the exhaust when the steam-port is wide open. Next let the eccentric rods be crossed when the eccentrics point away from the link, because then the lead will increase towards mid-gear, which is better than losing it in the intermediate gears. To explain how to equalise the admission is difficult without figures; the principle, however, on which it is done may be shortly told. First it must be understood that since the angles of admission are equal, the engine will get more steam at the back end of the cylinder than at the front, owing to the obliquity of the connecting-rod. Moreover, it can be imagined that the slight movement of the block in the link in working will have an effect in shortening or lengthening the admission according as it moves to or from the centre of the link. This movement is taken advantage of by so placing the reversing shaft and its arm that the movement of the block in the link corrects the inequality in the admissions.—F. A. M.

[46220.]—**Link-Motion.**—You may use one of the three forms shown on the annexed sketch. But if I were you, I should prefer 1 or 2 to 3 for these reasons: the extremity of the eccentric rod comes just opposite the stud of the valve rod when your engine is in full gear. No. 3 is perhaps more compact, but requires larger eccentric sheaves. Moreover, the chief difficulties lie in the fact that since the stud of the valve rod is below the extremity of the eccentric rod, you will find it difficult to determine the proper angular advance and throw. They can only be discovered by approximate guesswork, entailing a succession of tedious trials, especially when you have not at your disposal an apparatus or working model to facilitate your researches. Having adopted No. 1 or No. 2, you will proceed to determine, by some well-known method, the angular advance, throw, outside lap, lead and side lap (if any), from the knowledge of the lengths of admission, compression, pre-admission, early exhaust, &c. The unknown elements are found as if you had to deal with a single eccentric. I should strongly recommend the beautiful and general method of Zeuner's polary diagram. Both eccentrics may be set with the same angular advance. The length of eccentric rods is not to be less than 10½ times the throw, or else no methods in use to find the above elements will give correct results, as such methods are based on the fact that when the length of the rods is over 10½ times the throw, this length may be disregarded. We shall, besides, see that in the case of a link it is advisable to have very long eccentric rods. The length of the link marked A B on the sketches seems immaterial. It cannot, however, be too short nor too long. If it is too short, the amplitude of its oscillations is greater than is necessary, and the stud of the valve rod works hard, and this would be noxious to the regularity of the movements of the slide. A good proportion is from 0·8 to 0·9 of the diameter of the piston. This limit ought not to be exceeded, as otherwise an over-long link will impair the working of steam in the cylinder, as will be explained hereafter. The radius of curvature of the link is equal to the length of the eccentric rods. This condition it essential. When this radius of curvature is not made equal to the length of the longest rod, it will be difficult to insure equal leads for each side of the piston and for each notch of the sector. As to the suspension-links, they can be indifferently connected, either at the middle, or at any one of the two extremities of the link; care must, however, be taken to make the suspension-link as long as can be done. The distance of the suspension-link's extremity connected with the tumbling-shaft from engine-shaft, is equal to the length of eccentric rods, minus the *versed sine* of the link's curve. Had you given us the dimensions of your steam-ports, and conditions under which the steam has to work the piston, I should have been pleased to work out the design of your link, and show how to proportion its different parts. Fig. 4 is a skeleton sketch of link, No. 2, often in use. O is the centre of shaft. O C = O D throw of eccentrics. C A = C B vertical length of eccentric rod. A B = chord of curvature of link. No important error would arise from substituting the length of this chord for that of the arc. The link is suspended at E by the link E F, the distance of E from O Y is equal to C A — *versed sine* of arc A B. The radius of curvature of A B is equal to A B; the centre is about D, but the smallness of the sketch could not allow me to mark it neatly. Concluding remark: I have said before that the link must not be too long. It is shown by practice and theory that the lead increases as the link is lowered (this is only true in the case of open rods, as in Fig. 4). But for all that, the opening of the steam ports is getting less and less. The cut-off begins early, and the expansion is long. It is the same, of course, with compression. These two occurences are detrimental to the working of the engine. They are more marked with short eccentric rods. Avoid them, and as much as as possible, try to get long rods, so that the length of the link will be short when compared with them. See the most recent four-coupled engines on the M.R.; the links are placed beyond the motion-plate; such a distribution is generally found to work regularly. It is perhaps more for the purpose of being enabled to reverse the motion than to have the advantages of the cut off, that you want to fit your engine with a link. Still, I should advise you not to disregard the observations given above, as you will lose nothing by being a little at the trouble of setting accurately your valve-gear. If your steam-ports are relatively shorter but wider than they would be in a locomotive, I should insist chiefly upon long rods and a short link.—Ed. Gobert, B.Sc., Nottingham.



[46224.]—**Silver Solution.**—I do not wonder that J. M. Stocks got a "dirty mess" by introducing a few drops of CS_2 into a plating solution. The instructions in Gore's "Electro-Metallurgy" are as follows:—The brightening effect is produced by attending to the following directions: Take one quart of ordinary cyanide of silver plating liquid, old liquid by preference, containing 2lb. of cyanide of potassium per gallon; add to it 4oz. of strong liquid ammonia, 4oz. of bisulphide of carbon, and 2oz. of ether, and shake it occasionally. After it has stood twenty-four hours, add two ounces of the supernatant liquid to 20 gallons of ordinary silver plating solution, with gentle stirring, every alternate day. Or add it every day during the morning in summer, and evening in winter. But in every case it is highly important to add only the least possible quantity necessary to produce the effect, for a greater number of silver plating solutions have been spoiled by addition of an excess of brightening liquid than by all other causes put together. If too much "bright" is added the plated articles become of a brown colour, and frequently spotted. The bisulphide of carbon mixture gradually becomes black; it may stand an indefinite length of time, and as 2oz. of the supernatant liquid is taken out, an equal volume of old plating solution, strong in cyanide, or a strong solution of cyanide alone, should be added; this gradually decreases its blackness, and also prevents its producing a precipitate when added to the solution in the vat.—Sydney H. Holden.

[46234.]—**Drum Timepiece.**—The French drum timepiece is universally voted by the trade a perfect nuisance. The principle on which the escapement is constructed is unsound—the impulse being given only from one pallet (*a*). The best remedy I can suggest is the alteration of the resting pallet (*b*) to the form indicated by the dotted lines in the accompanying sketch. Frequently, the cause of stopping is the wearing flat of the back pivot just above the pendulum. This, of course, increases the friction, and stops the clock. In such a case file the pivot to a V shape, commonly called a knife-edge: this will give it a light action. Should neither of the above suggestions avail, the only remedy is new pallets to take over three or four teeth.—C. H. Spurge.



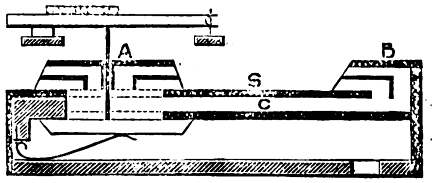
[46286.]—**Geneva Watch.**—Near balance in plate is a screw with half a head; move this just enough to allow watch to pass from front. Be careful to keep balance from contact with side of case, or cylinder will be broken. Be sure not to forget this in putting back movement to case. Ascertain if mainspring is wound; if so, put a small bristle in 'scape-wheel to prevent watch running down when cock and cylinder are being taken out; unscrew cock, and gently prise it up with tweezer's point; take cylinder out of 'scape-wheel teeth, also steady-pins out of plate. After these are loose on plate take them away, holding top and bottom of hairspring stud with tweezers, balance between. Take off hands with a good pair of pliers, and face by unpinning—if screwed, by half a turn to the screw holding it. After face is off, take out hand-wheels; minute-hand pinion can be taken off by a smart tap on end of set-square, where the minute-hand goes on, and is finally taken out by pulling the set-square at back. Now remove bristle, and let spring run down; after which take out all cocks one by one, and keep each screw, wheel, and cock separate, or difficulty may occur in putting together. Get a moderately stiff brush, some good chalk, and after cleaning off all grease with benzoline, brush with a circular motion, using as little chalk as possible; brush the wheels and plate; clean pinions with a bit of cork cut wedge-shape, and holes in cocks and plate with peg. After plate, cocks, wheels, pinions, &c., are all clean, put them back in their places. We now come to the cylinder: examine this with the cock, and it will easily be seen how to take them in pieces; clean cylinder inside and out with elder-pith, and cork cut to a point; take out jewels and clean with pith. The cock jewel comes out by removing the two small screws underneath; the cock holding bottom jewel should be unscrewed before cleaning the plate, and put back after plate is cleaned; this jewel is in a brass setting, and is screwed with one screw under cylinder. In putting back cylinder and cock after they are in place, be sure the hairspring is flat, and does not rub anywhere; also be sure the outer coil is exactly between the regulator-pins when they are in any position, or the watch cannot be regulated to a nicety; put one drop of oil to each pivot with a fine blunt-pointed needle; also one small drop on 'scape-wheel teeth.—Skip.

[46295.]—**Paralysis.**—Your friend has undoubtedly been attended by medical men who know nothing, or, at any rate, very little of the case in question. Paralysus of the legs is a disease which cannot be cured without the help of an experienced surgeon, and it is quite impossible for you, although you might do him good for a short time with the machine you speak of, to enable him to regain his walking powers. I know a friend who once suffered severely from the same complaint, and who has been successfully cured within the space of eight months by F. Graham Bennett, M.R.C.S. and L.S.A., 7, Hertford-street, Mayfair, London, W., to whom he was recommended, although despaired of by other medical men.—Lennox Moore, Cambridge.

[46296.]—**Harmonium or Organ.**—Thanks to "D.," but being a public person, and only making my own instrument by way of amusement, I shrink from advertising my address—willing, nevertheless, to give it to "D." in any private way. Does "D." misunderstand me? I did not intend to make combined pressure and exhaust instrument. My question is, Which of the two is best? Doubtless the wind admitted to the American reed by the cell measuring it explains one great reason for purity of tone—not forgetting the bend, of course. Holding this theory, I intended to turn my 2-row American soundboard upside down, on to pressure-bellows, putting the usual harmonium-pallets on. And for the other 2-row, I had thought to use a harmonium-pan with bent French reeds. But how to put extended pallets for this 4-row I could not see. Before passing judgment, will any gentleman possessing a harmonium open up his instrument and try the effect of a few cells placed over the reeds. To intending A. O. builders I commend "Elève's" instructions for improvement of bass by the additional depth of windchest at that end. I have made my own instrument 1¾in. at bass end, and with sub-bass reeds bent and twisted too, I have got a tone so pure and rich that it is really superior to many "subs" of the best makers. "Saul Rymea," "D.," "Organon," and other gentlemen of the wavy ether—venerated offspring of the ancient Jubal—shall we press you to speak, or shall we exhaust your patience?—Beta.

[46296.]—**Harmonium or Organ.**—In a harmonium containing four rows of vibrators, the pallets should be made of sufficient length to cover all the pallet apertures belonging to each key, but the leather covering the pallet should not extend the full length of it, but only where it covers the pallet-holes. By this means the pallet will be better and the leather on the pallet will bed nicely over the pallet-holes. The pipe-like quality of tone, which is to be found only in the American organ, cannot be produced by a reed-organ constructed on the harmonium principle. In the American organ, the reeds are thinner than those of the harmonium. This characteristic, combined with the suction principle of drawing the air downwards through the reeds, and also the manner in which the reeds are voiced, produces the much admired pipe-like quality of tone. If my advice is of any use to "Beta," I would suggest that he should construct an organ on the suction principle, having four rows of vibrators as follows:—One set of 16ft. reeds of five octaves, one set of 4ft. reeds and two sets of 8ft. reeds. By this arrangement the following stops could be introduced: Bourdon, Baritone, Principal, Diapason, Bassoon, Flute, Dulciana, and Hautboy. An octave coupler added to the above would greatly increase the power and beauty of tone of the instrument.—G. Fryer.

[46296.]—**Harmonium or Organ.**—I send the inclosed rough sketch as my idea of the easiest way to alter a 2-row instrument to a 4-row, or larger. As for turning the present arrangement upside down, what do you expect to gain by it—improved tone, or simplicity of construction? From what little I have seen or heard, you will secure neither. If your present board is an ordinary recent make, you will find that there is sufficient room above middle C to add 2 half-rows, as at Fig. A, which will enhance its capability very much—viz., ½ set of 8ft. pitch to form celeste tone with your present 8ft., and, of course, as solo as well, and ½ set of 16ft. pitch voiced, say, oboe, without disturbing any part of the action. If you decide on doing so, put the celeste set on the opposite hand to your present 8ft. I have treated two boards this way with good results. If, however, this should not satisfy you, add two complete sets at the back of your soundboard, either in the ordinary style, or one above the other, as shown at B, which is more get-atable. In this case you will have to remove your pallets, and put a set of channels across the underside of the soundboard, as shown in the cut (C); about ¾in. deep will do, which will, of course, increase the depth of the windchest, but the same pallets will do, and you would only require a fresh set of pitman rods; and you may even make them do if you have room to lower your keyboard as much as you put to the depth of your windchest. If you look at "Elève's" drawings (by the way I wonder where he is—I owe him a debt of thanks), you will see how the sub-bass is arranged with an extra pallet; this, perhaps, would suit you better, but it means more careful workmanship, and a nasty touch if you are not pretty well up to it. I expect your chief difficulty will be the tube-boards, if you want anything differing from the shop ones; should you make them, I could perhaps give you a hint or two. I have in hand now, nearly complete, a two-manual, with 10 registers, which I have made throughout. I intend to send a set of drawings of same, if our editor thinks them suitable.—Joiner.



[Please send.—Ed.]

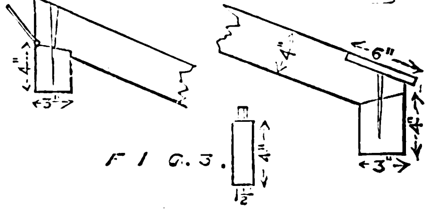
[46309.—**Filter.**—Water filtered in the way stated is good enough for washing, &c.; but scarcely so for drinking, as it usually tastes "flat." If you could give the effluent from filter a good fall to the tank you would greatly improve its taste. Charcoal is considered a better filtering medium than sand.—Labor Omnia Vincit.

[46309.]—**Filterer.**—The water would be quite good, especially if off slate roof. Have used water stored in stonework cistern for years, and some time since had a portion analysed by a first-class analyst, whose certificate runs thus—"from the almost total absence of minerals, and the small percentage of lime, it is fit for every domestic use, being simply equal to soft water."—West Glo'ster.

[46310.]—**Water Supply.**—It is not practicable to get a siphon to work under the circumstances stated. If you cut through the hill I doubt if you would get any supply then through a ½in. pipe with 1ft head.—Labor Omnia Vincit.

[46310.]—**Water Supply.**—On reading this query I was at first inclined to say that it would be impracticable "to get a siphon to work with 1ft. of fall through a ½in. pipe half a mile long"; but on further consideration I do not see why it should. If the pipe be filled upwards from the two ends, and all the air driven out at the highest point, and if a perfectly-fitting air-pump be placed there, and if all the pipe-joints are perfect, there might be delivered at the end of the pipe 100 gallons in 24 hours. That is as much as would flow through a pipe so small and so long, and possibly the flow might cease, even though it begins again; and in any case it would be necessary frequently to withdraw the air, which would accumulate at the air-valve. The best way would be to continue the end of the pipe downwards into a well, 10ft. or so, and pump the water out when wanted, because even if the quantity above named would flow through the pipe, it would run so slowly that it would be unsatisfactory to draw it from a tap. There would be no advantage in cutting through the hill to lay a ½in. lead pipe; but great advantage in doing so to lay a larger pipe, of cast iron, or even of earthenware, if the joints be made watertight; in which case more water could be got through even with 1ft. of fall.—Charles Slagg.

[46313.]—**Roof for Lean-to Hothouse.**—I have built two without help, one 20ft. long by 15ft. wide, the other 7ft. wide, but longer. I recommend pitch-pine, for the reason that, even if not kept well painted, it does not decay. My rafters are 4in. by 1½; they are tied together by two angle-irons, 20ft. by ¾ of inch (in shape of letter L), and about 5ft. apart. The last time I painted the roof I took the precaution of supporting it by procuring some lengths of second-hand, and discarded iron gas-pipe at the price of old iron, one to each alternate rafter, standing them on bricks and mortar 9in. square. If I built another I would have the rafters 5in. by 1½, and no supports. The "plates" front and back are 20ft. long, 4in. by 3. There should not be any horizontal ledges to hold condensed water. This is most important. Fig. 1 shows how the rafters are fastened at back; the iron spike 7 or 8in. long, the slope for draining top of plate, and the ventilator between rafters to be closed by wire and bell-crank, and pushed open with a stick. Be careful to use two sizes of carpenter's bits in boring, or you will split the wood. Fig. 2 shows how the rafters are fastened in front—the spike and slope of plate to get rid of condensed water, and the piece cut out of all the rafters, and section of a piece of wood 20ft. long, 6in. wide, ½in. thick, to carry water to spout; the first piece of glass overlaps this ½in., the remainder should only overlap each other ¼in. Fig. 3 shows section of rafter, with strip of wood ¾in. high and ½in. wide nailed on. The advantage of this way is, that if the rafters are not quite straight, or perfectly equidistant, your bead will be, if nailed on the last thing before glazing; 20in. is a nice medium size for width of glass. You need not make any allowance for expansion; do not overlap the glass in front or end, it makes a nasty green mess; if the butt ends of glass are brought together, it is as tight as a cracked pane, tighter than an overlap. The house, 7ft. wide, has rafters 3in. by 1½in. This is ample. Give one coat of paint to every piece of wood before nailing it in place. This will preserve from getting saturated and warping while the job is about, and make all your joints much better.—Gamma.



[46318.]—**Protecting Steam-Pipes.**—If you cover a steam-pipe 1in. diameter with 1in. of Leroy's non-conducting composition, you will certainly prevent condensation. If you cover a water-pipe with the same, the frost, even in Canada, will have no effect on the water inside.—One who has Experience.

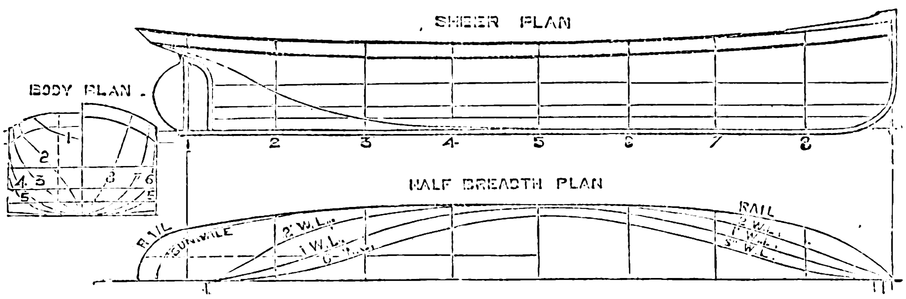
[46319.—**Engineering.**—"Inquirer" can see any number of self-acting inclines in work at Portmadoc or Festiniog, but none so flat as 1 in 10, although such a one would work if, say, the first 20 yards were made much steeper, say 1 in 4 or 5. Much depends upon the weight of the rock to be conveyed. Owing to the great length of the incline and its flatness, it would be better to divide into two, or else run a part of the distance level, and so increase the rate of gradient.—D'Elgo, M.E.

[46319.]—**Engineering.**—If "Enquirer" will come to my address he can see exactly what he requires, and inclines such, as I do not think there are elsewhere in England. He can then carry out what he wishes. Some of our inclines are one in three. Should "Enquirer" find it convenient to come here he might drop me a post-card, stating what day I might expect him, and I will arrange to be at liberty to show him our inclines and give him all the information in my power.—Chas. Anderson, Resident Manager, 22, Battersby Junction, viâ Northallerton, Yorkshire.

[46321.]—**Tipping Clay Tobacco-Pipes.**—Construct a small coke furnace, with an elongated aperture a few inches above the fire-bed, so that the stems of the pipes may be inserted; then get up a white heat with coke and the fire is ready for use. Next mix a portion of red-lead in water and stir till it has the consistency of cream, after which it must be brushed on to the tips of the pipes, shake off the superfluous drops and place the stem-ends of the pipes in the furnace for a few minutes. When they have attained to a dull white heat they must be instantly withdrawn, and the ... bulbs shaken off whilst hot; on cooling they are ready for use. Red-lead alone gives straw-colour; but greens may be obtained by an admixture of solution of copper; browns with the addition of oxide of manganese; orange, with a solution of bichromate of potash, mixed amongst the lead-water. A hard varnish may be got without the use of fire with a mixture of methylated spirit and shellac, which dissolves at once, and may be coloured to any shade with pigments; but it is not so efficient as the lead-glaze.—George Hamilton, 8, Riley-street, Cromer-street, W.C.

[46327.]—**Steam-Launch.**—"Dow" does not say what kind of a launch he would like to have. The size of his boat would depend greatly on the weight of his engine and boiler, and the duty it is intended to perform. The breadth should be about 6ft., or one-fifth the length. The depth should not be less than 3ft. 6in. If he likes to be particular in setting off his frames, he should lay them off on a small drawing on paper, say, to a 1½in. or 3in. scale, and work this off on the scrive-board to its true size. From this he could work from.—Chippy.

[46327.]—**Steam-Launch.**—I send lines of one 30ft. inside of post to inside of stem, 6ft. 3in. extreme breadth, 3ft. 6in. from top of keel to rail: scale ⅛in. to the foot. In setting off the frames, it would be better to lay it down on a larger scale. If your frames are 1in. by 1in. angle iron, 21in. or 24in. apart would do. You will see by the plan how the frames are set off.—W. A. S. Shields.

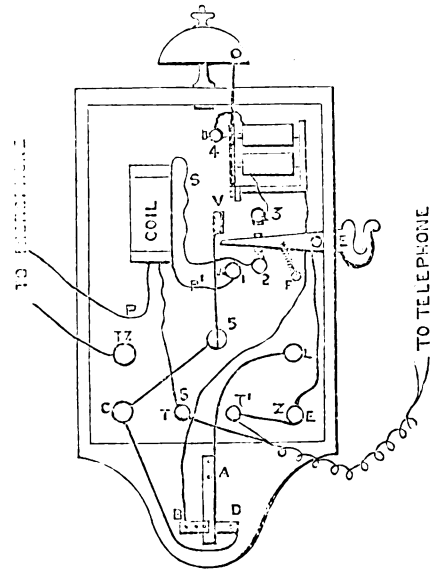


[46333.]—**Gregorian or Cassegrain.**—There is no difficulty in replacing the metal mirrors by glass ones, except that opticians don't seem to care to make them of the short foci required for such a telescope, probably 2ft. focus the large mirror, and 4in. or 6in. the small one. The mirrors must, however, not be spherical, or they will be useless. By fitting it up as a Cassegrain, a mirror of longer focus could be employed, which is an advantage; but the small convex mirror is more difficult to get made true, than the small concave of the Gregorian, though when true, it is freer from aberration, or rather renders the combination freer. The cost on either system would be about the same, say, £5 10s. to £6, and I think the money would be better expended on a Newtonian mirror. The old stand he might perhaps sell.—C. N. R.

[46334]—**Purifying Gas.**—"Rosicrucian" should have given more particulars about this mode of purifying, if whether the ordinary dry lime method or otherwise. However, assuming they are simple dry purifiers, there should be eight sieve-plates—seven for holding lime, and one for crushed coke. This one, placed next the inlet, should have a ¾in. mesh, and ordinary gas-coke in lumps, only large enough not to fall through, should be laid on all over, about 3in. deep, the object being to spread the gas evenly over area of purifiers before coming into contact with the first lime sieve. It will also absorb what small amount of tar and ammonia there may be left, and prevent the incrustation of first sieve of lime, which, without the coke, would harden and prevent the passage of the gas. Each purifier should have clean coke once in two months; it is quite as essential and useful in purifying as the lime itself. The lime must be slaked, and sifted through a ½in. mesh, laid lightly and evenly on perforated sieves, and should be slightly damped, but not made wet enough to get hard, or you will have trouble. For testing quality of light refer to "Ours" of Feb. 3rd, page 525, query 45794. The simplest test for sulphuretted hydrogen that I know of is as follows:—Take as much acetate of lead as will lie on a shilling, place in a saucer one-third full of water; when dissolved, take a piece of writing-paper, dip this in the solution, and hold over a gas-jet, not lighted, inserted in main between purifier and gas-holder. If no discolouration takes place the gas is right; but if it turns black it contains impurities, and should be at once seen to. With regard to the best coal for gas-making, you must remember there are no two samples alike, either for quality or quantity; and if you can get an 18-candle gas at, say, 10,000 cubic feet per ton from your home coal, you cannot much improve matters unless you mix a little cannel with it; but do not use all cannel, or you will have to purchase coke. I have had the anti-dip valves at my works for some years. They are worthy the attention of small works' proprietors, giving, by relieving back pressure on retorts, quite 1,000 of gas per ton of coal.—On Guard.

[46336.]—**Telephones.**—I shall be much obliged if "T. C." will give me the promised information. There is one home-made telephone at either end, each of which in turn transmits and receives. One wire is stout copper insulated; the return is galvanised iron not insulated. Is this correct? I shall also be obliged if Mr. Lancaster, in reply to same query, will say how microphone should be added to telephone.—Meme.

[46336.]—**Telephone Circuits and Call.**—The rough sketch I send will explain how to make all the connections. This one is the same as supplied with the Blake's Transmitter, and is as simple as any I am acquainted with. You will notice the hook E has the telephone off, the spring F has drawn the hook contact down on contact 2, S¹ is the secondary wire of the coil; a current coming from S¹ passes through contact 2 into hook to B through contact to A to terminal L, this being line. The other end of secondary, S, is fixed to terminal T; T¹ is connected to terminal Z E; zinc of battery and earth is connected to terminal Z E, hence the two letters; the telephone cord is connected to T T¹; the primary wire of coil, one end P to microphone, the other end P¹ to contact 1; T Z is terminal of transmitter zinc; C is terminal for copper or carbon end of battery. When the telephone is on the hook it draws it down and places hook contact in contact with bell contact 3. A current now being sent from the other end to ring up, passes through L A B to 3 through bell coils, regulating screw 4 through keeper and frame to Z E. The act of taking off the telephone allows the hook to slide off the vulcanite V, and lets the ring 5 come in contact with contact 1; this puts C in connection with one end of primary P, the other end P¹ was already in connection with T Z through the microphone. The instrument is now ready for speaking to. A current now coming through line passes through A B hook 2, secondary wire to T through telephone cords, coil, T¹ to Z E. To ring up A is pressed on D; this does not affect your own instrument, as A leaves B before it touches D, so cut your own instrument out. Shall be willing to give you any further information.—George Tolman.



[46352.]—**White Fungus on Fish.**—A paper appeared in *Science Gossip*, No. 186, June 1, 1880, on "Salmon Disease, and its Cause." This may give "C. O." the information wanted. Personally, I have recovered gold-fish attacked with *Saprolegnia ferax* by isolating those diseased; placing each subject in a shallow vessel of water, and sponging lightly over with silver-sand two or three times daily, changing the water each time.—J. C. M.

[46355.]—**Photo-Enlargement.**—If "H. C. F." can get his glass negatives to fit into the magic-lantern, he might be able to obtain very fair enlargement on Morgan's argento-gelatino-bromide paper, which is the most simple and efficient article he can use. First thoroughly darken the room, and use only a red light to work by, and screen any white light that may be reflected from the lantern; then place the negative in the lantern and focus it upon a sheet of clean paper placed upright against a flat surface (a very good way is to moisten the paper and fold the top edge over a sheet of glass and stand it upright against the wall on a table). When the picture is clearly defined, and of the desired dimensions, cover up the front lens of the lantern, or place a screen of red glass between it and the image; then, having moistened a piece of Morgan's paper in clean water to make it lay flat and smooth, substitute it on the glass sheet for the piece of ordinary paper used for focusing, and remove the screen from the lens, when the image will be clearly focused on the sensitised sheet. Expose for three to five minutes, according to amount of light; then remove and develop with a ferrous-oxalate developer, until the picture is well defined; then wash and fix as for a gelatino negative. Practice alone will give experience, and experience efficiency.—F. C.

[46356.]—**Analysis of Alloys.**—If only the metals named are present the following method will serve to separate and estimate them:—Heat a known quantity (2 or 3 grams) of the finely-divided alloy with strong nitric acid until all action ceases, then dilute and filter. The precipitate will contain all the tin in the form of metastannic acid, and nearly all the antimony in the form of antimonious and antimonic oxides. Wash it on the filter, transfer to a silver dish, and fuse it with excess of pure sodic-hydrate, by which it will be converted into a mixture of sodic stannate, and sodic metantimoniate. On treating the mixture with dilute alcohol, the sodic metantimoniate remains undissolved, and may be collected on a filter, washed with alcohol, dried, fused with potassium cyanide in a porcelain crucible, and the reduced antimony detached and weighed. The alcoholic filtrate is boiled to expel the alcohol, diluted, acidulated with sulphuric acid, and precipitated with hydrogen sulphide. The tin sulphide is collected on a filter, washed, dried, and converted into stannic oxide, by careful roasting in a porcelain crucible, and weighed. The nitric acid solution will contain the copper, zinc, and iron as nitrates, together with a little antimony. It is evaporated with excess of dilute sulphuric acid, to expel nitric acid, diluted and precipitated with hydrogen sulphide. The precipitate containing the copper and antimony as sulphides is digested with a solution of potassium sulphide, and filtered. The precipitate is washed, dissolved in nitric acid, and the copper precipitated by sodium hydrate, and weighed as cupric oxide. The antimony present in the potassium sulphide solution is precipitated by adding excess of hydrochloric acid, converted into tetroxide by treatment with fuming nitric acid, and subsequent ignition in a porcelain crucible, and weighed, the amount obtained being added to the main portion already determined. The filtrate containing the zinc and iron is boiled to expel the excess of hydrogen sulphide, and then, with a few drops of nitric acid, to peroxidise the iron, nearly neutralised with sodium carbonate, mixed with a small quantity of barium carbonate, digested for a few hours in a corked flask, and filtered. The precipitate is dissolved in dilute hydrochloric acid, and the iron precipitated with ammonium chloride and ammonium in excess, washed, dried, ignited, and weighed as ferric oxide. The filtrate containing the zinc is mixed with ammonium chloride, precipitated with hydrogen sulphide, the precipitate dissolved in nitric acid, and reprecipitated by sodium carbonate. The zinc carbonate is then filtered off, washed, dried, ignited, and weighed as zinc oxide.—Analyst.

[46360.]—**Roofing.**—The best slate to be had for love or money is the new quarry, Velinheli, size 20 by 10, on 1½in. by ¾in. laths, spiked by two 1¾ copper nails to each slate. Seconds quality, these slates will cost in London about £8 15s. 6d. per 1,000, of 1,200. Price per 100 square yards, labour, laths, and nails included, £13. You should get it done for this sum, and if unable to get these slates, let me know, and I will help you. If properly done, there needs no felt at all; but if you must felt, why, then, there is no better material to go under slates; but I cannot recommend it. If Portmadoc slates are used, it will cost, labour and all included, £9 18s. per 100 square yards. These are good for exposed situations, as they lie evener and closer. Cost at quarry, £5 10s. per 1,000 of 1,200, and weigh 2tons 10cwt. per 1,200.—De Lisle, Contractor and Builder.

[46365.]—**Income-Tax.**—I am obliged to Mr. Wetherfield. I see his meaning, but the difficulty is this: the tenants pay Schedule A, and I am bound to, and do, allow it out of the rents, therefore, if I pay on pension and appointments, I should be compelled to appeal each year to get back that paid on ground-rents, or put up with the loss. I may mention that I have not been asked for a return for three years, and the last time I did not show the rents, as I was told my return was too honest—it was already paid; but the contention of the Surveyor is that I must pay on the appointment, no matter if the income is under £150. Is that so?—J. W.

[46368.] — **Clock.** — You must unscrew the winder; turn the opposite way you wind, and it will come off; also take off the hand-setter; you must pull it off—it does not screw; and you will find the back free.—Escapement Maker.

[46368.]—**Clock.**—To take off back, turn winder in opposite direction to that of winding, and it will unscrew; take off hand-setter with pincers by a straight pull. To remove back, press fingers on, and, with a slight turn, it will unhook. If screws are out of front, the movement is now out of case. If "Anxious Amateur" wants to clean his clock, he must begin by first measuring how far balance-spring comes through stud, and be sure he puts it back in same place. Take out wedge which holds spring in stud; also take spring clear out of regulator, and remove one screw, supporting balance-pivots, and balance with spring are now free. Before going farther, let down mainspring by tying 'scape-wheel loosely to frame; remove pin or screw in pillar nearest pallets, and carefully pull apart frame, which will let out pallets; but be sure no other pivot gets out of place, or the clock will go to smash. Another way to let down spring is to withdraw click from ratchet after putting winder on, and letting it down by half-turn each time, and replacing click; but the first method is least dangerous, if my instructions are carefully attended to. Should the clock be too dirty to run down, put a little oil to pivots.—Skip.

[46370.]—**Lathe.**—Get the holes cast in the standards a free fit; get the two slide bars accurately turned, with shoulders to bear against the standards, or the lathe will certainly vibrate. Tap the ends, and put on double nuts on do.; when adjusting for parallelism, bring true with pegs of wood in holes, then place a band of loam round each side, and fill up with Babbit's metal, or block tin alone. This will make all secure. The screw is best placed between the bars, as giving a more direct pull to saddle. Neither the leading screw, nor those appertaining to the slide-rest, will admit of being screwed with a "screw-stock," they must be chased up, as an inaccurate screw-lathe is an absurdity, and no screw of any length can be made to approach accuracy in a screw-stock. The nut for leading screw ought to open in two pieces, *à la* Whitworth, and you would do well to get the getter-up of your slide-bars and screws to make this also, and as for the slide-rest, unless you are possessed not only of a larger gear, a larger amount of experience, and the most liberal supply of gold, don't undertake it. The very patterns would cost more than you could buy one for. You "must" chase the thread upon the mandrel with a comb. I would strongly recommend you to have either a beech "shears" plated on top and sides, or, better still, a cast-iron one instead of shaky bars, which would vibrate were they 1½ diameter, if such a diameter of face-plate and work were attempted.—J. J. A., Liverpool.

[46372.]—**Classification of British Beetles.**—"A Lady Entomologist" will find "Pye's British Beetles," (published, I believe, by Longmans, at 10s. 6d.), a very useful book on the classification. If, however, she wants a more exhaustive work, "Cox's Handbook of the British Coleoptera" (Janson's, 17s. 6d.), is the best book at present published.—Coleopterist.

[46373.]—**L. and S.W.R. New Coupled Bogie Express Engines.**—There are 13 of these engines. They number from 135 to 147.—Gem.

[46374.]—**Gauging Water.**—In Box's "Hydraulics" is a table of the flow of water through a notch-board 1in. wide, and at depths varying from ¼in. to 125in. This would suit you, I think. Labor Omnia Vincit.

[46375.]—**Steam Trap.**—For compactness and certainty of working, I have not found any trap tetter than Vaughan's Ejector. All steam-traps I have ever seen require cleaning out at times.—Labor Omnia Vincit.

[46375.]—**Steam-Trap.** — I have had several years' experience with Oxley's steam-traps, and they do their work very satisfactorily. We have steam-pipes from boilers at bank to engines underground, 48 fathoms, and, of course, there is a great deal of condensation of steam, the pit being cold and pipes uncovered; but Oxley's steam-trap keeps us all right. They are a good deal employed in this (Cleveland) district, and, I think, give general satisfaction.—Brakesman.

[46376.]—**Weight of "Grosvenor" (No. 151, L.B.S.C.) Empty:—**

	Tons.	Cwt.
On leading wheels	10	8
,, driving ,, ...	14	0
,, trailing ,, ...	8	12
Total weight empty....	33	0

The tender holds 40cwt. of coals and 2,520gal. of water. The total weight of engine and tender in working order is 59tons. I have not the weight of the "Terriers," but will endeavour to obtain them. Sections and elevations of the North British engines appeared in Vols. XLV. and XLVII. of *Engineer*, but their weight was not given.—Meteor.

[46377.]—**Electric Motor for Tricycle.** — I am making one, and the weight is about 60lb. I calculate eight Bunsen or Grove cells of large size will propel it on level road, I should think, six or eight miles per hour. A smaller motor and less battery power is advisable to propel it a little. This would make it equal to level road the day through, and would perhaps avoid the "Locomotives" Act. George Tolman.

[46390.]—**Turning Cotton Calender Rollers.** "G. H." requires a scraping tool for reducing ends of calender rollers, which should be made out of steel 2in. broad by ⅜in. in thickness and about 8in. or 9in. in the flat part, with a shank forged down to fit into a handle about 1ft. in length, so as to make up a tool about 18in. long. The nose of the tool should be ground quite square, and cutting edge should be a slight curve to prevent corners digging. Twenty-five revolutions per minute would be quite sufficient for speed. A temporary rest may be formed either out of 4in. square timber hard wood or a piece of iron bar held by suitable brackets bolted to the chucks of the calender. Either cotton, paper, or brass bowls may be trued up in this manner. If the metal roller in contact with the cotton has a good even surface, use water while scraping, and it will show when the ends are sufficiently reduced by the middle portions of the roller becoming dry.—J. Rawlinson.

[46395.]—**Gilding Watch Plates.**—To make watch plates have the frosted appearance, take 2½ nitric acid, 2 muriatic acid, full strength. Dip the articles for a few seconds, rinse in water, use scratch brush with a circular motion, and then gild. —Pivot.

[46397.]—**Slide-Valve.**—If "Wykehamist" is a resident in the old city from which he takes his signature, he can have the subject explained and illustrated to him any day by taking a walk down the meadows to the Corporation Sewage Works, where he will see the same kind of valves he writes about. For the information of others, I may say that there are two sets of valves, one called the main slides, working against cylinder-face, and the other the expansion valves, which slide against back of main valves. Each set is worked by a separate eccentric. The main valves have a steam-port at one end, and are not moved to alter the cut-off. This is done by a right and left-hand screw on the expansion valve-rod, so that whichever way the hand-wheel on end of valve-rod is turned, the expansion valves move over the steam-port in valve sooner or later as the case may be. These valves are used in other kinds of engines, as well as beam-engines.—Labor Omnia Vincit.

[46404.]—**Medical Battery.**—Do you require a battery of 20 or more cells, or is it a coil and battery; the latter has been described in "ours." You could purchase a set for less than the cost of materials.—George Tolman.

[46405.]—**Stains on Dry-plate Negatives.**—(1) Immerse the plate after fixing and washing in a bath composed of alum 2oz., citric acid 1oz., water 10oz., or in water slightly acidulated with hydrochloric acid. Prevention, however, being better than cure, dissolve a few grains of sulphite of soda in the developer. This prevents its rapid discolouration, and thus staining of the film is avoided. (2) There is no reliable method of effecting this much desired restoration.—Baboon.

[46405.]—**Stains on Dry-plate Negatives.**—A saturated solution of alum with one drachm of hydrochloric acid to about five ounces, is about the best thing for pyro-stained negatives. I think if "J. L." mixes fresh developing solution as soon as the first discolours, he will not be much troubled by stains. I have never heard of any way of renewing faded mercury intensified negatives. Have tried, but only fogged the plate all over, or cleared away all traces of picture.—E. F. C.

[46405.]—**Stains on Dry Plates.**—"J. L." does not state the kind of stain on his negatives. Let him immerse his unvarnished plates in a solution made of one pint of a saturated solution of alum, to which has been added 2oz. of citric acid. This may remove the stains. Some stains are easier removed by soaking the plate in a weak solution of hydrochloric acid. Some negatives that have faded to a yellow by the injudicious use of mercury may be restored by removing the varnish and dipping the negative in hyposulphite of soda. —W. T. Bashford.

[46408.]—**Copper Salts.**—You do not say definitely what you wish to do. Do you want to precipitate copper from a solution of its sulphate by means of zinc? If so, no bath of "double salts," which, by the way, I do not know what their composition or use would be, is needed. Place a piece of clean zinc in the solution; copper will be precipitated, an equivalent of zinc being dissolved, forming sulphate of zinc. The finely-divided copper can be afterwards washed and dried.—Arthur E. Morris.

[46409.]—**Sulphuric Acid.**—As you ask about the factor used by Dr. Ure to estimate percentage of H_2SO_4 from the sp. gr., I have sent it. Multiply the logarithm of the sp. gr. by 350; the product is exactly the percentage of acid. Should you wish it, I will send table showing the percentage of H_2SO_4 in solutions of various sp. grs. and also showing degrees of Baumé and Twaddle.—Arthur E. Morris.

[46412.]—**Pendulum Spring.**—To "Nicholls." —To get spring from collet, take off collet from balance with a sharp pocket-knife, put collet on a tapering piece of pegwood, or anything round, that you can press the collet on firmly; then take a very fine needle, and press pin out of collet (with needle), and balance-spring will come out easily. To cut off inner end, lay spring flat on a piece of clean note-paper, take a pair of fine-pointed tweezers in one hand, and anything with a point in the other, and break off bit by bit till you have broken off sufficient to admit the collet freely; but first you want a spring the proper size and strength. To get the size, put a spring rather less than your old one (which you say is too large) between the curb pins, and balance spring stud as if you were setting the watch in beat; after you have pinned in the spring, see that the second outer coil does not touch the inner curb pin or the stud, and that the centre of the hair-spring is exactly in the centre with the foot jewels; if so, you can put that down for the proper size; the next you want the strength. Before you take off old spring from balance, take hold of outer end with tweezers, and gauge the distance between balance and outer end of spring (while swinging), then put on new one, and gauge that, and if the distance be about equal, no doubt your watch will go about right. Before you pin up tight, if your spring is not flat, raise or lower it by the centre coil; when flat, pin up tight. If you will advertise your address, I will help you to put watch in thorough good order.—Nicholls.

[46417.] — **Instantaneous Photography.**— The unaided hand cannot expose a plate with sufficient rapidity to secure the impression of rapidly moving objects; but the hand can be used to liberate a spring that will expose for, say, 1-25,000th part of a second, and this is how the so-called instantaneous photographs are easily secured.—W. T. Bashford.

[46417.]—**Instantaneous Photography.**—In respect of the theoretical principle involved, your assumption is quite correct, and also in your illustration; but practically such a movement would not be detected unless the train were photographed broadside on. This, however, has not yet been accomplished. In the one or two examples of such which have been taken, the point of view chosen has been situate about 30° or 40° to the line of advance. An exposure measured by the fraction of a second could not be given by manipulating the opening and closing with the hands; but there are many mechanical arrangements for accomplishing this with almost inconceivable rapidity, and by which an exposure could be made of less than a 1,000th of a second. With a drop-shutter having a narrow slit, and working immediately in front of the sensitive surface, there is practically no limit to the shortness of time, especially if the gravity is assisted by springs. Jannsen claims to have made an exposure of about 1-3,000th of a second by these means. These short spaces of time are not assumed, there are instrumental means for measuring the intervals.—Baboon.

[46420.]—**Cupola.**—If "A Constant Subscriber" will advertise his address, I will give him all the necessary information, as it would take a deal of space to answer his query. I gave the sizes of a cupola to melt 5cwt. of iron two weeks ago.—Cast Iron.

[46423.]—**Gravity Clocks.**—To "Clerkenwell Clockmaker."—The barrel arbors of gravity or any other clocks do not require hardening. Some are even made of iron, but steel is much to be preferred.—A Clerkenwell Clockmaker.

[46425.]—**Gelatine Emulsion.**—But a very short time, unless you add an antiseptic. An ounce of a 10-grain alcoholic solution of thymol to each 10 ounces of finished emulsion will keep it good for a year at least.—Baboon.

[46425.]—**Gelatine Emulsion.**—I have kept unwashed gelatine emulsion containing a small quantity of acid (I think three grains to the ounce) quite good for nearly three years; after it had "set" in the bottle I poured over the top of the emulsion a small quantity of methylated spirit. This may have assisted in the preservation; I believe the washing would not affect the result. *Washing Emulsion.*—A very simple way of washing emulsion is to coat the plates with unwashed emulsion, and after allowing plenty of time to get thoroughly set, to place them in plate-boxes constructed to allow a stream of water to pass over the plates and out at the bottom of the box; after this washing for a couple of hours, or all night if preferred, near up to dry. This mode of washing has been peculiarly satisfactory in my hands.—W. T. Bashford.

[46425.]—**Gelatine Emulsion.**—Pour as much as you will want at a time whilst warm into separate bottles, and then you will not have to melt the emulsion more than once. Cover with alcohol when it has set, and it will keep well in a cool place. It is said to gain in sensitiveness by keeping in a moist state. To wash emulsion, get a piece of clean canvas, spread it out, and put emulsion in a heap in the middle. Then gather up the sides, and twist it so as to make the emulsion go in the form of a ball in the middle of canvas. Hold it under water in a large jar, and twist it till all the emulsion is forced out into long threads. Tie a piece of muslin over the jar, and invert it, and all the water will run out through the muslin. The washing is simply to fill the jar with fresh water through the strainer, shake it a bit, and allow to stand for five minutes, then drain off, and put more fresh water. I should do it about six times. When finished, it should be left to drain for two hours or so. I should think unwashed emulsion would keep as well as washed.—E. F. C.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, M.I.C.E. has replied to 45962; J. W. W., 45990.

45741. Civil Service Strictures, p. 459.
45745. Artificial Limbs, 459.
45762. Boat Tabernacle, 459.
45765. Watch Jobbing, 459.
45766. Watch Fuse Chain, 460.
45787. "D. H. G.'s" Overhead, 460.
45789. Sulphurous Anhydride from Vitriol Chambers, 460.

46009. Guttapercha Socket, p. 553.
46026. G.W. Engines, 554.
46029. Analysis of Silicates, 554.
46041. Cement Testing, 553.
46014. Melting Fat, 554.
46052. Old Violin, 554.
46056. Medical Coil, 554.
46057. Planing Machine, 554
46059. Potato, &c., Boilers, 554.
46060. Digesters, 554.

QUERIES.

[46427.]—**Electric Engine.**—I am anxious to construct a machine of this nature sufficiently powerful to drive, say, the overhead motion of my lathe in ornamental turning. The power required for this purpose is very little, say the eighth of a horse, or even less. Yet this power (though small) is required at times continuously for an hour or more. This, though by no means hard work with foot-motion, becomes tiresome and monotonous, and it has occurred to me that a motor actuated by an electrical current would be just what I require; being easily controlled, occupying little space, noiseless, and cleanly. There have appeared in the English Mechanic from time to time, numerous hints and disjointed instructions from different contributors; but so far as I have noticed, nothing sufficiently detailed or practical to induce an amateur to undertake the construction of a motor of this nature with the full assurance that when finished it would answer his expectations. Would Mr. Lancaster, or any other contributor well up in such matters, kindly give, through these columns, a drawing with fully-detailed practical instructions and dimensions, of an engine capable of giving out, say, a quarter horse-power, and possessing the following amongst other points of excellence?—Greatest power with smallest amount of battery waste; compactness; simplicity of construction; little liability to derangement; speed and power easily controllable; and economy in working; and at the same time describe the best-known form of continuous battery not liable to give off noxious gases. Now I believe that an article or a series of articles plainly and concisely written, giving every dimension, number, and mode of wrapping magnets, with every other particular, would be welcomed by many readers, and its construction undertaken by many amateurs requiring a small, continuous, and unvarying power. —Ivory.

[46428.]—**Pumping.**—Will any reader tell me how many gallons of water would a pumping engine throw at a stroke, running at the rate of six strokes per minute? The engine is 7ft. stroke, 12in. in diameter. Please put it in plain figures.—E. J. D. P. H.

[46429.]—**Skin Disease.**—Will Dr. Edmunds, or any reader of the English Mechanic who has been troubled with psoriasis, kindly inform me if it is possible to effect a really permanent cure? I have tried many remedies during the last five years (under the best medical advice at my disposal), both internal and external; but they have all failed to give more than temporary relief. I am inclined to believe that proper diet has a good deal to do with this trouble; because, during a voyage to India some years ago, the skin affection disappeared, owing possibly to the lack of milk; for on returning home and resuming the use of milk, the psoriasis came back again. As, however, a number of medical men assert that milk should be freely used, I am at a loss what to think regarding it, but shall be glad of any information.—Marine Engineer.

[46430.]—**Colours on Fabrics.**—What are the tests usually employed in trade to test the stability of a colour on a dyed or printed fabric? Maybe, Mr. Allen will oblige with the information.—Pro Bono Publico.

[46431.]—**Worsted and Woollen Yarns.**—What are the chief distinguishing characters between worsted and woollen yarns? Which of them dyes up the best and takes the most permanent colour?—Pro Bono Publico.

[46432.]—**Spiral Spring.**—Will any reader tell me how to make a spiral spring about No. 12 gauge steel wire, and how to temper? What kind of steel would you recommend for toughness and strength?—An Amateur Reader.

[46433.]—**Potato Disease.**—To Mr. Adams.—Will Mr. Adams, the writer of "Observations on the Potato Disease," last May, please say in what form the potash recommended should be applied?—M. E.

[46434.]—**Medical.**—To Dr. Edmunds.—Might I ask Dr. Edmunds if he would consider it indiscreet for a young man to marry a young woman aged 25 who has been troubled with pleurisy and sore throat? The querist, being left a widower very early in life, in consequence of his wife's decline, would fain ask if, in this case, the complaint might assume a serious form? The young woman's doctor has advised marriage.—Cautious.

[43435.]—**Magnetic-Bell Hammer.**—Might I ask Mr. Lancaster to inform me how to connect up a wheel revolving magnetic bell-hammer? I have taken it adrift, and forgot how to join up connections again.—Amateur.

[46436.]—**Chemical Balance.**—Can anyone recommend a good balance that will weigh from 50 grains to one milligramme, and not exceed £2 in price? It is for use in the study of agricultural chemistry. Any information will oblige—Agricola.

[46437.]—**Soda Lime.**—How is soda-lime prepared? What is its action on nitrogen? Give equation. Can the soda-lime from one combustion be used over again? —Agricola.

[46438.]—**Handel Organ, Crystal Palace.**—Can any of your readers inform me what alterations are being made in this instrument?—F. J. W.

[46439.]—**Legal**—Will Mr. Whetherfield, or some other legal gentleman, kindly answer the following?—A. left property in the hands of two trustees to be equally divided between B. and C. at the death of D.; C. died a few weeks before D. C. left all her share to E. unconditionally; but E. is the issue of C. by marriage with deceased sister's husband. There were two executors to A.'s will, but by some misunderstanding they were not together when the will was proved. The one that proved the will has handed over all the estate to B. I may say C. appointed the same executor to her will. He says that it is not necessary to prove C.'s will, because E is the issue of deceased sister's husband. Cannot E. claim her mother's share?—One Anxious to Know.

[46440.]—**Analysis of Soot.**—Perhaps some of our chemists will be able to give a few hints on the analysis of soot, and the ingredients usually estimated, with value per unit of each?—Agricola.

[46441.]—**Vacuum Brakes.**—Can any reader of the Mechanic tell me the name of the vacuum brake now in use on the Bristol end of the Midland Railway? How is the vacuum formed, maintained, and destroyed? Are there any books yet published, describing the various systems of continuous brakes?—M. B. W.

[46442.]—**Launch.**—To "Sunlight."—I shall be much obliged for a working sketch (with dimensions) of the most approved form of stern-tube bush, with wood bearings; and also of a thrust block and bearing for a screw-shaft 1¾in. dia. Does the advantage of having a propeller abaft the rudder outweigh the manifest disadvantage of the arrangement? Probably "Sunlight" has frequently had opportunities of judging.—L.

[46443.]—**French Wire Gauges.**—I should be obliged by the information what the measures in decimal inches are of the Paris and French wire-gauges?—E. T.

[46444.]—**Press for Moulding Blocks.**—I am making a composition which is to be made into blocks of the following dimensions; 2in. × 2in. × 3in. This composition is of such a consistency that if the hand be dry it may be handled without adhering to it. To make this material into blocks, I press it through a die and cut them off to the desired length. What I want is a machine which will make this material into blocks. Would a press such as is used by soapmakers answer my purpose, or could any reader give details of a machine suitable?—S. S. S. S.

[46445.]—**Gazogene.**—Will some fellow-reader tell me how to repair an ordinary domestic gazogene which leaks between the upper and lower bulbs?—W. H.

[46446.]—**Mr. Bennett's Battery.**—I have just set up one cell of this form, as described on p. 5, porous pot 6in. by 1½in.; tin can 4in. by 4in. Within five minutes of the solution being in, the bell started, and has been going for a couple of hours, and seems likely to keep on. It is ringing about the same as it does with two pint Leclanché's which have been going a twelvemonth. One thing I failed in—that was, getting the "potassium hydroxide," or "caustic soda," at anything like 2d. per pound. I went to a good wholesale druggists, and they told me "potassium hydroxide" was not "caustic soda," but "caustic potash"; so I had "caustic potash," and paid three shillings per pound for it. It is in round sticks, about ⅜in. by 6in. This makes the cell as dear as a "Leclanché," very nearly. What I want to know (and I don't expect I am the only one) is, how to get the alkali meant in the paper, whether it is potash or soda, at anything like a reasonable price?—W. W. H. G.

[46447.]—**Gauges for Lead Pipes.**—I have been in the trade of lead pipe-making for some years now, and we have only gauges made by ourselves. Would someone inform me is there a standard gauge, or is there any arithmetic rule that I could use for the purpose?—Thomas Price.

[46448.]—**Powder-Mixing Machine.**—I want to make a machine to thoroughly mix powders, about 56lb. at a time. Will some of my fellow-readers kindly inform me how?—H. T. J.

[46449.]—**Underground Siphon.**—To "Tubal Kain."—Oblige me with the following information. What should be the discharge of water in gallons per minute from a siphon-pipe 2in. diameter, and the pipes 300ft. long, and the fall of the same about 1 in 4, and the vertical height from the surface of the water, including the valve-piece to the top of the bend to the path of the incline, is about 3ft.? A formula on the above will greatly oblige.—Anxious to Know.

[46450.]—**Separating Fat from Mineral Oil.**—I have a quantity of fat mixed among mineral oil. Can anyone tell me how to separate the fat on a commercial and paying plan, or for what purpose could the mixture be sold as it is?—Chandler.

[46451.]—**Spring Blinds.**—I want to make a self-winding spring blind for outside of shop. Can any reader kindly oblige me with instructions how to make one about 10ft. wide—the kind of spring used, and the mode of fixing it, as well as the strength of spring required, according to size of blind, is what I want to know.—Engineer.

[46452.]—**To "Finem Respice."**—I am about to construct a brass camera on the principle of the one described in query 34379, Vol. XXVIII., p. 304; and should like to know if the size mentioned would be suitable for taking lake and mountain scenery: the lakes being about one mile across, and the mountains about 5,000 or 6,000ft. high? 2. If 1-32nd of an inch would be strong enough for a camera of 5in. dia to be made in two pieces, one to slide inside the other, rack and pinion being used to focus with? Can it be made light-tight on this principle? 3. Are Darlot lenses of 1in. dia. to be obtained ready fitted with rackwork and central stops? Can rack and pinion be purchased separate from the lens? —An Enthusiast.

[46453.]—**Mortgage.**—To Mr. Whetherfield.—M. took up a mortgage (£325) of C. for 15 years in 1861, to which 5 per cent. was to be paid yearly, but paid some time afterwards every quarter. C. sent M. six months' notice to call in mortgage on the 15th June, 1870. M. paid interest regularly up to 1869, and being pressed for money was not ready just at the time to pay the next three quarters of 1870. C. put M. in the County Court, and got judgment against her goods, and sold them on Dec. 23, 1870. On the following January (1871), C. put up property for sale, and said he sold it for £496. C. paid F. another £100 pounds that M. owed, but F.'s security was on a different property. C. was offered his own mortgage (£325), but refused to take the money before the time expired. C. will not answer any of M.'s letters; and he has had possession from 1871. M. went away on business before he sold the houses. Before M. came back, C. had got into the houses and turned a man out that was put in by M to keep possession. M. wants to know whether he can't recover property by paying the £325 and interest now? or if not, what is best to be done to bring the mortgagee to book? Can you tell me what it will cost? I am not able at present to pay a solicitor his charges till after I get my property.—George Mountjoy.

[46454.]—**Gas from Wood.**—How many feet of gas should I get from 112lb. of wood? Would the ash left in the retort be of any value?—California.

[46455.]—**Educational Prize Trust.**—Last year, one J. Bell, in London, offered prizes for the solutions of six numerical puzzles. Have the prizes been paid, and where have the solutions been published?—N.

[46456.]—**To Mr. J. Charles King, or any Wheelwright.**—I have a job to put a new hub to a very heavy timber gig wheel without taking it to pieces; every part is sound but the hub, which is broken out, being of bad timber; but the spokes are sound, and the felloes and strake tires are as good as new. To rip it to pieces and drive the spokes into the hub, and felloes on to the spokes, and then refix the strake tires red-hot, would make but a damaged job for many of the spokes and felloes, even if the wheels could be taken apart without breaking several of the felloes and spokes. How is the hub to be put into the wheel without disturbing any part of it?—Joskin.

[46457.]—**Battery.**—I have to thank Messrs. Tolman and Lancaster for their replies to my query about battery, and in answer to the latter gentleman, I may say that I require a battery-power equal to four quart Bunsen's cells, which can be kept constantly charged and ready for use at any time. It is to work an electric hammer which operates by means of a small electro-magnet, wound with No. 32 silk-covered wire. It is similar to the one used by dentists, and is worked for two hours at a time. Now I wish to know what is the most economical and best form of battery I can use?—Malleus.

[46458.]—**Fernery Pipes.**—In my fernery window the warming-pipes are of brass, and take a great amount of cleaning, as the drops of water tarnish them. They were not lacquered, because it was pointed out that this would turn black as soon as the hot water passed through them. Is there any kind of varnish or enamel that I can get to do them over with that will preserve their good appearance, both against the heat within and the splashings of water without? If anyone can tell me either how to make such, or what to get, and where to get it, I shall feel obliged.—Adiantum.

[46459.]—**Drilling Machines, &c.**—I have one of Mr. Cohen's little drilling machines, but can't make it any practical use to me. If I put stock in vice, I have to hold the article to be drilled in my hand. It will never do for me to hold it in my hand to drill pivot-holes in watchwork, for I can't hold it firm or steady enough for that. Would "Alfojoe," or others of the trade, kindly name the best sort of drilling-machine for an amateur clock and watch-jobber, who has not a mandrel or lathe; nothing but a small vice to hold the stock? I should like one that would drill from ⅛in. down to pivot-holes, either in brass or steel. I have thought about an American drill-brace with a gear-wheel. I thought by this I could put the article in vice, and hold the brace in my hand, and drill with greater speed and force than with the bow. Are those machines ever used by clock-jobbers? I am a self-taught jobber, and very anxious to learn the trade; if any will tell me how to proceed I shall be thankful. Can someone also tell me how to lessen a gold ring in diameter (without cutting it), and how to make gold paint for painting jewellery after it has been soldered?—A Learner.

[46460.]—**Tortoise-Shell.**—My tortoise has died, and as the shell is a nicely-marked one, I want to preserve it. Can any reader kindly tell me the best way to abstract the carcase? Would boiling affect the shell in any way?—W. G.

[46461.]—**Charcoal Furnace.**—Will a reader kindly inform me how to make a small charcoal furnace for heating retorts, crucibles, &c., and suitable for other general chemical operations?—Hugh Tunnadine.

[46462.]—**Measurement of Electric Current's Strength.**—Will someone kindly describe how I can make an instrument for measuring the strength of electric current in ohms or any convenient and well-known unit? I wish to find the power, as a generator, of a dynamo-machine I have constructed, but do not know how to set about it; oblige—Country Ploughboy.

[46463.]—**White-Lead.**—I intend to have a considerable quantity of painting (dwelling-houses) done, and wish to guard against adulterated white-lead being used, and shall feel thankful for a suggestion as to how I can do this. The best sample I can get from a shop is only 4·75 sp. gr.; and according to a rough test, appears to contain nearly 20 per cent. of baryta, and a large quantity of chalk.—Creta.

[46464.]—**Steel Rails.**—What percentage of their main lines have the principal railway companies laid with steel rails? Also, what are the weights per yard and lengths of the rails? What is the advantage of keying the rails on the inside, as on the Midland, instead of the outside? What companies adopt this plan?—McK.

[46465.]—**Midland Carriages.**—What is the length of the longest bogie carriage? What do the initials, "M. S. J. S.," on the carriages of the Midland Scotch trains, stand for?—McK.

[46466.]—**Staining.**—Will some chemical friend give a list of a few chemicals having such a marked affinity (like pyrogallic acid and ferric sulphate) as will be suitable for marbling or mottling, in imitation of tortoise-shell, horn and various fancy woods, giving the colour of the solutions and their precipitates?—W. W.

[46467.]—**Rheocord.**—Will any of your correspondents kindly inform me if they know any simple form of rheocord which will reduce voltaic currents to almost zero?—Physiologist.

[46468.]—**Brake for Omnicycle.**—I wish to have a band-brake to my omnicycle. I thought of having a grooved wheel with steel band secured to metal hub with three or four screws, and a handle to reach to my present rest-handle, and a click or dog to the handle to go into a notch secured to the side of the backbone; so that when the brake is full on it will remain fixed until, by a thumb-piece attached to handle, it can be relieved. Sketch will oblige—One in a Fix.

[46469.]—**Toning.**—Is it possible to tone platinotype prints to a purple or brown colour?—Lex.

[46470.]—**Diagrams of Oscillating Engines as on London River.**—Will some of "ours" say how these are taken, so far as the fair leads and gear are concerned? The pipe on which indicator is fixed stands up level with cylinder cover; how then is the string fixed to crank, and how conducted to same from the indicator? Clear particulars and drawing will oblige—Working Fitter and an Old Reader.

[46471.]—**Great Eastern and Great Northern Joint Line.**—Could some of your railway correspondents give me a little information about the above line, as I see that a portion from Spalding to Lincoln is now opened for traffic? What is the route the line takes? What works will be undertaken on the portion of the existing line between March and Huntingdon? When will the works be commenced in this locality? Who is the contractor for the construction of the line?—A Hunts. Man.

[46472.]—**Magneto-Electric Machine.**—Will some reader of the "E. M." kindly inform me how to make a magneto-electric machine, and how to regulate the current? Is the machine used in electro-deposition? I want, if possible, to use one for depositing gold and silver in the place of the Daniell cells I am at present using. A machine giving a current equal to two quart Daniell cells would be quite sufficient for my work.—A Young Jeweller.

[46473.]—**Pressure of Water.**—A lock-gate is 12ft. wide, and has a depth of 8ft. of water pressing against. What pressure does the lock-gate sustain? Also, if it be required to find the pressure against the lock-gate 2ft. from the bottom, how must I find it?—W. H. B., Bradford.

[46474.]—**Chime Clock.**—I have had the above to clean, verge escapement, good-going order; maker, Jonas Rant, London, no date. The owners wish to know the probable age. Can any of "ours" tell me what years the above maker carried on business in London? Also, what is the use of plate 1½in. dia. with figures on it from 1 to 12? This plate is between dial and hour-hand, and fitted a tube, the inner end at back of dial, had a pear-shaped boss which fitted loosely the tube or boss of hour wheel. There was nothing that I could see missing from the clock.—Hopeful.

[46475.]—**L. & N.W.R. Engines.**—Will any of our readers kindly give the number of Snipe, Skylark, Sheldon, St. Alban's, Telegraph, and Iron Duke? Also the dates of Atlas, Councillor, Elwy, Wyre, Simoom, Vizier, Vulture, Viscount, Lawrence, Medea, Lapwing, Arab, and Python?—Gem.

[46476.]—**Dull Window-Glass.**—I have some vineries and frames in close proximity to smoky chimneys of dwelling-houses of my neighbours; and in consequence they are always dull and obstruct the light, being covered with fine soot, which seems to penetrate into the very substance of the glass. I have tried scrubbing with soap, and also washing with hydrochloric acid; but all to no purpose, and they appear to get duller every year. Can any kind reader tell me how to remedy this?—Caxton.

[46477.]—**G.W. Engines.**—Wanted the dates and size of cylinders of the following engines?—1581, 1513, 1220, 852, 826, 780, 619, 487.—C. H.

[46478.]—**L. & N.W.R.**—Will some reader kindly favour me with a sketch and detailed dimensions of the L. & N.W.R. tank engines (outside cylinders, four-coupled, dome close to funnel) which run on the North London Railway from Broad-street?—E. E. R. Tratman.

[46479.]—**Steam Carriages.**—Can any reader give me a sketch of the following steam-carriages, mentioned in Mr. Clarke's "Locomotive Engines," with particulars?—1. "Enfield," Eastern Counties Railway, when Mr. Samuel was engineer of that line. 2. "Express," same line; but, I think, of more recent date. 3. "Fairfield," which used to work the Tiverton branch (broad gauge) of the G.W.R. I believe all three were constructed by Adams and Co.—E. E. R. Tratman.

[46480.]—**Landlord and Tenant.**—To Mr. F. N. Wetherfield.—Tenant took furnished rooms at per week. Having occupied them, and was given latch-key, afterwards arranged for an employé to occupy them. He also was supplied with key. The rentbook was kept and paid in the name of first tenant, who was considered responsible. The employé was called away suddenly, and never gave notice to give up rooms, the bill being forwarded, the first or responsible tenant still holding his key, and neither having given notice. Can I recover rent and price of key? And does the fact of holding key constitute tenancy?—Householder.

[46481.]—**Boiler-Pump.**—To "Sunlight" and Others.—I have a boiler-pump worked by an eccentric on flywheel shaft. I want to know how much water per stroke it sends into the boiler. My idea is to multiply the length of the stroke by the diameter of ram.—Slocum Podger.

[46482.]—**Gregorian or Cassegrain.**—To "A. N. H."—I am sorry I did not mention the distance between the mirrors in my last. It must be about 22in. Will you kindly suggest curves? If you have had experience of Cassegrain's telescope, perhaps you will let me know what you think of it?—G. L. E.

[46483.]—**Diamond Work.**—Could any of your readers inform me what alloy is used for diamond spray-work, or if it is just the pure silver? as I find our work to tarnish quicker than English.—Jeweller.

[46484.]—**Lathe.**—Will some of our lathe correspondents kindly advise?—I have a 3½in. back-geared lathe, in which the backgear slides endwise in and out of gear, and the pulley is fastened to front gear-wheel by a small bolt and nut sliding in a slot in front of wheel. I want to put a division-plate on front of cogwheel, but must have a different way of clamping pulley to mandrel first. I thought of doing it a way I have seen some, with a nut on mandrel at the back of the pinion on pulley, and this is screwed up tightly when working without gear and holds by friction between pulley and front gear-wheels. But the space between mandrel and back gear-wheel is only a little over 3-16in., and that is not enough for a proper nut. Would it do if I had a cylindrical nut, and screwed it by a sort of hook-wrench put into holes in its surface? Would a nut only 3-16in. thick be strong enough? If this way is not advisable, could someone tell me how to manage it without using front of mandrel gear-wheel?—E. F. C.

[46485.]—**Pedal Organ, &c.**—Will one of our correspondents in such matters advise me whether to build an 8ft. or 16ft. tone pedal Lieblich bourdon to a one-manual organ containing Lieblich Gedact, 8ft.; Gamba, 8ft.; Dulciana Principal, 4ft.; and Fifteenth, 2ft.? Also, give address of a firm who supply the strained and unstrained white leather for bellows, pallets, &c.? Organ-builders are so exorbitant in their charges for these things.—Sly Dog.

[46486.]—**Baking.**—I wish to commence a bakery capable of turning out 70,000lb. of bread per week. What is the most improved method of kneading? Which is the best style of oven, and how heated, and where can they be seen at work? Any other information will be welcome.—H. Washington.

[46487.]—**Chemical.**—Would any chemist kindly furnish a simple and easily-applied test, whereby salt-water may be distinguished from fresh when absorbed in small quantities by cotton, jute, or other fibres, either in the raw or manufactured state?—L'pool, N.

[46488.]—**Legal.**—To Mr. Wetherfield.—A. owns a foundry at the back of B.'s house. The chimney connected with the boiler was, until recently, carried to a distance of about 50ft. from B.'s house, and then to a height of about 30ft.; but a new boiler has been put up, and the chimney carried straight up not more than 15ft. from the ground. It is now close to B.'s garden-wall, and about 15ft. from his house, and the volumes of smoke are a continual nuisance. Is this allowable; and if not, what remedy is there?—E. J. Babbage.

[46489.]—**Bicycle Making.**—I shall feel obliged to any of our readers who could inform me whether, in fitting neck and back-fork in backbone and front forks (hollow) to head, they have to be drilled and pins or rivets put through in addition to brazing, or will brazing alone suffice to hold them? I may mention that it is a 48in. all-bright machine I intend making for my own use. Any hints on the fitting, &c., of machine together will be thankfully received by—An Amateur.

[46490.]—**G.P. Joints.**—Will one of your readers kindly inform me how the joints are now made in the underground (street) telegraph wires? The Chatterton's compound, which was formerly used at each stage, has, I believe, been discontinued; and nothing but sheet percha used. Perhaps one of your readers would kindly give the details, how to make a joint to test well and look well?—Inspector.

[46491.]—**Telescope.**—To Mr. Lancaster.—I have a 48in. telescope, 1½in. aperture, and, strange to say, when I look at an object a sort of cloud covers the eyepiece. This is removed by removing the eye about an inch from eyepiece of instrument. I should like to know what is wrong?—Object.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, March 22, and unacknowledged elsewhere:—

R. Healy.—John Wilks.—R. O'Hara.—J. Bateman.—Chance Bros. and Co.—R. Vion.—Rev. W. L. Pendered.—G. W. Weeks.—J. Noble.—Rev. J. Rawlins.—F. Nunns.—Collodion.—Starlight.—Poor Peter.—Total Heat.—T. Neilson.—Platform.—Kappa.—Meteor.—N. S. Godfrey.—R. P.—Amateur Polisher.—J. H. B.—Vega C.—Gymnastic.—Jumbo.—Fellow Workman.—W. G. S.—Fond of Wood Turning.—G. Tolman.—Conrad.—F. W. G.—W. Hosken.—Clyde.

A NEW VOLUME.

No. 885 was the first of Volume XXXV. Reader willing to oblige us by recommending "ours" to new subscribers should do so now, when a new volume is commencing. The index to Vol. XXXIV. is published in this number and cases and bound volumes will be on sale shortly. Readers desirous of making up their sets for binding the last volume are recommended to do so at once, as the back numbers soon run out of print.

Enquirer. (You can obtain a copy at Somerset House or your local private registry. The cost is not heavy, but according to length.)—U. S. A. (We cannot insert queries asking for information about persons. 2. The climate of the district named is the most enjoyable in England, except in the extreme south-west, where a great deal of rain falls. Penzance or Falmouth ought to suit you, and if you find them too relaxing you can easily shift your quarters to the northern coast, where the fresh breezes from the Atlantic sweep "all down the thundering shores of Bude and Bos" at a rate that ought to satisfy the most ardent lovers of the boisterous.)—E. Berliner. (Received with thanks. Will gladly accept and report.)—S. Croft and Sons. (We do not know the address. You had better ask "Tubal Kain" for it through the "Address" column.)—Would-be Watch Jobber. (We do not see that you can do anything else but follow Mr. Beaumont's example as detailed on p. 628. You are evidently hardly prepared to start in business for yourself yet.)—Man of Kent. (We are of the same opinion as your medical man, and even if you still experience no ill effects, should advise you to be very careful.)—Oxodus. (If your hip joint is really dislocated, you had better see a surgeon, and not waste valuable time in quacking yourself with galvanic bands for rheumatism and liver complaints, or listening to old women's tales about "want of oil in the sockets.")—Clean Water. (You can do nothing with the filter but get rid of it, and get another with a movable top, so that you can yourself remove and clean the charcoal block at least once a month.)—E. Carter. (Received, but could not spare the necessary space. We have already devoted some room to the association, and wish it all success, but are very crowded just now.)—

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, MARCH 31, 1882.

THE GONIOSTAT.

By J. H. EVANS.

THIS instrument is one of the most useful, and is, consequently, a necessary adjunct to any amateur mechanic's workshop. In the first place, it is as well to draw attention to the fact that a great many tools are often entirely spoiled from being badly ground; the angles are rendered anything but what they originally were, and, therefore, a reproduction of any work previously done by a cutter that has been ground by hand is quite impossible, and it is to aid those in want of the knowledge of such instruments as the engraving represents that I endeavour to give all the details necessary for making such a tool. There were, at an earlier period, several different plans devised for effecting the same purpose, but I think the present one is the best in every way. It was a rule not long ago to fit the instrument into a box, having three trays to draw out, each one having a different plate let in —viz., one of oil-stone, one iron, and one brass. But I have arranged it on a different principle; that is, to have a mahogany block 9in. by 12in., and all the three sharpening plates on the same surface; the Goniostat is fitted in the centre of the block, and a mahogany cover fits over the whole lot, so that it is simply to remove the cover, and when setting the tools they can be passed from one to another of the plates in much less time and with greater facility than when the plates have been taken from different places. When getting up a cutter to perfection it should be finished upon the iron plate with a little crocus. We find that a keener cutting edge is thus obtained, and I would here advise all who essay to try ornamental turning, never to be afraid of devoting time to sharpen the tools before beginning to cut.

To make such an instrument will require excellent work, and although there is not much to look at in it, it is by no means an easy thing to do. Fig. 1 represents a front view of the instrument, and shows distinctly how the different angles are obtained. It will be seen that the arc is equally divided on each side of the centre line, so that double angle tools may be got up to the greatest perfection. Fig. 2 shows a side-view, whereby the divisions on the steel arc are seen, also the manner of putting together the knuckle joint, and the two steel pins upon which the instrument is worked. Taking the side view, it will be seen that the steel piece Fig. 12 is fitted to the metal, and curved to fit over the top of the steel arc, so that when the screw C is tightened, the curved piece will clamp down upon the arc, and hold it tightly to the division at which it is set. The engravings are made to exactly the half-size of the original, so that little or no difficulty will be experienced in making patterns, and to facilitate operations I will, at any time, allow castings from my patterns, and so save any trouble at all in that respect. Having, then, the castings and forgings all ready, first see that all the rough edges are taken off, and as a beginning take the large plate, Fig. 3, and get the front up to a surface; then place it upon a wood chuck that has been previously surfaced, set it so that as much of the back of the plate as possible can be turned between the projections where the tool-box, Fig. 5, fits, and that in which the arc works. In making them we generally have three or four placed on a large chuck, and turn them all at the same time. When turning one, however, the same process must be gone through, and to hold it to the chuck, good strong cement is the best, as it does away with clamps, which are sometimes in the way. I had better give the proportions for such cement as we use, and find answer in every way: It is simply made of resin and beeswax, two of the former to one of the latter, made hot in a small ladle and placed round the edges of the work with a spoon. When the work is turned a slight blow with a hammer will loosen it all, and the cement can be used over and over again. This, I may mention, is a most serviceable item in a workshop, and is used for many other purposes. Having turned the back, the parts not turned should be filed off true to the turning, and if well done, and the plate has been flat upon the chuck, it should be the same thickness all over. This being the case, the outer edges may be made to the proper shape. We may now proceed to bore the hole A, Fig. 3, in which the pin of the tool-box A, Figs. 5 and 6, is to be fitted; although the drawings are made half-size for the convenience of the paper, they will give the dimensions. I will give, however, the exact sizes for the various fittings. This hole then, A, Fig. 3, is ⅜ of an inch in diameter, and countersunk at the back, with a pin countersunk ⅝in. diameter, and 3-16in. deep. The screw may be made with the thread that is the most readily obtained, and, as these appear to be the Whitworth threads, as a rule, the 3-16 of that make will do perfectly well. Before proceeding with the steel parts, the action had better be got to work; therefore, Fig. 4 must form the next piece to do. The thickness of the front plate is ¼in., so that Fig. 4 should be the same. The top having been filed up flat, let it be placed on a chuck and turned in the same way as Fig. 3. When done, it can also be shaped up to what is required. It will be seen in Fig. 4 that the points of the screws project through about an eighth of an inch. The heads of these screws are ⅜in. diam., and the screw may be the ¼-Whitworth. I will take it that these shall be considered the threads throughout, provided the finer threads, which have been discussed, are not in the possession of the person about to make such a tool as that now under our notice. The screws in their place, the joint will be the next thing, and to file it up to a perfect fitting is not an easy task. I will endeavour to give the best idea I can of doing it to perfection. Having the two screws in their place, we will leave them for a time, and cut out the place where the curved parts in Fig. 4 are to work into Fig. 3. In order to get these out well, a long countersink, with a pin on it the same size as that on the points of the screws,

FIG. 1

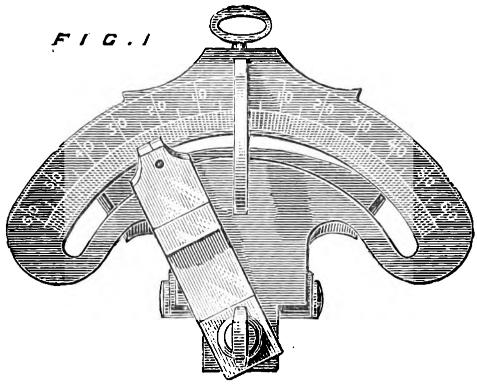


FIG. 2

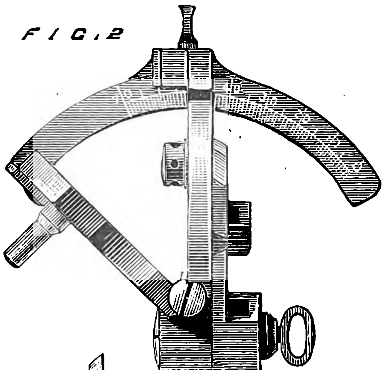


FIG. 4

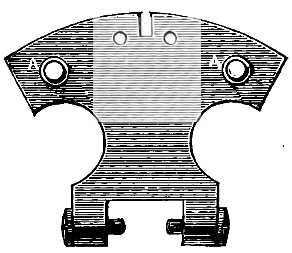


FIG. 3

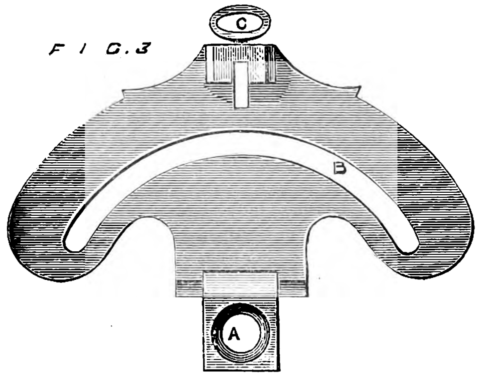


FIG. 5

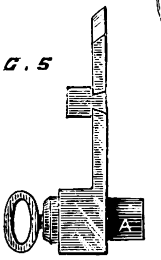


FIG. 7

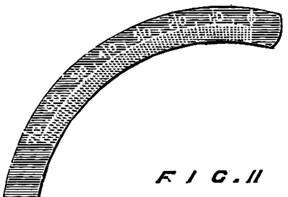


FIG. 8

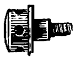


FIG. 9

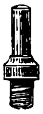


FIG. 10

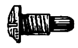


FIG. 12

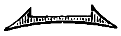


FIG. 11

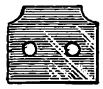


FIG. 6

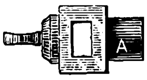
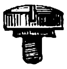


FIG. 13



must be made, and it must be made sufficiently long to allow the chuck in which it is fixed to revolve without interfering with the sides of Fig. 3. The diameter of the joint to be cut is exactly $\frac{3}{8}$in., so that that must be the size of the countersink, and it must only be made to cut on the end. A small hole the size of the pin on end of screw must now be drilled in the metal in a line with the back face of Fig. 3, and side of it cut away with the countersink till it reaches the body of the metal, where it fits between the space seen in Fig. 4. Having cut out the place for the joint, to fit the other portion will form the next part, and I will, as I say, give a hint as to the best means to adopt. I have said that the screws are $\frac{3}{8}$in. dia. in the head, which is the exact size of the countersink, and we have found the surest way of making a good joint is to make a pair of screws with the heads the exact size of the countersink used to cut the recess and harden the heads; this will be a guide to file the joint to, and the screws being hardened will prevent too much being taken off where it should not be. Care must, of course, be exercised, or the files will soon be of little use; but a good viceman has no need to damage the file because the guide is hardened. It will be observed that where the instrument is jointed it opens to a right angle, so that more than half the circumference must work freely. Having the body of the work jointed up, the steel arc, Fig. 7 will be the next part to proceed with. The radius of it must be described from the centre of the knuckle-joint, and the best way to get the arc to its proper curve will be to take the centres and strike out the curve on a small plate with a square edge, the latter being for the purpose of placing the base of the steel arc, Fig. 11, against to test the accuracy of the work as it proceeds; if the dimensions are carried out according to the drawings, the curve will be easily obtained, and it will save a deal of trouble; it is $\frac{1}{8}$in. wide; the two holes seen in Fig. 11 are countersunk with a cone countersink, but this is not a matter of much importance. The shape of the heads may be different if desired.

The two holes seen in Fig. 4 are those into which the screws fit to hold the arc to the metal; the mortise hole in the front plate, Fig. 3, is that which the steel arc passes through, and must be very carefully set out, as it should touch the steel at any part during its movement—that is, when set by any angle denoted by the divisions on the arc. When this has been so far finished that it works well, we may proceed to fit the tool-box, Fig. 5. This is made of steel, and a forging will be necessary, on account of the various projections in it. The steel being properly softened, the pin A must be turned to fit into the hole A, Fig. 3. There are two different ways of holding this piece while being fitted: either to fix the square part in a jaw chuck, or to centre it and turn it between the centres. It the latter way, it must be made the length required, which will, of course, be the depth of the hole into which it is to be fitted, and then drilled and tapped. Whichever way it is to be done, the bottom face must be turned quite true to the pin, so that it will move round in its place without injury to the face of the metal. I should always recommend turning such a fitting between the centres, especially where, as in the present case, the reverse side has to be turned. When the pin has been properly fitted, it must be reversed between the centre and the boss, turned with a hollow true to it. This side is also tapped 3-16in., and has a thumb-screw fitted to it to fix the tool in its place; towards the end of the thin piece nearest the division, a piece of metal is fixed so that the end of the tool will pass through. This is to steady it, and make it more rigid when being set; also to insure its being square to the instrument. The best way to fit the metal piece in is to make two dovetail slots, and fit the metal to them, and slightly rivet it over at the bottom. It will be seen by the engraving, Fig. 1, that the end of the tool-box projects just beyond the radial slot: and on the extreme end it is filed to an angle, in the centre of which a fine line is made to read off the division on the metal-plate. The radial slot B, Fig. 3, may now be got out, and there are two different ways of accomplishing it. One way, and a simple one, is to line it out carefully from the centre of the hole A, and then drill a series of round holes close together, and with a round file break them one into the other. This done, it must be made quite true with narrow pillar files, and a small crossing-file for the concave part. This may appear an old-fashioned way in these days of drill spindles, overhead motions, &c., &c. The best way, however, is to bring into use the last-mentioned tools; and to do this, the plate, Fig. 3, should be placed upon a true surface-chuck—I think a wooden one the best for many reasons. It must be chucked quite true to the hole A, and to insure this a boxwood pin fixed in the centre will suffice. In making quantities we have, of course, proper standard chucks; but all that is really required is that the slot should be true to the hole. When it has been fitted as described, it is held down flat on the chuck by a clamp at each of the two corners. This done, a drill-spindle is placed in the sliderest, having in it a small rose-end cutter, and this, driven at a high speed, will soon cut out the slot both clean and true. If a segment apparatus be on the lathe, by all means use it, for the distance of the cut each side; if not, the length being lined out, no difficulty will be experienced working the lathe-head backward and forward by hand. To cut out such a slot in the latter way is, of course, the most practical; but still, in the absence of the tools, it can, and must, be done with a file. When this part is finished so far, and the tool-box fitted, it must be put in its place, and by making a line on the steel the width of the slot, the position for the binding-screw, Fig. 8, may be determined. This hole is tapped, or rather can be so, with the 3-16, and the plain part made to pass freely through; the screw should have a thin steel washer under the head, as it will hold the tool-box down better. It is not absolutely necessary, but it is better to have it. The diameter of the head of this screw should be half an inch, or as large as possible, provided it will pass by the under part of the steel arc.

We now come towards the finishing of the instrument. The two pins, Fig. 9, which screw into the two holes, A, Fig. 4: these must be precisely the same length, which is $\frac{3}{4}$ from the shoulder, and screwed tightly up to the collar, which, in order to give a better hold, should be $\frac{3}{8}$in. diameter. These having been fitted, we may look upon the instrument as ready for dividing, and the starting-points must be taken when the two pins, Fig. 9, are in their places. If these were to be shortened or lengthened afterwards, the divisions would be incorrect. As to the actual finishing-off of such a tool, this is entirely in the hands of the person who is making it. It will, of course, work just as well without being highly-polished; but if it is desirable to do so, the same directions as I have given for other work will apply in this case.

THE ECONOMY OF ELECTRICAL RAILWAYS.

On Friday last Prof. Ayrton, lecturing at the Royal Institution, made out a good case for an actual trial of an electrical railway on a working scale,—such a scale as would be necessary for the conveyance of passengers and goods over a light road of the ordinary gauge. The standard gauge must be adhered to for two reasons—because the comparison will then be direct, and because there is no likelihood of its being changed, even if the motive-power employed on railways were revolutionised. The question whether locomotives shall be employed to do the hauling, or whether current shall be supplied to electric-motors from dynamos driven by stationary steam-engines, is purely one of cost, and from that point alone can we expect directors and engineers to examine the scheme propounded by Prof. Ayrton on behalf of himself and Prof. Perry. If, in addition to economy of making and running expenses, it can be shown that railways worked by electricity are safer than the present system, there is much reason to wish that a trial on a large scale should be made as soon as possible, though it is scarcely to be expected that the experiment will be made on the Underground line. In examining the question by comparing the relative advantages and disadvantages of the rival systems — for the electrical is so far perfected that it is a system—it may be advisable to point out the weak points of the ordinary system in which trains are hauled by steam-propelled locomotives; gas-engines, compressed-air motors, &c., being practically out of court. The first disadvantage is clearly that which was pointed out years ago, when Stephenson fought the battle of the locomotive, viz., it has to pull its own weight in addition to that of the train. On the average we may say that it is equivalent to six carriages full of passengers, and for obvious reasons a large proportion of the weight is carried on a few points, so that not only must the road be made strong to carry the weight, it must be made very strong, and be carefully looked after to prevent and remedy the damage done by heavy loads passing over it at high speeds. An ordinary third-class coach, full of passengers, weighs less than 10 tons, while an engine weighs, say 40 tons, two-thirds of which rest upon the rails in as short, or probably a shorter, space than that occupied by the wheel-base of the passenger coach, so that while the coach presses the rails at four points with $2\frac{1}{2}$ tons at each, the four coupled driving-wheels press on them at each point with a weight of 7 tons. It is clear that, besides the disruptive effect produced by the passage of such a load at high speed, there is great wear and tear of rails and tires. In Stephenson's time the alternative was a stationary engine, to draw the train by means of ropes and chains, a system which that far-seeing engineer said would never do for the railways of the future, and though quite aware of the drawbacks to the use of the locomotive, he also did not fail to notice the enormous waste of power in hauling chains and ropes over pulleys and drums. But if we can dispense with the heavy non-paying weight of the locomotive—which is a costly machine at first and expensive on repairs—it follows that railways will cost much less to build than they do now, and will be maintained at far less annual expense. Then, a locomotive weighing as much as six carriages, and an average train being taken as ten coaches, it is clear that 50 per cent. of the total power is expended in propelling the engine itself, and as that means 50 per cent. of the coal burned, there is a large margin of economy on that item alone, if other things are equal. It is well known that a horse-power can be produced in a compound condensing engine at a smaller expenditure of coal than is possible in a locomotive, so that we may fairly say 70 per cent. of the fuel necessary to propel a train can be saved by dispensing with the locomotive and making each carriage self-propelling. In the electric transmission of power there is waste from mechanical friction and from electric friction; the latter can be avoided or reduced to a minimum by making the load on the motor so small that it will run nearly as fast as the generator which converts the mechanical energy of the steam-engine into electric energy. Experiments have been made which show that the efficiency of an electric-motor is 70 per cent. of the work done by the steam-engine; but, if we put the loss between the engine and the dynamo at 20 per cent., and that between the dynamo and the motor at 20 per cent., the total is 40 per cent., against which we have a set-off of 70 per cent., leaving a balance of 30 per cent. of fuel saved by the use of electricity. Another series of experiments have proved that a horse-power can be obtained for every 50lb. dead-weight of electro-motor, and we must remember that these machines are still in their infancy. Still, a horse-power for every 50lb. dead-weight is a long way better than can be done with a steam-engine, and is more than twice the power obtainable from a similar weight in a locomotive. The great advantage of the electric motive-power under this branch of the subject is, that the power will be distributed: each coach will be fitted with motors capable of propelling it, and there will be no necessity for using a machine capable of hauling a dozen carriages when it is required to take only three or four. We have no intention of entering into the theoretical aspects of the question: they will be found treated by Dr. Werner Siemens on p. 202 of our last volume; but having seen that the economy of the electric system is clearly superior to that of the steam locomotive, it remains to be discovered how best to utilise electricity. The chief difficulty is the conveyance of the current to the motors without undue loss through heating of the conductors, and without leakage—a very serious loss where long conductors are inefficiently insulated. The simplest method is obviously to use the two rails, one as the lead, the other as the return, the connection being made through the motor by means of the wheels on opposite sides. These necessarily must be insulated from one another, or the current would pass through the axle instead of the motor. That is the system adopted in the Berlin railway, but later modifications use both rails as returns, and have a special rail or cable for conveying the current. Both these methods have disadvantages, the chief of which is the great loss by leakage, a loss which Profs. Ayrton and Perry believe they can minimise. In the paper by Dr. Werner Siemens (see p. 202, Vol. XXXIV.), that distinguished pioneer in electrical engineering expressed the opinion that the electromote would never supplant the steam-locomotive, mainly because the latter possessed "freedom of motion," or is self-contained; but he thought that electrical railways might with advantage be erected in crowded districts, and be used especially in tunnels and for underground systems. Profs. Ayrton and Perry have gone a step beyond: they evidently think that the days of the locomotive are numbered, although a tolerably long life may still be in store for our old servant. They propose to lay a well-insulated cable alongside the line, and take the current through the motors by means of a rail on which the train will rub, and which will be divided into sections, fairly well insulated from one another and from the ground. By means of connections automatically worked by the train, the current would be supplied only to that section on which it was for the time being required, and consequently the loss from leakage would be reduced to a minimum; in fact, Profs. Ayrton and Perry "venture to think" they have reduced the leakage on the longest railway to less than what it is on the shortest by any of the systems hitherto suggested or tried. Several methods of making connections between the sections and the cable have been devised, but one in which contact-boxes are used at every 50ft. or so, would involve a considerable outlay of capital, and is, we consider, out of the question. In the simpler form, the rubbed rail is divided into sections as long as the method of insulation will allow, and a train passing out of one section takes off current from that section and puts it into the section just entered. Thus there must of necessity be a clear space of a section between two following trains, for a train having left section A, and entered upon B, the section behind is blocked, and any train entering it is automatically brought to a standstill, for the reason that it is not only deprived of motive power, but is actually braked by the electro-motor becoming a generator short circuited on itself. With such a system as this it is evident that signals could be dispensed with, while by suitable arrangements the train could be made to automatically record its progress along the line to all the stations. As to the motive power, stationary steam-engines would be erected at suitable spots, where space could be obtained cheaply; but there would be dynamo-machines to generate the current and electro-motors on the axles of the vehicles. What these would cost and how long they would run without repairs we have no data on which to found even an estimate, but there does not seem any reason why they should be more expensive than locomotives, and they certainly would not cost so much in repairs. There is, then, the capital outlay for the cable, the rubbed rail, and the contact-making connections, which would scarcely be covered by the saving in signalling wires, especially where there were many junctions and both signals and points absolutely necessary. These details of expenditure are not at present forthcoming, but it is probable that the large saving in forming the roadway and building bridges would more than cover the outlay incidental to the electrical system. There is no present probability of any of the main lines altering their arrangements in order to introduce electro-motors, but there is plenty of room for making light railways and putting the new system through a thorough trial.

EXHIBITION OF BICYCLES AND TRICYCLES AT BIRMINGHAM.

AN exhibition, promoted by the Speedwell Bicycle Club, was opened on the 22nd inst., at Bingley Hall, Birmingham, and as the first provincial exhibition of its class it proved a decided success, both as regards its exhibitors and its visitors. Bingley Hall is well adapted for exhibition purposes, and possesses, besides ample floor space, an extensive gallery, which was used for showing the capabilities of the various machines. The entries numbered about 300, and most of the first-class makers were represented. Messrs. Singer and Co. exhibited about a dozen machines, all of which maintained the reputation of this firm for design and finish. The "'Xtraordinary," recently noticed and its merits discussed in our columns, attracted much attention. Messrs. Baylis and Thomas, whose novelties for the season were mentioned some short time since, exhibited several specimens of their manufactures, including a "Stanley Excelsior Hollow-fork" semi-racing bicycle, a splendid machine, which was much admired. The Machinists' Company showed an assortment of machines, as did also the Caroche Company, including a Juvenile Tricycle and Sociable. Amongst the novelties exhibited must be mentioned the "Four-in-Hand," a most imposing-looking machine, manufactured by the Centaur Company. It is constructed to carry four riders, two ladies in front on seats, and two gentlemen behind on saddles, all facing front and pedalling forward. It is very little larger or heavier than an ordinary Sociable, and consequently the extra pedalling power makes it unusually easy of propulsion. It is finished and fitted in a very superior manner, and was one of the best machines in the exhibition. The same firm also exhibited their "Convertible," which can be used as a double or single machine (by an extra wheel being supplied), and can be converted in about three and a half minutes. Mr. Burdess showed a machine, the novelty of which consisted in a backward action of the pedals instead of the ordinary forward motion. Amongst the Howe Machine Company's exhibits was the new tricycle invented by Mr. S. Warwick, whose patent they use. It presents several novel features, one of which is that by a new gearing, worked by a simple movement of the handle, speed on a level road can be instantly changed for power when hills have to be climbed; the same action also works an arrangement which stops the pedals, so that in descending a hill the feet remain stationary while the machine is in motion. There was also exhibited by Mr. Eade, a special hill climber, the "Monarch," which it is claimed will easily ascend the steepest hills. Mr. Eade was not content with saying what his machine would do, but had fixed a steep incline about 1 in 7, and some 20ft. long, across which was fixed, at the steepest point, a piece of wood 2½in. square. The "Monarch" was easily ridden up and down this incline, and passed over the bar in the easiest fashion. It appeared thoroughly under control on any part of the gradient, and attracted much attention. The Small Arms Company (Limited), and the National Arms and Ammunition Company (Limited), both exhibited several machines, which bear the stamp of the excellent workmanship that might be looked for from these firms. Mr. G. Townend, who makes a speciality of juvenile tricycles, exhibited several machines, and they appeared, by the juveniles who were riding them about, to be very easy of propulsion, and quite safe. The "Hopwood" pedomotive-carriage, is an entirely new machine, which the inventor states is neither a bicycle nor a tricycle. It is constructed to carry two persons as passengers, and is intended to be worked by a coachman or "outrider." We were not able to see this machine completed, as it was late in arrival, but mention it as a novelty which we shall notice again.

The Manchester Tricycle Company exhibited a "Favourite" machine worked by the hands only, which they say is specially designed for those whose legs are weak or useless; to such this machine may be a boon, but the seat appears to be uncomfortably low. Messrs. Palmer and Co. exhibited a tricycle which has their patent centrifugal balance movement, very ingeniously constructed and well worth the attention it received. Mr. Lucas, of "King of the Road" renown, as applied to lamps, was there with an excellent display of his manufactures, and showed his latest improvements, which are an adjustable wind-up burner for regulating the light without opening the lamp, and a contrivance to prevent smoking. Mr. W. Bown had a very large display of bicycle fittings, &c., all of which were of excellent finish and workmanship. Mr. Bown is, however, more celebrated for his "Æolus" bearing which has been, from its first introduction, most extensively used by nearly all the prominent makers, The front wheel bearing has this season been so far improved that the outer case and cap are made of solid stamped steel, the internal curved surfaces being left dead, hard, and highly polished. The adjustment is also improved, so that the lock bracket cannot become detached from the serrated edge of the cap. Most of the machines exhibited were fitted with the "Æolus" bearings, which are highly esteemed by both makers and riders.

WATCH-CLEANING AND REPAIRING.

By "A FELLOW-WORKMAN."

(Continued from page 25.)

New Holes.—(*Continued.*)

DRILL the hole the rest of the way through; now rivet the bush firm, and broach the hole, so that the wheel will run easily; countersink it on the outside, and polish off level on the inside.

This method answers for third wheel, contrate, and small holes in general. The centre and fusee holes seldom require repairing. The centre hole is filled up and drilled in the centre of the countersink. The position of the fusee-hole is first got same as small holes, then filled up as follows:—Broach hole larger; then take a square file, and file notches round the inside of the hole—this will keep your bush from slipping; chamfer it a little on both sides, fill up, and make your hole. Brass is one of the most treacherous metals we have to deal with. You may think you are drilling it straight, but when you have done you will find your mistake; so you had better, when drilling large holes, to drill a small one first, and then broach it to the required size.

In fitting screws to regulator, cock-plate, or barrel-bridge, to make the hole for the screw, you proceed similar to fusee-hole, only you don't want the position. After you have filled the hole up (we will suppose you are fitting a new screw, hole, &c., to regulator, or time-plate as it is sometimes called), you put regulator in its place; then take needle, and make mark round the inside of the hole in the regulator: this will give you the position of the hole required.

The following is an easy way to put a pinion to contrate-wheel:—Take your pinion, in rough, and fit on carriage (19 and 20), as shown at Fig. 25; now fit a small drill-head, or rose, over the end of the pinion, as shown Fig. 25 (the dotted lines), leaving just length enough for your pivot. Now place it in the turns, and with a good pivoting-file file up pivot as follows:—Fig. 26 shows: C is a piece of brass, or steel wire, cut half-way through with a little slot B, made with a three-square file for the pivot to rest in while it is being filed; D is the pinion, E the rose, the dotted line A is the file. While you push the file from you, you draw the bow towards you in a see-saw fashion.

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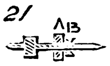
21



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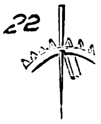

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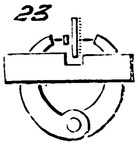

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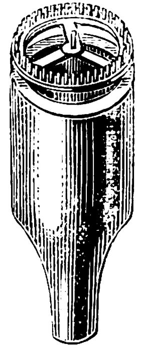

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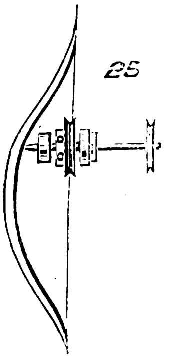

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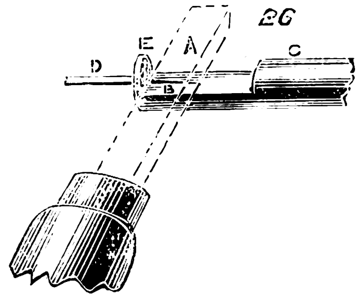

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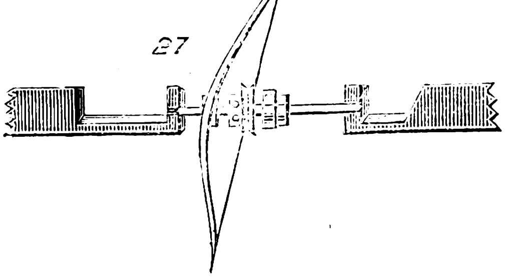

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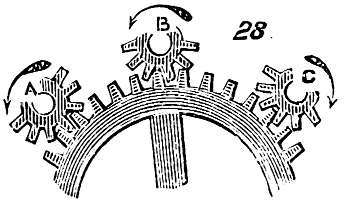

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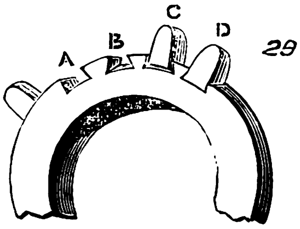


You must keep watching your pivot, or else you will soon find it disappear. When you have got it small enough, you must polish it. If you have not a polisher you can make one. Take an old, small file, grind it smooth, and polish it with oil-stone, or anything that will give it a smooth face; put some fine emery on a piece of wood, the same as on a knife-board. Now lay the tip of your file on the board, and slide it on to the board, not straight, but from right to left, three or four times. Now remove all traces of emery from the polisher, and it is ready for use. The other pivot is done in the same way, only you must be careful not to break off the pivot you have just made. When you have finished both pivots, you must turn up for the wheel. You must place your pinion in the turns in such a way that you may not break the pivots off while you are turning for the wheel. I think that Fig. 27 will sufficiently explain what I want you to understand about the protection of the pivots. You first drill a hole through, larger than the pivot, then you chamfer this hole about half-way through: this chamfer must be large enough, so that the shoulder of your pinion will enter and take its bearing, letting the pivot run free. Now turn up for wheel, same as Fig. 21. A should be a little chamfered, B more so, to allow of its being turned over for riveting. You must keep offering your wheel, so that you do not get it too small. When it enters about half-way, you can drive it the rest; then with a pointed tool you can turn over the flange B. It will not require any more riveting. I forgot to mention that you must measure from shoulder by the old pinion, as they must both be the same length. Now place your wheel in a pair of simple callipers with touch (Fig. 23), when, by turning the wheel slowly round, you will soon see if the wheel runs true. If not, put it between the plates with the escape-wheel, and see if any part of the contrate-wheel runs the right depth (see Fig. 28).

A is right, B is too deep, C is too flat. In A you will see that there is only one leaf of the pinion working on the tooth of the wheel; the others go in and out without touching. B: you see the leaves here are wedged in the teeth, and also touch as they enter. C: you see here they touch as they enter. Having found a part (or made a part) that is the right depth, you mark it. Now, by bending the *other* crossbars to the one which is correct, you will get the wheel true. To find out which way the bars want bumping, place the wheels in the callipers (Fig. 23), and perhaps you will find it wants bumping towards its top; that is, it runs too fleet. Place it on the stake, as shown Fig. 24, which is a piece of tube held in the vice; place your wheel, as shown in sketch, with the pinion nearly touching the back of the shake. The offending bar will then lie across the hollow. Now, if you give the said bar a tap with the tail of a small hammer (do it lightly, or else you will over do it); place it again in the callipers, and you will soon see the effect; strike it close to the pinion. Sometimes you will find a tooth gone out of the wheel. Fig. 22 is the proper way to put in a new tooth. See that the contrate-pinion is free of the escape-wheel pinion.

Third Wheel.—This wheel is managed the same as escape-wheel, but the teeth are put in different.

Fig. 29.—A is a slot cut for the tooth; B is chamfered at bottom and sides; C is the new tooth, which should fit tight and be a little wider than the wheel. Now, if you rivet the tooth, it will fill up chamfer, and will be perfectly firm.

Centre wheel is managed the same as third wheel.

Fusee (or Chain) Wheel.—There are several kinds of fusees; the oldest, I believe, are the visible clicks. The little steel click (or dog) is very easily made. You can buy what is called click-wire; four-pennyworth will be plenty.

(*To be continued.*)

PRACTICAL NOTES ON PLUMBING.—XXX.*

By P. J. Davies, H.M.A.S.P., &c.

FIGS. 158 and 159 will be found described at the bottom of the second column of Chapter XXIX., on page 26.

FIG. 158

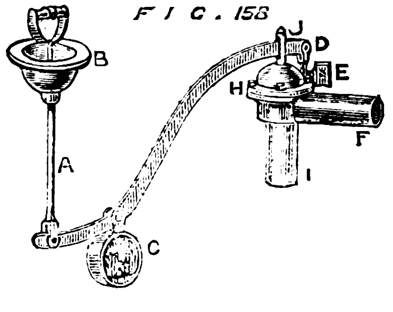
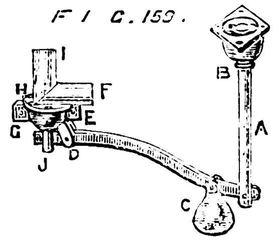


FIG. 159.



Basement Hopper Closets and Water Supply.

We have now arrived at the class of w.c. that has been beyond doubt very much neglected, so far as the water supply is concerned, for the simple reason that careless workmen will argue that it is only a servants' closet. This argument, however, presents no valid reason why these closets should not be flushed as thoroughly and perfectly as any valve-closets, inasmuch as though they may be in a part of the house not frequented by the upper members, they nevertheless must, if imperfectly arranged, affect the sanitary condition of the house; for wherever foul gases are allowed to escape they must permeate more or less the whole atmosphere throughout the building; and, in fact, if there is to be any difference the servants' closets in the basement should be the most effectually flushed, as foul air, excepting carbonic acid gas, always rises, not descends. A farther reason why the hopper closet should be best flushed is, that the best or valve-closet will work properly if the water is allowed to flow into the basin through an only eighth of an inch pipe, because the basin of the valve-closet quickly fills up by the dribbling income of water, and on opening the large bottom-valve this accumulated water will leave the basin *en masse*, and with a force equivalent to that acquired by throwing down a good pail-full of water: now with the hopper valve quite the contrary is the case, as such feeble, and I may say, inadequate supplies are almost useless; in short, the water should be supplied through a pipe in proportion to the head and valves selected, caution being used to prevent their closing too quickly. I have called attention to this in a former article.

An examination of Fig. 164 will show you the old-fashioned hopper closet-basin L, with a diaphragm cottage-valve V, fixed to a wooden block or brick in the wall; as a rule these basins are fitted with a $\frac{3}{4}$in. supply pipe, and $\frac{3}{4}$in. valve, as at Fig. 160, and with the water supply from a cistern not more than 5ft. or 6ft. above the closet floor-line; such supplies as the above are nothing more nor less than shams. The pipe should be at least $1\frac{1}{2}$in., and a clear way-valve without sharp bends.

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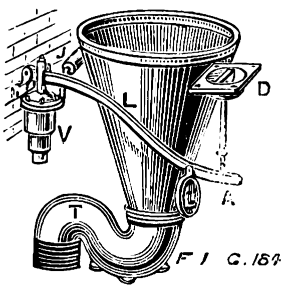


FIG. 164.

Fig. 165 is the cottage-valve V, screwed on to the back-board E; this valve is also shown fitted with the regulator R, which allows the valve-lever to fall slowly. To guarantee the proper working in such instances, it is essential that a proper pull should be selected for this description of levers—i.e., a pull having a long slot for the lever to work through, as illustrated at Fig. 157 A; this allows the lever to drop down without the possibility of its pressing the lever downwards. In fitting the lever to such pulls as these there is one point to be noticed—namely, that you should never allow the lever to rest upon the bottom part of the slot, because if it is allowed to do so the valve cannot properly shut. In proof of this, in the event of the valve allowing the water to run or leak out, examine the lever, and, in many cases, if not most, the above fault will be found the cause. The fault, however, not unfrequently arises from a deposit of lead shavings or solder being deposited in the valve, in which, if you take off the top of the valve you will find the deposit in the seating of the valve; to remove which allow the water to run freely for about two minutes with the top off.

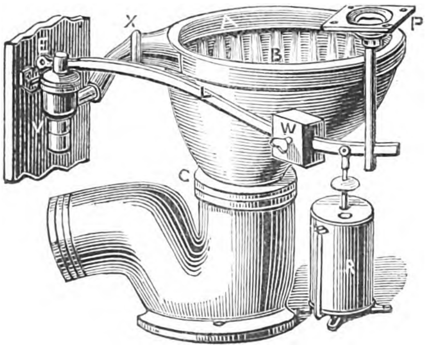


FIG. 165

Stop-Cock Supplies to Hopper Basins.

Years ago it was the usual method to fix a simple stop-cock for the supply to servants' closets, and, in fact, some thousands are so fixed to this day, more especially by provincial plumbers; under these circumstances I think it will be not out of place to suggest the best method to adopt in fixing the same. Fig. 166 illustrates a basin with the description of supply we now have in consideration. J is a fall-down kind of hinged handle, F the cock, B 18in. (or about) of lead pipe from the cock to the arm of the basin, A the putty joint, E the supply-pipe. It may readily be seen that any kind of cock can be used; but those generally selected are ground in. Now, as some of the water companies have raised an objection to the use of the stop-cock for supplying closets, on account of its not being absolutely and thoroughly self-closing, the contingency has been met by bringing into use the "Stool-cock," fitted with a pull-up lever and pull, as shown at D, B, A, 167, or the same end may be accomplished by the use of a self-closing stop or bit-valve, working on either the diaphragm or the falling piston principle.

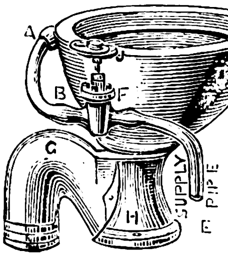
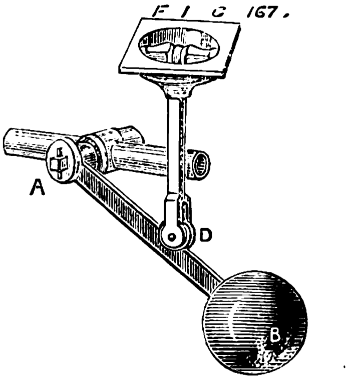
FIG. 166.


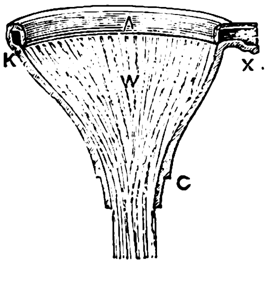
FIG. 167.


Flushing-Rim and Other Hopper Basins.

Be it most distinctly understood that no matter how good may be the pipes and valves used, unless the spreading arrangements within the closet basin are properly constructed—that is, so that the water shall spread over the whole surface of the basin. There are many methods invented by various manufacturers for arranging this most important point, and most of them are generally effective if properly fitted, so that a great measure of the responsibility rests upon the workman.

The first introduced was the fluted oyster-shell pattern, next the old leaden spreader cut to the shape of half an ellipse; at other times to the shape of a semicircle (see the closet-basin in Fig. 137, also the basin in Fig. 136); after this came into use the copper spreader, tinned over, then the fan with the long screw, fan, nut and union, but now quite out of date.

After this the perforated flush rim, which allowed the water to run out in small streams, as shown at B, Fig. 165 (this kind, I must say, I think, is not quite the acme of spreaders). Last, and not least—for I consider it the best—is the fan or lipped flushing-rim, as shown at K, Fig. 168; also at B, Fig. 169. These basins are a great improvement, and possess considerable advantage over those requiring the lead or copper spreader, inasmuch as if the water supply is plentiful (as of course it should be), the basin will be thoroughly washed, as shown at Fig. 170, and, candidly, I fail to see the want of any better closet. Fig. 171, at C, illustrates a basin fitted with a copper spreader.

FIG. 168.


If you again examine the basin, Fig. 168, it will be easily observed that the water, coming from the fan or lipped-rim, sends a thin layer of water completely over the surface of the basin, and that this layer becomes concentrated. It is very easy to estimate the value of this basin when you consider that at the point of the fan the water is $\frac{1}{8}$in. in thickness, and that as it descends to where the soil is likely to be it gradually concentrates to a thickness of $\frac{3}{8}$in., and finally to $\frac{3}{4}$in. During the last twelve months I have fitted up a great number of this kind, and have found them invariably to act in the way here described.

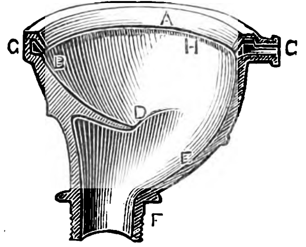
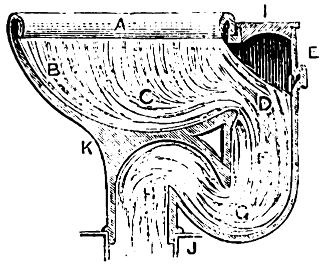
FIG. 169.


FIG. 170.


Basins and Traps in One Piece.

Seeing that there are some hundreds of closets that might and are included in this title now in the market, I shall only bring two or three of the most prominent before your notice. Fig. 171 represents one of, if not absolutely, the first made, and is a very good one for the reason that the basin is so constructed that there is always a layer of water for the soil to drop into, which to a great extent tends to prevent the accumulation of soil on the basin. Fig. 170 is also an improved kind of closet basin and trap combined. Fig. 169 is a basin having a lip D, which throws back the water from the front of the basin, and upon the spot where the soil is likely to stain the back part of the closet basin. Fig. 172 is a kind of lip-trap basin; E is a diaphragm which dips into the water, D, and so forms a very compact trap; A is the supply valve fixed upon a floor bracket or frame; K is the connecting pipe from the basin to the valve.

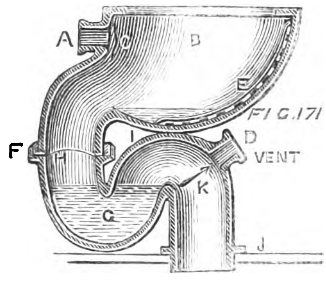
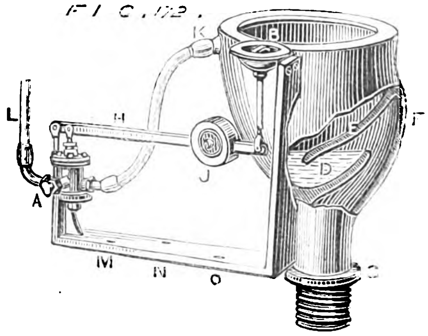


FIG. 171

FIG. 172.


ASTRONOMICAL NOTES FOR APRIL, 1882.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination. North.	Sidereal Time.
	h. m. s. p.m	h. m. s.	° ′ ″	h. m. s.
1	0 3 54·04 ,,	0 42 52	4 36 47	0 38 58·39
6	0 2 21·73 ,,	1 1 6	6 31 13	0 58 41·15
11	0 1 0·78 ,,	1 19 25	8 22 54	1 18 23·92
16	11 59 44·52 A.M.	1 37 51	10 11 7	1 38 6·68
21	11 58 37·69 ,,	1 56 27	11 55 9	1 57 49·45
26	11 57 41·54 ,,	2 15 14	13 34 16	2 17 32·22

The Method of finding the Sidereal Time at Mean Noon for any other Station will be found on p. 390 of Vol. XXXIV.

Solar Activity still continues to be manifested, the Sun never being free from spots for a single day. The Zodiacal Light may still be seen after sunset in the west during the earlier part of the month.

The Moon

Is Full at 5h. 46·7m. in the afternoon of the 3rd, and enters her Last Quarter at 6h. 29·9m. a.m. on the 11th. She will be New at 9h. 38·0 p.m. on the 17th, and enter her First Quarter at 6h. 55·9m. in the early morning of the 25th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	13·0	10 42·9 p.m.
6	18·0	1 42·2 a.m.
11	23·0	6 11·1 ,,
16	28·0	10 38·8 ,,
21	3·6	3 16·0 p.m.
26	8·6	7 15·8 ,,

The Moon will be in conjunction with Mercury at 10 p.m. on the 16th; with Venus at midnight on the 18th; with Saturn two hours later; with Jupiter at 4 a.m. on the 20th; and with Mars at 9 a.m. on the 24th.

Occultations of (and a near approach to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
1	B.A.C. 3726	6	3 11 a.m.	Dark	105	143	3 59 a.m.	Bright.	211	250
1	ε Leonis	5	11 31 p.m.	Dark	341	350	11 45 p.m.	Bright.	320	332
9	B.A.C. 5954	6	†5 40 a.m.	N.	185	198				
21	B.A.C. 1733	6½	9 14 p.m.	Dark	50	91	10 1 p.m.	Bright.	295	331
25	60 Cancri	6	7 26 ,,	Dark	88	100	8 39 ,,	Bright.	222	248

† A near approach.

Mercury

Is a Morning Star during the whole of April, but is rapidly approaching the Sun, and is very indifferently placed for the observer. He is, moreover, becoming more and more circular in outline, and his angular diameter dwindles from 6·2″ on April 1st to 5″ by the end of the month.

Day of Month.	Right Ascension.	Declination	Souths.
	h. m.	° ′	h. m.
1	23 13·1	7 32·4S.	10 34·4 a.m.
6	23 40·4	4 49·9 ,,	10 41·9 ,,
11	0 9·6	1 38·1 ,,	10 51·4 ,,
16	0 40·9	2 0·0N	11 3·0 ,,
21	1 14·6	6 0·1 ,,	11 16·9 ,,
26	1 51·2	10 15·3 ,,	11 33·7 ,,

Hence Mercury will travel from Aquarius across the whole width of Pisces into Aries. The stars lying in and near his path are all very small.

Venus

Is an Evening Star all through the month, and may be seen very near to the Western horizon after sunset. She is now perceptibly gibbous, but her diameter is relatively small (9·8″ at the beginning of April, increasing to 10·2″ by the 30th), and she is by no means an interesting telescopic object.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	1 21·0	7 31·4	0 41·9p.m.
6	1 44·1	9 56·3	0 45·3 ,,
11	2 7·5	12 15·4	0 48·9 ,,
16	2 31·2	14 27·1	0 52·9 ,,
21	2 55·3	16 30·0	0 57·4 ,,
26	3 19·9	18 22·4	1 2·2 ,,

It will be seen from the above Ephemeris that Venus, starting from about the middle of Pisces, will cross Aries and be found at the end of the month in the confines of Taurus. On April 5th she will be rather less than 1° north of ο Piscium. She will pass rather more than 1° to the north of σ Arietis on the 19th, and 2° south of δ in the same constellation on the 23rd. She will further be in conjunction with Saturn (1° 53′ N. of him) at 7 p.m. on the 19th, and with Neptune at 11 a.m. on the 21st.

Jupiter

Is now too near to the Sun to be fairly visible, a remark which applies, *a fortiori*, to Saturn.

Mars

Is above the horizon during the whole of the working hours of the night; but he is becoming a very insignificant object now, his angular diameter decreasing from 8·4″ at the beginning of April to 7″ at the end of it. He comes into quadrature with the Sun at 5 a.m. on April 2nd, and hence, in a sufficiently powerful telescope, his gibbosity is now very obvious. From the small diameter of his disc, though, his permanent markings are practically undiscernible with small or inferior instruments.

Mars.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	6 53·8	25 12·7	6 13·8 p.m.
6	7 3·5	24 54·4	6 3·8 ,,
11	7 13·5	24 33·5	5 54·1 ,,
16	7 23·7	24 9·9	5 44·6 ,,
21	7 34·1	23 43·5	5 35·4 ,,
26	7 44·8	23 14·2	5 26·4 ,,

The path thus indicated lies (practically) wholly in Gemini, although at the end of April Mars will be found in that part of the sky where Gemini and Cancer are conterminous. He will be rather more than 2° North of δ Geminorum on the 11th.

Uranus

Continues to be fairly well placed for the observer. His angular diameter has imperceptibly diminished from the 4″ of last month to 3·8 this.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	11 7·7	6 29·0	10 31·1 p.m.
6	11 7·0	6 33·1	10 6·7 ,,
11	11 6·4	6 36·9	9 46·4 ,,
16	11 5·8	6 40·3	9 26·2 ,,
21	11 5·3	6 43·3	9 6·0 ,,
26	11 4·9	6 45·9	8 45·9 ,,

Uranus, as thus shown, continues to move slowly away from σ Leonis. From the middle of the month he will be in the same low-power field of view as the small variable star S Leonis.

Neptune

Has now left us for the season.

Shooting Stars

Should be watched for between the 4th and the 11th; between the 19th and the 21st (particularly on the 20th), and again between the 26th and the 30th.

Greenwich Mean Time of Southing of Ten of the Principal Fixed Stars on the Night of April 1st, 1882.

Star	Souths. h. m. s.
β Cancri	7 29 56·79 p.m.
ι Ursæ Majoris	8 10 51·39 ,,
α Hydræ	8 41 25·63 ,,
Regulus	9 21 37·20 ,,
α Ursæ Majoris	10 15 50·63 ,,
δ Crateris	10 32 47·03 ,,
ε Corvi	11 23 15·93 ,,
γ^1 Virginis	11 54 47·97 ,,
α Canum Venaticorum ..	12 9 35·08 ,,
Spica Virginis..	12 37 58·70 ,,

The Method of determining the Greenwich Mean Time of Transit of either of the Stars in the above List for any other night in April, as also that of finding the instant of its Local Mean Time of Southing at any other Station, will be found on p. 392 of Vol. XXXIV.

IMPROVEMENTS IN GALVANIC BATTERIES.

AMONGST recent improvements in voltaic cells, there are few which have more to recommend than that described on page 5 by Mr. Bennett, who seems to have attained a long-sought desideratum—the manufacture in the cell of a product more valuable than the zinc consumed. It is evident that if in any combination for a voltaic cell, we can get the current and produce at the same time a substance of more value than, or as valuable as, the materials used to make the cell, batteries will be able to compete with dynamos. Messrs. J. and S. J. Higgin, of Manchester, proposed to effect this object, but as they did not proceed beyond the provisional stage, presumably they were not altogether satisfied. They proposed to use tin as one element, carbon as the other, with dilute sulphuric acid. In one form of cell they use a hollow cylinder of tin with an inner porous cell containing a carbon rod or cylinder, which is surrounded with granular pyrolusite or manganese peroxide to absorb developed hydrogen. During the action of such a battery, the dilute sulphuric acid produces proto-sulphates of tin and of manganese, which remain in solution in the cell. When it is desirable to renew the exciting liquid, they use the solution obtained from the battery cell in order to obtain such preparations of tin as are required in the dyeing and printing of textile fabrics, and in other industrial processes. To the solution is added a quantity of oxide of manganese, and proto-sulphate of tin is converted into a persulphate. It is then only necessary to dilute the resultant with water in order to precipitate stannic acid, from which other preparations of tin may be obtained by the employment of suitable or ordinary processes. The battery may be varied by substituting a perforated or porous copper cell filled with pyrolusite for the carbon element, and a solution of caustic soda for the dilute sulphuric acid; in which case the spent liquid obtained from the cell will contain stannite or stannate of soda, which may be readily recovered. In another modification a compound solution of nitrate of soda and of caustic soda is used as the exciting fluid for a battery having tin and carbon elements.

An improvement in bichromate batteries, by which they are made to give a "much greater" E.M.F. and constancy has been patented by Mr. T. Coad, of South-street, Finsbury. To a hot saturated solution of nitric acid, bichromate of potash, and nitrate of potash he adds about one fourth part by measure of sulphuric acid, and when cool the solution is fit for use. The exact proportions of the components are not stated.

ELEMENTARY LESSONS IN DRY PLATE PHOTOGRAPHY.—IV.*

Exposure and Development.

A NEGATIVE may be said to be a pictorial representation of any object which shows all the shades of nature reversed. Thus a negative of a landscape, when held up to the light shows all objects, such as the sky, and those which are really white in black, whilst the darker parts are represented by transparent glass. A marvellously short exposure is enough to impress all the details of a landscape on a plate in such a manner that by acting upon the plate with certain chemicals, these details may be made visible. This operation is called development, and consists essentially in strengthing an image, so faint as to be invisible to the eye, till it becomes as vigorous as we desire. Anyone, however unconversant with photographic operations, will perceive that when once we have obtained a reversed picture, we have nothing to do but to place this in contact with a sensitive film, and allow light to act through the negative, to have a picture with its shades true to nature. This latter process is performed with sensitive paper, and is termed printing.

Upon correct exposure and development, nine-tenths of the technical success of negative-making depends, and when once the student has thoroughly mastered the relation of the one to the other, half the battle will be over.

Let the beginner select an object upon which he will make his first attempt. A brightly lighted landscape, with strong contrasts of light and shade, is the best; it need not be picturesque. A suitable view can generally be got out of some window, or a very suitable subject is a bust or statue placed either in a well-lighted room or out of doors. We shall suppose in the present instance that the landscape is selected. The camera should point neither towards nor away from the sun. If the sun shine direct into the lens, the plate will be destroyed; if the sun be directly at the back of the camera, the picture will look "flat." Now, let our student consider the process which goes on during exposure. He knows that when he has his camera with a dry plate in position, and when he has removed the cap of the lens, a perfect picture of the landscape, with all the shades of light, will be thrown on the sensitive film, and that the light will be acting upon it. Now it is evident the brighter parts of the picture will first take effect, and afterwards the darker, until the exposure has been prolonged to such a period that all the shades of light except those which, as we explained, appear in the landscape absolutely blank, will have impressed themselves. At this point the correct exposure has been given. Had a shorter time been allowed, some of the darker shades, or, as it is technically called, the detail in the shadows, would have failed to impress themselves, and the resulting negative would have been said to be under-exposed. On the other hand, had the exposure been prolonged, the light emanating from the apparently black parts of the landscape would have impressed the plate, which would eventually appear to be darkened all over, and would be said to be fogged from over-exposure. It is said of a correctly-exposed negative, that it has all the detail in the shadows without being fogged.

Now we shall show the student how he can tell, by the behaviour of the plate during development, whether he has hit the much-desired correct exposure, or not. He will require to light his dark-room lamp, and to get by him the three flat dishes, the two measuring glasses, all the stock solutions, and his box of dry plates.

Now let him place his camera in position, opposite the view to be photographed; let him remove the cap from the lens, and place his head under the focussing-cloth. Any thick dark cloth or shawl answers the purpose; or a piece of black velvet or macintosh, about two feet square. He should remove the stop from the lens entirely, if it has movable stops, or, if the stops be rotary, should turn them till the largest one is in use. This will make the image on the ground glass very bright, and, by turning the focussing-screw first one way, then the other, he will easily find in what position the image is the sharpest. When he has discovered this, let him place the smallest stop in the lens. We say the smallest stop, not because it is necessarily the best for the picture which he is going to take, but because it will enable him to give a comparatively long exposure.

Having his camera fixed and focussed, let him place the cap on the lens once more, and retire to the dark-room with one of his double dark slides for the sensitive plates.

When once here, he must place the dark slide open in front of the lamp. Now, he must lower the light till there is only just enough to enable him to see. He must open his plate box now and take out two plates—two glasses must be placed in the dark slide at once, but one may be a "dummy" if he happen to have but one dry plate; that is, either a clean plate or a spoilt negative. In placing the plates in the slide, let him be very careful that in each case the side of the plate which appears dull, on account of its having the sensitive film on it, is placed towards the outside. Now, having closed his dark slide and wrapped his plates up again, let the photographer return to the camera. He should carry the dark slide under the focusing-cloth, for further security against light, and in placing the slide in the camera and during exposure should keep the whole apparatus under the cloth for the same reason. He now removes the focusing screen, and places the dark slide in the position occupied by it, keeping the side marked 1 towards the lens. He now withdraws the sliding door, which is the only thing which intervenes between the lens and the sensitive plate. He takes his watch in his hand, and remove the cap from the lens for (say) five seconds, replaces it, slides in the shutter of the dark slide, and carries the latter off to the dark-room. We have supposed any of the usual view lenses to have been used, the landscape to be brightly lighted, the time of year to be spring or summer, and the time of day morning or noon.

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* Condensed from the *Photographic News*.

MEDICAL ELECTRICITY.*

By Dr. W. H. Stone and Dr. Walter Kilner.

MEDICAL electricity, said Dr. Stone, who read the paper, had been up to now a heterogeneous mixture of loose statements, doubtful diagnosis, and erroneous therapeutics. With hysteria, Metallotherapy, and magnetic appliances, they did not propose to deal. Science is in far too elementary a state to see through these obscure, though real phenomena. Probably, the key to the great enigma of the connection between electricity and nerve force had yet to be found. The bold statement that "electricity is life" is demonstrably false in many particulars. Speaking generally, medical electricity had suffered from its exclusive handling by physiologists and physicians, who might receive valuable help from physicists; indeed, the writers of the paper were actually soliciting such assistance at the hands of this young and active society.

The speaker proceeded to divide the forms in which electricity had been used medically into four, namely—(1) continuous currents, (2) continuous currents made to intermit, (3) induced currents, termed generally "Faradisation," (4) statical electricity. The last of these was the first employed, but it had given the least satisfactory results of any. The third method had been far the most deeply studied. Duchenne's great work on Localised Electrisation early drew attention to this department. That genuine and indefatigable observer was able to point out so many definite diagnoses, and to isolate so many new nervous and muscular diseases by means of the induction-coil, that to this instrument had been given somewhat excessive prominence as a therapeutic agent. Physiologists had also found in it a convenient stimulant for testing the action of nerves and the irritability of muscle; perhaps also the localisation of brain functions. Hence muscular contraction and the action of intermittent currents in alternate directions had been too much relied on as evidence of activity.

Before, however, a single step could be taken in this scientific path, we must have some tolerably accurate mode of measuring the agent we are employing. It is obvious that the units used should be as far as possible those generally adopted in the scientific world. To begin with resistance: This in the human body is singularly great, and is especially located in the epidermis, which, when dry, is an excellent insulator. Wetting it with sulphate of zinc or common salt diminishes this resistance very materially; though even when care is taken in this respect, the residual opposition to a current is large. From hand to hand it is usually about 6000 ohms. In the larger bulk of the trunk, from the sacrum to the nape of the neck, it never, even after long wetting, sinks much under 1,500 ohms. That of the head, from nape to forehead, is about 2,000 ohms. In one case it was more precisely 1,930 ohms, in an adult, and in another, a child, 2,500 ohms. The resistance of different tissues, though not exactly to the present purpose, had been studied by Prof. Eckhard, who stated that muscle was the best conductor, and that this being taken as a unit, cartilage would have a resistance twice, tendons and nerves about 2·1, and bone nineteen times as great. Matteucci states that muscles conduct four times as well as nerves, brain, or spinal cord. The resistance of the skin varies from day to day, being modified by moisture, and by the fulness of the capillary vessels. In a particular case, the positive pole of a battery was placed on the sacrum of a child, and the other on the leg, over the extensors of the foot. By using the same current, and adding quickly a known resistance, the resistance of the body was at first found to be 11,250 ohms, which, on thoroughly soaking the skin, was reduced 2,875 ohms. Three days previously, the resistance before soaking was 13,000 ohms, and after that process sank to 3,000 ohms. Personal idiosyncrasy exercises influence, a delicate skin conducting better than one which is coarse. The face and neck offer the least; the soles and palms the greatest resistance. Disease causes variation of conductivity: the skin over affected muscles in lead paralysis has its resistance increased, while in many old cases of hemiplegia it is decreased to a greater or less extent according to the amount of atrophy which has taken place.

The resistance of muscle in disease is sometimes diminished, sometimes augmented. Augmentation takes place, at the commencement of degenerative changes, from the inferior conductive power of fat to that of healthy muscle. In a case of infantile paralysis, the sound leg had a resistance of 2,500 ohms, the affected leg of 3,250 ohms. In a wasted muscle of many years' standing, the enormous resistance of 16,500 ohms. was reached. It was both easy and desirable to multiply facts such as these.

The second preliminary point was the current which could be borne with impunity. Here results were very discordant. In the three fatal cases from touching the conductors of dynamo-machines, at a music-hall, in the Russian Navy, and at Hatfield, the necessary facts for measurement were absent; although Dr. Siemens had stated that he had often taken a current sufficient to produce a powerful light with impunity. In a case now in St. Thomas's Hospital, a current of 50 milliwebers was borne with difficulty, and one of 20 milliwebers with ease and great benefit. A case of diabetes, recorded by Dr. Stone in the *Proceedings* of the British Association at York in 1881, took about 10,000 microampères, or 10 milliwebers, through his head, from nape to forehead, after some practice; using for its production from 15 to 20 cells of bichromate battery. The particular battery, however, mattered very little; Leclanché's bichromates, and zinc-carbons with sulphate of mercury, all act well, and need not be of large size or small resistance.

In consequence of the high resistance of the skin, it was essential to give a large size to the poles employed for applying the current, &c. Amalgamated zinc, with the mixture of potter's clay kneaded with the solution of common salt, used in physiological experiments, laid over it, was perhaps theoretically, the best; but powdered carbon placed in a bag and immersed in salt and water, answered equally well; or the surgical appliance termed Spongio-piline, a thick felt, backed by indiarubber, through which a well-tinned copper wire was threaded, so as to encompass its whole circumference without anywhere projecting so as to touch the cuticle. The poles could hardly be too large.

A convenient form of Thomson galvanometer with graduated shunts, due to Dr. Kilner, was shown, and also a simple but effective instrument for producing intermissions in the current at any required interval of time. This apparatus consisted of a metronome with contact pieces dipping into mercury cups at each oscillation, a condenser being placed under the instrument to get rid of the extra current, and so to equalise the physiological effect of the making and breaking currents.

The measurement of induced currents presented considerable difficulties. The Conference at Paris had recommended the use of standard induction coils, but this method does not give any but arbitrary measures. Dr. Stone had tried and showed a vacuum tube, in which the tension of air could be varied by combining it with a barometric column and a movable cistern. This gave a ready means of varying the force of the discharge, by using it as a shunt of variable resistance, and had the interesting results of shunting the "make-current" at a definite point, while allowing the "break-current," which is about six times stronger, to pass between the platinum points; thus obtaining an induced current in one direction only. Latterly he had adopted also condensers of definite capacity charged to definite potentials. The writers were, however, still experimenting with another method, depending on Sir W. Thomson's determinations of spark length. The most practical method at present seemed to be to pass a continuous current of measured strength through an automatic commutator, which at alternate oscillations diverted it in one and the other direction. If there was any real physiological value in rapid reversals of direction, as was claimed by some experimenters, it could thus be secured, without the use of an induction coil. Another form of rotating commutator was also shown, in which an ebonite cylinder, pressed on by six springs, at each quarter-turn connected, first, the condenser to the battery, so as to charge it, and then discharged it through the patient. To obviate the necessity of employing a large battery with the condenser arrangements, Planté's secondary battery could be charged in parallel position from a small number of Grove's cells, and discharged through the condenser in series. In all these contrivances, however, as the current gained in tension, it seemed to lose somewhat in chemical and catalytic power, and to assimilate gradually to the static form.

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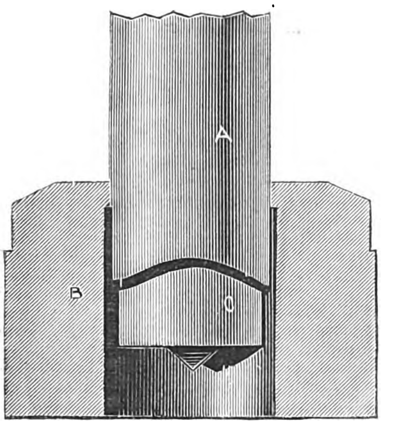
* Abstract of a paper "On Measurement in the Medical Application of Electricity" read before the Society of Telegraph Engineers and Electricians.

DIETZ'S IMPROVED PUNCH.

THE accompanying engraving represents a new form of punch for punching either iron or steel plates, made by R. E. Dietz, of 56, Fulton-street, New York. This punch, says the *American Machinist*, as shown at A, is first turned up to the desired finished size to fit the die B, the same as in making ordinary punches. Then, by a special attachment to the lathe, a peculiar shoulder is turned upon the punch, as shown at C, leaving two high edges and two depressed edges exactly opposite each other. The object of this arrangement is to punch and ream a hole perfectly parallel at one operation. It is accomplished in the following way: The lower part of the punch passes through the iron and pushes out the wad, after which the cutting edge around the side passes through and trims the hole smoothly to an exact standard size. It has been known for years past that the common punch in general use has a very damaging effect upon the iron and steel plates punched by it. For instance, in punching holes for ¾in. rivets through iron plate ½in. thick, the diameter of the hole on the lower side of the sheet will be generally from 1-16in. to 3-32in. larger than the punch.



In punching common iron with the ordinary punch, the iron will be torn so as to leave sharp ragged edges; but in a hole punched with the new form of punch the sides will be found parallel. Another distinguishing feature is that the surface of metal in the hole is condensed, so that it is much harder, and will resist the shearing action of excessive strain upon the rivet even longer than drilled plates, the punching involving much less expense than drilling. This is owing to the fact that a drill does not condense the metal, neither does it cause a flow as is the case with the Jenkins punch. In proof of this statement specimens were cut from the same sheet and tested. One specimen was drilled and riveted while another was punched and riveted. These specimens were then pulled apart in a reliable testing-machine with the following results: Drilled specimen gave way or sheared with a strain of 39,210lb., and the one punched with the Jenkins punch at 39,850, while another punched with the common punch sheared with a strain of 38,820lb.

THE "LONDON" GAS-ENGINE.

A SIMPLE and compact gas-engine, known as the "London," made under Hutchinson's patent, has been on view at the Building Exhibition in the Agricultural Hall. In outward appearance the engine resembles a pillar of cast iron, oval in section, with a flywheel on one side and a pulley on the other. The slide-valve is carried in a casing at the foot, and the whole is mounted on a hollow iron base. The cylinder itself is planted on the base, and occupies the lower part of the pillar or case, the crank working in the upper portion. It will be understood that by this arrangement there is a large air-space all around the cylinder, and following each stroke of the piston a strong current of air passes through the space, thus keeping the explosion chamber cool without the use of water. For simplicity this engine is unexcelled, and as it occupies but little room (a half-horse, 3ft. by 2ft. 4in. on the floor, and 4ft. 11in. to top of flywheel) and requires no lubrication to either valve or piston, it will commend itself to all who have occasional use for "power." The engines are made from one-man up to four horse-power, and a two-man is said to cost only three farthings an hour when working to its full capacity—two-man being the "nominal" power only. The parts are all made to gauge and are interchangeable; they are, with the exception of the flywheel, pulley, and slide-rod, inclosed in the case, and are thus out of harm's way. In fact for simplicity the "London" leaves nothing to be desired.

SCIENTIFIC NEWS.

IN rapid succession we have received no fewer than four Dun Echt Circulars, Nos. 45 to 48, tolerable evidence of Lord Crawford's method of distributing astronomical intelligence. They all refer to the comet discovered by Mr. Wells on March 18, though there appears to be some doubts as to the date. *Science Observer* code telegrams have been received from Dr. J. Palisa and from Dr. Oppenheim. Elements and ephemeris have been received from Mr. S. C. Chandler, jun., Profs. Pickering and Boss, and from Dr. Holetschek, the last being the latest. We give the results in tabular form:—

	C.	P. and B.	H.
T =	June 1·42.	June 15·76.	June 8·51.
π − ☊ =	222° 19′	202° 57′	211° 56′
☊ =	200° 11′	206° 40′	203° 34′
i =	70° 51′	74° 47′	72° 51′
log. q. =	7·7782	9·0257	8·6484

The ephemeris for Greenwich midnight, April 2, is about R.A. 18h 20′; N.D. 41° 58′. Mr. Lohse says the comet is moderately bright, has a straight tail about 6′ long, almost exactly *preceding*. Dr. Oppenheim says the nucleus is tolerably well defined and round, less than 1′ in diameter, as bright as an 8th mag. star, with a tail less than half a degree in length. The comet is increasing in brightness.

Preparations are being made for the observation of the total eclipse of May 17th. The French will probably have two expeditions, as M. Bischoffsheim has promised to pay the expenses of an expedition to Egypt. The most suitable spot for observations appears to be about sixty miles north of Luxor, but the central line passes very near Bagdad and Teheran, where the duration of totality will be half a minute more than at Luxor. It will be seen that there is little choice of spots for observing, and as this eclipse and another that will be visible in Brazil are the only ones during the present century in which the sun will have sufficient altitude at accessible stations for making useful observations of the corona, the opportunity will not be lost.

Prof. E. Ray Lankester, M.A., F.R.S., has been appointed to the chair of natural history in the University of Edinburgh. Sir Wyville Thomson, it may be remembered, resigned this chair last year.

Mr. J. Baillie-Hamilton's new harmonium or reed instrument has been on view at Harrow School, and on Saturday the Premier paid a visit in the company of the Princess Louise. The instrument, it is understood, will be used temporarily in Westminster Abbey. The various stages in the development of this instrument have been described in our pages under the heads of String Organ (see p. 225, No. 685) and Constrained and Free Reeds. The original idea, to vibrate a string by means of wind, by attaching it to a reed, has, we understand, been abandoned, and Mr. Hamilton now uses free-reeds in groups of three, connected by a "bridge," which so modifies the individual tones as to produce a single note of great sonorousness and purity. The defect of the instrument is sluggishness, which may, however, be overcome.

Griscom's little dynamo-machine, or electromotor, which we described on p. 387, No. 823, is now shown at the Crystal Palace, in the Eastern gallery, driving lathes and sewing-machines. The current is obtained from a bichromate battery with large cells.

The Eastern Electric Light and Power Co. have obtained a concession of the waterfall at Penang, and are erecting special machinery to utilise the power for generating electricity for lighting and other purposes.

In an experimental train on the Eastern Railway of France, a Gramme machine, driven by belting from the axle of the guard's van, was found capable of keeping the Maxim lamps fairly incandescent when the train travelled at a fair speed. Accumulators were used for supporting the light when the train slackened or stopped.

A method of increasing the resistance of iron to torsional, tensile, and transverse strains has been patented by M. Séguin, of Paris. The metal is raised to a cherry-red heat, and is then plunged into a mixture of sulphuric acid and water, equal parts. The iron is allowed to remain in this bath until its temperature is reduced to that of the liquid, and is then plunged into hot water.

Edison has patented an electric railway-brake, which consists of a metallic disc, fixed on the axle, and which runs partly between the cheeks of a large horseshoe field-magnet. When the circuit is made, a resistance to the motion of the disc is created and the train is brought to rest.

On Wednesday last, Prof. S. P. Thompson delivered another lecture at the Crystal Palace, this time "On the Electric Transmission of Power," in the course of which he dwelt upon the want of economy in the steam-engine, and the power that might be used for electrical purposes in tidal flows now allowed to run to waste. The subject is an important one, and demands attention for several reasons.

The Institution of Naval Architects held its meetings this week at the rooms of the Society of Arts, on Wednesday, Thursday, and Friday. The papers read were mainly of a technical character, but some have an interest for all workers in steel.

A new method of tempering metals, especially steel, has been brought before the Paris Academy by M. Clémandot. It consists in heating the metal to a cherry-red, compressing strongly, and keeping under pressure till completely cooled. Steel thus acquires excessive hardness, and such molecular closeness and fineness of grain that, when polished, it looks like polished nickel. Like steel tempered in the usual way, it can be permanently magnetised; at least, pieces of the Gower and Ader telephones, magnetised more than three months ago, have kept their magnetism perfectly. Compression being an operation which can be measured, graduated, brought and kept within set limits, one can temper at such and such a pressure, just as one may work with such and such a pressure of steam. M. Clémandot operated with various steels, and found the Allevard steels greatly superior to others. Metallurgists and electricians will doubtless be glad to cultivate the new field which this method opens up.

M. Pianta, manager of the General Company of Telephones in Italy, has the intention of transmitting from Venice to Milan the opera of "Lohengrin," now being performed at the former place. He has introduced improvements into his transmitters, which increase their power considerably, so that they have been used for distances of 120 kilometres (say 75 miles) without diminution in distinctness of the sounds transmitted. The lobby of the Scala Theatre Royal, in Milan (which has the largest stage in Italy) has lately received 92 Edison electric lamps, in place of as many gas-jets. This light is to be extended to the corridors.

The book-production of Germany again increased last year, but only about 1½ per cent. on the previous year, in which 14,941 new works appeared. The total number of books and maps last year was 15,191. Educational literature, and books for young people generally, take the first place with 2,414 works (though this is 32 less than in 1880). There were 1,472 works on theology, 1,469 on jurisprudence, politics, and statistics, and 1,226 on belles-lettres.

It will be remembered that M. Richet lately made some experiments as to how fishes were affected by chlorides of various metals put in the water. He has now tried those metallic solutions on the hearts of frogs. It appears that the toxicity or poisonous effect is not related to the atomic weight, even in metals of the same family. There are notable differences, too, from the results with fishes; thus, nickel, which acts on the gills of fishes less than copper, iron, and potassium, is much more active than these metals on the frog's heart. Copper, which is so dangerous to fishes, has very little effect on the frog. Thus, the opinion is confirmed, that the poisonous effect of a substance varies according to the tissue with which it is in contact. Some of the metallic chlorides stopped the heart in systole (contraction), some in diastole (dilatation). The method by which M. Richet arrives at these results, as also that of M. Paul Bert in another set of experiments (described at the same *séance* of the Paris Academy), relating to the influence of the nerves on the lymphatic system, seem to be of a type with which our physiological schools are happily less familiar than the Continental.

A convenient apparatus for determining the melting point of easily-fused metals and alloys, has been lately described to the Berlin Chemical Society by Herr Liebermann. The commencing fusion of a small column of the substance breaks an electric circuit, so that a bell in the latter stops ringing. The apparatus comprises a beaker-glass with cork cover, through which pass two brass bars, connected at top to the battery and the bell. From their lower ends two platinum rods of unequal length extend down into oil; the ends of these bend towards each other, and support in opposition two pieces of pure graphite, between whose hollowed surfaces is vertically held the small cylinder of metal or alloy. A thermometer fixed in the cover dips in the oil. The beaker-glass is heated from below, and the thermometer is noted when the bell ceases to ring. Herr Liebermann gives numerical results for tin, showing the validity of the method. The melting-point of tin in a stream of carbonic acid and in air, he determined with the same apparatus; the results, though quite available, were not quite so concordant as when oil was used.

The town of Saint Etienne, in France, is supplied by a torrent called the Furens, the waters of which are barred by two dams. It is now proposed by M. Conte-Granchamps to utilise the water-power to drive small Fourneyron turbines, actuating directly some dynamo-electric machines, with a view to providing Saint Etienne, about 8 kilometres distant (say 5 miles), with both motor force and light. The fall is about 133ft., and the daily supply is such as to give theoretically some 617 horse-power, of which a well-arranged turbine would receive two-thirds, or 400 effective horse-power. Allowing for loss by conductors, it is estimated that about 200 effective horse-power would be utilisable at Saint Etienne.

A rich and very extensive deposit of iron, capable of yielding as much as 70 per cent., has been discovered in Lapland.

The Municipal Council of Naples have approved a project presented by M. Lamont, for construction of an underground railway connecting different parts of the town. The line will not be wholly subterranean. Compressed air will be used, and the carriages and tunnels will be lit with gas. The most interesting novelty will be an underground station within the mountain. This station will be connected, by means of a hoist, with an open railway placed above, and serving the villages on the top of the mountain. Between the station at the top and the subterranean station, the vertical distance will be more than 240 metres (say 800ft.)

For the public lighting of Paris 45,815 gas-burners are provided, besides 63 electric lamps, 65 vegetable-oil lamps, and 293 mineral-oil lamps. The total consumption of gas, public and private, in 1880, was 209,915,941 cubic metres. There are eleven gasworks, employing 3,254 workmen, and using nearly 810 million kilogrammes of coal.

The boiling temperature of zinc was estimated at 1040° C. by MM. Deville and Troost. M. Edm. Becquerel, however, obtained the figure 932°, showing a wide discrepance. M. Violle has lately investigated this matter by a new method, and he confirms M. Becquerel's result, the number he obtained being 930°.

Rouen is at present the fifth port in France. The Chamber of Commerce there have lately been considering the question of electric illumination for the quays, which (on completion of works now in progress) will have a total length of about 11,800ft. on the two sides of the river. Careful experiments were made with the Jablochkoff, Siemens, and Sautter and Lemonnier systems; and preference has been given to the last as presenting most advantages with regard to light cast, work expended, and carbon consumed by the lamps per hectare of surface. (Particulars of this competition will be found in *Annales Industrielles*, March 12th.) MM. Sautter et Lemonnier use a continual current Gramme machine and the Serrin regulator.

At the Technical Society of Riga, Prof. Pfuhl recently exhibited a (so-called) jute-velvet, in which a cotton fabric supports a hair-cover of jute. This cloth (produced in a way described in the *Deutsche Ind. Zeit.*) is said to be well adapted for articles of furniture, curtains, &c. It is not attacked by moths.

Mr. Esterbrook, superintendent of buildings in New York, said, in course of a recent examination with regard to the fire at the *World* building, that there ought not to be an iron shutter permitted on any building in the city. The effect of these shutters is to prevent firemen getting access to the fire till it has become a raging, uncontrollable furnace. The shutters might be of use in narrow streets in protecting a building from fire on the opposite side; but they should, in that case, only be closed when danger is imminent. In general, a far better protection is a solid shutter made of wood, and lined on both sides with tin.

We last week referred to facilities enjoyed by the public in Berlin and Hamburg for communication by telephone. A recent report by the Telephone Company of Zurich shows that things are in a still more advanced state in that Swiss town. There are eleven places into which the public may enter, and, for a small payment, converse for a quarter of an hour with any of the subscribers, who are 378 in number, connected with two central stations. Four of these telephone-chambers are in tobacco-shops, two in post-offices, and the rest in sundry shops. Among various other institutions adopted by this enlightened town is the connection of the telephonic system with the central telegraph system. Thus, any subscriber can dictate his telegram to the telegraph employé, and so gain the time which his domestic would otherwise take to convey it to the office. The State realises an economy on the carriage of telegrams addressed to the subscribers. During 1881, there were 8,914 telegrams transmitted by telephone.

The circulatory apparatus of star fishes is one of the most difficult subjects in comparative anatomy, and it would now appear from researches by MM. Perrier and Poirier, that the savants who have studied it have been quite mistaken. The star fish has, in fact, no circulation, properly so called. What was taken for a heart is merely a gland, and the supposed vessels are merely folds of an internal membrane limiting the radial prolongation of the general cavity of the body.

A NEW apparatus for the determination of melting-points has been described by Mr. C. F. Cross and E. J. Bevan. The apparatus consists of a small platform of thin ferrotype iron or silver, having an opening for the reception of a thermometer bulb and a small indentation or depression about 1·5mm. deep and 2mm. in diameter. A very small quantity of the substance is melted in the little depression, and while still liquid a thin platinum wire, bent like an L and fused in a glass float, is immersed in the liquid and held there until the substance solidifies. A thermometer is then inserted in the opening, and the whole apparatus plunged under mercury. The mercury is gently heated, and the thermometer carefully watched. As soon as the substance melts the float rises instantly, and the temperature is noted. Stirring is unnecessary, the whole of the substance is surrounded with mercury, and the attention can be concentrated on the thermometer.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

THE PLANET MARS IN 1881-2.

[19858.]—I HAD not, till this morning, met with any published observations of Mars during the recent opposition; those with which I have just been favoured, through the especial kindness of Sig. Schiaparelli, have surprised me exceedingly; and I hasten to communicate a brief notice of them to your columns. Your astronomical readers are aware that during the opposition of 1877-8 this celebrated observer detected, with an achromatic of exquisite sharpness by Merz, and in the pure sky of Milan, a number of narrow, dark streaks, intersecting the so-called continents, which have been from their aspect termed "canals," though many of them attain the breadth of our Red Sea. These had been seen in part by Green, at Madeira, but not considered of sufficient distinctness or permanence to be admitted into his chart; and, in fact, it was not till after his departure from Madeira that they had been fully recognised at Milan; it has been shown also by Dr. Terby, of Louvain, that several of them have been represented from time to time, in the drawings of different observers. In 1879-80 they were all but one recovered by Schiaparelli, who has given them in a collective map. In the last opposition, when favourable weather compensated for the planet's greater distance from the earth, he not only retraced the whole of them, but found twenty of the number *doubled* by parallel dark lines at a greater or less distance, covering the equatorial region of the planet with a gigantic network; and, in conjunction with some other singular changes, tending to show that the idea of a close analogy between that globe and our earth will not be much longer entertained.

March 28. **T. W. Webb.**

THE SEARCH FOR COMETS.

[19859.]—THE Americans—always foremost—have just commenced a systematic plan of comet-seeking. Hitherto observers have worked independently of each other, and a good deal of useless sweeping has resulted by several observers watching the same regions. This state of things has now been obviated by an arrangement giving to each observer a special district for exploration; in fact the American comet-seekers have been formed into a well organised and efficiently equipped association, which gives promise of most important results.

It is now proposed to begin observations in this country on a plan of somewhat similar character, as soon as the moon has left the evening sky at the end of the first week in April, and I shall be glad to hear from any of your astronomical readers who may desire to take part in the observations. We may be certain, in the event of a new discovery, of valuable assistance from Lord Crawford's Observatory at Dun Echt, where accurate positions would be secured as early as possible.

I have arranged, in conjunction with Mr. A. S. Williams, of Brighton, to examine certain regions, a.m., and p.m., but neither of our positions commands a good view of the S.W. sky, so that unless another observer is found to take charge of this, a most likely region will have to be omitted from scrutiny. **W. F. Denning.**

Ashley-down, Bristol, March 25.

BRIGHTNESS OF STARS—AURORÆ.

[19860.]—I THANK "F.R.A.S." (letter 19508, p. 350, Vol. XXXIV.), for taking so much trouble on my account, and apologise to him for having unwittingly imposed upon him a "weary task." The list he gives from *Les Etoiles* is interesting. At first sight, Flammarion's estimates seem to disagree with Sir J. Herschel's; but as the former has made Arcturus = 1·0, and the latter Capella = 1·0, and as the *difference* between the stars is according to *both* the same, the discrepancies are for the most part easily explained; with the difference of

standard, Flammarion's estimates would, *cæteris paribus*, be about a quarter of a magnitude lower than Sir J. Herschel's. Raising the magnitudes assigned by the French astronomer by ·3, we find that the difference of light between Arcturus and Capella, Aldebaran, Procyon, Altair, ε Orionis, α Persei, respectively, is very much the same now as it was in 1837. (This would seem to indicate that the magnitudes of these stars are unchanged, and that, therefore, they are trustworthy "comparison stars.") But in the case of the following stars, the discrepancies between the measures of the two observers are striking:—

Star.	Flamm. reduced to J. H.'s scale.	J. H.	B. A. C.	Arg.	Proct.	Yarnall.
α And.	1·7	2·54	1	2	3	2 0
α Peg.	1·7	2·65	2	2	3	2·0
γ Or.	1·7	2·18	2	2	2	2·0
Polaris	1·7	2·28	2	2	2	2·0
γ And.	1·8	2·50	3	2·3	2½	2·3
γ Cyg.	2·2	2·63	3	3·2	3	3 0

Are any of these stars, then, variable? It has been suspected that γ Cygni is.

Capella.—I pointed out in my last letter that Sir J. Herschel considered this star slightly variable. The fact that Prof. Pickering (19072, p. 542, Vol. XXXIV.) makes the difference between it and α Persei 1·5, while Flammarion makes the difference only ·9, seems to point to an increase in its light.

β *Tauri.*—In Prof. Pickering's letter, β Tauri and α Persei are rated equal. Sir. J. Herschel made the former ·21 fainter than the latter. I think this star has increased in light since last autumn; at that date, it seemed to me to be distinctly inferior to α Persei; but at present it seems to be rather brighter.

All such instances of possible variation are important, in view of the Astronomer Royal's suggestion that *most* stars may be slightly variable. I had often suspected so myself, long before reading the report of the November meeting of the R.A.S. The Astronomer Royal's plan of a "mean" of many stars being taken, *seems* good; but how is the "mean" to be measured and employed?

Auroræ, 1881, Oct. 23.—At night, very cloudy; when clouds cleared auroral glow could be seen, extending over great part of sky.

Oct. 24.—Auroral glow; similar to, but fainter than, previous evening's.

Nov. 23.—Bright Aurora, which lasted from 6 p.m. to 10 p.m. About 8h. 10m.; the arch presented the curious appearance of being bent downwards a little to E. of the highest point.

Nov. 24.—In evening, auroral glow seen between clouds.

Nov. 25.—Faint auroral glow along horizon.

1882, Feb. 20.—About 9 p.m.; a greenish glow of aurora suddenly appeared in W.N.W., continued three hours, as a bright band spreading far along horizon. Did not send out any streamers.

March 8.—11.12 p.m.; band of auroral light across N.W. horizon.

Glasgow. **S. Maitland Baird Gemmill.**

STAR MAGNITUDES BY SEQUENCES—TO MR. T. E. ESPIN.

[19861.]—If you would explain in detail the method you adopt in estimating star magnitudes, it would no doubt be useful to many readers. Your letter (19554, p. 400) is very interesting, but the expression "simple sequencing" conveys a very vague idea of your mode of working. Do you not need to know the magnitudes of many of a group of stars to begin with? Please give all details. **Opera-Glass.**

ADJUSTMENT OF MIRRORS.

[19862.]—I did not reply to the letter of Mr. Haren (19805), supposing that someone might suggest some means of adjusting the large mirror. I agree so entirely with him that it is an important element, that I was astonished to find that it had been neglected by any of our amateurs. My experience leads me to the conclusion that unless *all* the adjustments are as perfect as possible, the instrument will not perform well. My plan is, to put a stop into the mouth of the tube (say for a 12in. mirror) with an aperture of 11½in. On looking through the adjusting-tube, with the small hole at the eye end, but *not* at the inner end, you see this stop as a thin ring projected upon the image of the mirror. If the image of the stop is not concentric with the image of the mirror, adjust the large cell until it is so. This will have slightly altered the adjustment of the flat. Readjust the flat, and then readjust the large mirror, if the image of the ring is not concentric; in two or three trials you will get your adjustments tolerably exact. It cannot be too strongly impressed upon the minds of the possessors of reflectors that, on fine nights, if the large mirror is good, its definition ought to be equal to that of a refractor. If it is not so, if there is any inequality in the concentric rings, be sure the adjustments are at fault. With mine, a 12in., by Calver, and a Steinheil prism, which is immensely more difficult to adjust than a flat, I have seen, on fine nights, stars of the second and third magnitudes, without a concentric ring—α Herculis, γ Andromedæ, and such like. Some time ago a young friend was in my observatory, and I set the telescope upon Castor. I asked him what he saw? He said, "I see two brilliant round dots." I replied, "Yes; and you couldn't have given better testimony to the beauty of the mirror, and the perfection of its adjustment, than you have given by that remark."

N. S. Godfrey.

St. Bartholomew's Vicarage, March 21.

TELESCOPES BY THE "OLD MASTERS."

[19863.]—Will you allow me to ask such of your readers as possess telescopes by the earlier makers to assist me in obtaining particulars of them? Though every year becoming more scarce, there are probably still in existence many fine old instruments, of whose performances we read in the writers of the latter part of the last century and beginning of this?

I may particularly mention the "Beauclerc" refractor by Peter Dollond, with triple object-glass; the 15in. aperture Cassegrain by Tulley; the 5in. apterture refractor by the same maker; Short's 9½in. Newtonian, made for Greenwich Observatory; many Gregorians by Short, Watson, &c.; and last, but by no means least, original Newtonians by Sir W. Herschel. These were instruments, in many cases, of *known excellence*, and often alluded to, and it would be very interesting to trace them to their present possessors.

If, then, your readers will kindly send to me, to the address given below, *as full particulars as possible* of *any* telescopes dating from before, say, 1830, stating (if reflectors) whether mirrors are in their original condition or repolished, and so forth. I shall be very pleased to send, in return, a classified and tabulated list of the information thus obtained to each such correspondent. Details of mounting of mirrors, materials of bodies, form of stand, &c., would also be valuable. May I specially ask the help of Mr. P. Vallance, whom I know to be the possessor of several fine old telescopes?

L. L. L.,
Care of Dr. Woods, Gillingham, Dorset.

OBJECT-GLASSES AND EYEPIECES.

[19864.]—Your correspondent, "Lens" (letter 19795), seems to be in a fog respecting the power of his telescope; let me try to lead him out of it. When he tests his instrument for "power," the object-glass is used simply as a luminous disc; and the image which he measures is the refracted conjugate image of it, formed in the back focus of the eyepiece. The ratio of the diameter of this light-spot to the aperture of the object-glass is the same as that of the foci of the lenses, and therefore gives the magnifying power of the telescope. Used in this way, the object-glass does not perform its legitimate service as an image-former at all; we are simply comparing the magnitudes of two luminous discs, placed at known distances on each side of the eyepiece. When the eyepiece is removed, we cannot compare the focal image with the aperture. Your correspondent is well aware that if he directs his instrument to, say, Jupiter, it makes no difference to the *size* of the image, whether he employs a 1in. stop or the full aperture. His object-glass enlarges the visual angles six times; but this depends on its focal length—not upon its diameter. Let him use a lens of 10in. focus in the same way as the 1in. eye-lens, and he will probably find the focal light-spot to have the diameter he has specified.

I do not think he will find it advantageous to employ crossed lenses instead of planos in a Huyghenian eyepiece; but this, and some other of his queries, must be answered by a practical man. For the Huyghenian combination, the rule for finding the focus of the equivalent lens is: divide twice the product of the focal lengths by their sum. To find the radii, which shall be in a given proportion, and produce any required focus, we proceed as follows:—Multiply together the required focal length, the refractive power of the glass (its refractive index, diminished by unity), and the given ratio increased by unity. The result is the longer radius. Divide it by the given ratio, and we obtain the shorter curve. As an example, suppose we have some flint glass, whose refractive index is 1·6, and that we require to form a lens of 4in. focus, having its front radius three times the back one. Here we have $4 \times (1{\cdot}6 - 1) \times (3 + 1) = 9{\cdot}6$; and 9·6 divided by $3 = 3{\cdot}2$, the shorter curve. This rule applies to a double convex or double concave; but if one surface only be concave, we must make the numerical value of our proportion negative, and the convex radius must be greater or less than the concave, according as the focus is required to be negative or positive.

From your correspondent's second letter, it would appear that he has some very misty notions regarding foci. I can only counsel him to read, and thoroughly master, some good elementary book on optics, such as Chambers's, or others. I will send a paper on calculating the foci of lenses, which will need a fair knowledge of arithmetic and a slight knowledge of algebra only. Beyond this I cannot assist him. An acquaintance with the elementary principles of a science must be obtained from some of the recognised textbooks, and the extent of mathematical knowledge which I have indicated is absolutely necessary to anyone who would wish to perform even the simplest calculations regarding lenses. **Orderic Vital.**

DR. HASTINGS' METHOD OF MAKING AND TESTING FLATS—CLEANING MIRRORS BEFORE SILVERING.

[19865.]—In my letter (19763), on Dr. Hastings' process of making and testing flat surfaces, a serious error occurs in the first column of page 593, and in the 26th line from the bottom, where the types, or, may be, my own manuscript, makes me say, that the polisher should be from ¼in. to ⅛in. less than the glass to be polished. It should read—from *one-quarter to one-eighth less than the glass*, without reference to inches, as it is entirely proportional. If we were making a 4in. flat, then the polisher should not be larger than 3½in. and may be as small as 3in. This might be inferred from what is said at the head of the second column; but it would, even then, seem paradoxical. I was pleased to see in the same issue of your paper, that Dr. Steinheil had furnished M. Houzeau a *perfect* plane for determining the flexure of telescopes. No doubt it was made in the same way as mentioned in letter 19763. Your readers must not think me slow in correcting the above error, as I have just received your issue of the 24th of last month, and to-day is March 10th, and it will be a fortnight before this reply will reach you. A note in reference to cleaning mirrors for silvering. Mr. Geo. Clark, of Alvan Clark and Sons, told me he never used nitric acid, only when he had to cut off an old film; but cleaned them with a solution of potash in water, and the *palm of his hand*. I have done a great deal of silvering lately, and have discarded the nitric acid entirely, using a solution of, say, 1oz. of pure potash in 12oz. or 15oz. water, and, as I don't care to risk the palm of my hand, nor do I care to risk that dangerous tool, a test-tube stuffed with cotton, I make a pad of cotton flannel filled in with good, clean cotton, leaving the soft side of the flannel outside. A good large pad can be made, and is a capital article for cleaning with. Pour a tablespoonful of the solution on the mirror; rub thoroughly; rinse off pretty well, though it will do no hurt if it is not thoroughly washed off; and with ordinary care you will have a clean mirror without those unpleasant nitric-acid fumes, that at best are "a thing of beauty, and a *smell* for ever."

Jno. A. Brashear.

Pittsburg, Pa., March 10th.

MICROSCOPICAL CLUB.—TO "H. C. S."

[19866.]—I shall be very pleased to assist in forming such a society as you mention in letter, p. 615, Vol. XXXIV. If you will communicate with me by post, we can exchange suggestions, &c., and devise means for practically starting such a society.

I should be much pleased, at the same time, to see a similar society for amateur photographers started in connection with the readers of the "E. M." If any feel inclined to help, please write to me, with suggestions, &c., and we will commune one with another about it. I advertise my address in the Address Column. **F. C.**

TESTING THE PURITY OF GUANO.

[19867.]—In 1877, being engaged in the collection of diatomaceæ, I turned my attention to those contained in guano. After much difficulty I obtained half a dozen samples of pure guano, through a friend connected with the trade, and having subjected them to the ordinary process, modified in the manner I will describe, I took the mean quantity of diatoms contained in a measured quantity of each sample as a standard.

(1) One drachm of the guano is agitated with a gallon of water and allowed to stand 3 hours, and the water poured off.

This is repeated; and should the water be much discoloured after standing the second time, the sample is impure.

The water being then poured off, the sediment is put into a large test-tube, by washing out the vessel in which it was contained with portions of 3oz. of water. When the whole three ounces with the sediment is in the test-tube, it is then well shaken and allowed to stand one hour; the water is then poured off.

(2) Add hydrochloric acid (fort) to the sediment till effervescence ceases; then pour it off, add half an ounce of fresh acid, and boil for two hours.

(3) Wash again as in (1).

(4) Repeat 2, substituting HNO_3 for HCl.

(5) Repeat (4); then pour off the three ounces of water after standing one hour; add one ounce of water to the residue; stir briskly with a glass rod, and while the sediment is in motion, place one drop on a slide, spread out with a needle, and dry with a gentle heat. Six slides being thus prepared, the mean quantity of diatoms is compared with the same quantity in the pure standard sample. The result is the quantity of pure guano in that under observation.

Each step in this process is a rough analysis of the guano; the purity is in proportion to the absence of colour of the water after washing.

The greater the effervescence with HCl, the more phosphates, &c., especially soda and calcium.

With HNO_3 the more potash.

The character of the coscinodisceæ and other forms are different from those contained in other substances—*e.g.*, I never found G. biseriatæ, but the variety of coscinodisceæ is greatly in excess of what is found in infusorial earth. Campylodiscus is rare. Surirella is comparatively rare; in fact, on comparing photographs of diatomaceous deposits there is a distinct difference in the general distribution and character of the diatoms.

I have examined several hundred samples supplied by friends, and though the process seems complicated, yet it is easy to carry out, and one hundred samples are almost as easy to manipulate as one.

In every case in which my advice was followed as to the qualities of a sample, the result was satisfactory. I will give one example of the frightful consequences of adulterated guano. A relation, an extensive landholder in the west of Ireland, sent me a sample. I reported favourably upon it, and he undertook to supply it to his own tenants in small quantities; that year's crop was good. Having perfect confidence in the firm, he gave a large order the following year; put it out without testing. The result was disastrous, and as its previous success increased its sale to nearly the whole of Mayo, the consequences were worse than if it had only been an original bad sample. A portion of the second guano supplied was sent to me; it contained 1 in 2,000 of pure guano. A lawsuit took place, and all sides lost heavily by the transaction.

I never would have thought of applying the method had I not been informed that no analysis was capable of telling the quantity of guano in any sample.

I have only found seven tolerably pure samples in some hundreds.

A. Cowley Malley, B.A., M.B., &c.

COLD SOLDERING.

[19868.]—Various nostrums have been proposed from time to time which profess to be reliable methods of soldering without heat; but when tried they have generally proved useless.

The following recipe, which is due to Mr. Fletcher, of Warrington, will, I think, be found to be more trustworthy.

It must be borne in mind that, though the first preparation is tedious, a large quantity of the materials can be made at once, and the actual soldering process is as simple and quick as it well can be.

Flux: One part metallic sodium to 50 or 60 parts mercury. (These combine on being well shaken in a bottle. If this is too much trouble, the sodium amalgam can be bought, ready made, from any chemist or dealer in reagents.)

This sodium amalgam must be kept in a stoppered bottle closed from the air. It has the property of amalgamating (equivalent to tinning by heat) any metallic surface, cast iron included.

Solder: Make a weak solution of sulphate of copper, about 1oz. to one quart of water. Precipitate the copper by rods of zinc; wash the precipitate two or three times with hot water; drain the water off, and add for every 3oz. of precipitate 6oz. or 7oz. of mercury; add also a little sulphuric acid to assist the combination of the two metals. When combined, they form a paste which sets intensely hard in a few hours, and this paste should be made, whilst soft, into small pellets.

When wanted for use, heat one or more of the pellets until the mercury oozes out from the surface in small beads; shake or wipe them off, and rub the pellet into a soft paste with a small mortar and pestle, or by any other convenient means, until it is as smooth and soft as painter's white-lead. This, when put on a surface previously amalgamated by the sodium and mercury, adheres firmly, and sets perfectly hard in about three hours. The joint can be parted, if necessary, either by a hammer and cold chisel, or by a heat about sufficient to melt plumber's solder.

Where expense is no object, Mr. Fletcher gives a recipe for a much stronger solder, which will set hard in 15 minutes. **Glatton.**

GRATIS ADVERTISEMENTS—NEW BATTERIES—CAUSTIC SODA.

[19869.]—On page 61 (19811) is a sketch of an electro-plating apparatus, together with an announcement where it may be seen and obtained. The next letter contains a sketch of a new battery, with an accurate and concise description of its construction. Now, doubtless Mr. Tolman will make HIS battery for sale; but he does not on that account merely send a sketch, and say where it is to be obtained,—he gives instructions which will enable anyone (if so inclined) to make it, and he reserves his business communications for an advertisement. He does not even append his address. Not so Mr. John E. Chaster, who says that his apparatus is very good and something new, but he leaves out how it is made; he tells us what is not required in his battery, but forgets to say what is wanted; and if he occupies the correspondence columns with a gratuitous advertisement, he should feel himself bound in all honour to give an accurate and good description of the whole affair and method of construction. As it stands, his letter is an advertisement pure and simple, and he should have sent it as such. I should not, perhaps, have noticed it so much were it not for the contrast between his letter and that of Mr. Tolman, who deserves the thanks of English Mechanic readers for his disinterested and valuable information, and I hope he will lose nothing thereby. As a rule, those who make their own batteries would not have them at all if they could not do so. That is just my case.

While on the subject of new batteries I will mention that I have just re-perused the details of Mr. Bennett's new cell, and would also advise "W.H.G." (46446) to read it again. He will there find that it is not stated that potassium hydroxide and caustic soda are the same thing—either will answer the purpose. Caustic soda is the cheaper preparation; but as there is no general use for it, it is not, as a rule, to be obtained retail. I would recommend him to try what is called "soda ash." I can't say whether it will answer as well as the purer preparation. A solution of caustic soda can be prepared by boiling together a solution of common washing-soda and some freshly slaked lime; an iron saucepan will do, and it will not injure the saucepan; say, 1¾lb. washing-soda, and ¾lb. slaked lime, boil in a quart of water for ten or fifteen minutes, allow the sediment to subside, and pour off the clear solution of caustic soda. This can, if necessary, be concentrated by evaporation. This quart of solution will contain between six and seven ounces of caustic soda, and will not cost more than 2d. to make. **Os.**

MAX ROSENFELD'S LECTURE EXPERIMENT.

[19870.]—At p. 51 of your last issue, you describe a very ingenious lecture experiment devised by Max Rosenfeld for showing, without the aid of a chemical balance, the increase of weight attending oxidation. In the course of your description you say: "The foil with its load is carefully removed, and held over a flame until the iron is converted into oxide. When cold, it is replaced on the glass cup, and causes the instrument to sink until the cup almost touches the water." A far more effective way of performing the experiment is to make a little mound on the foil, if iron, carefully reduced from the finely-powdered oxide at the lowest possible temperature, and then to apply for a moment the light of a taper to the extreme top of the mound. The iron will begin to oxidise at the point of application of the flame, and the oxidation will spread through the whole mass of the metal, notwithstanding that the taper has been removed; the hydrometer will sink the while. This method of performing the experiment is not original, but it may be new to some of "ours."

Alfred W. Soward.

THE EVOLUTION OF THE TELEPHONE.

[19871.]—On the 23rd inst. Professor A. E. Dolbear, of America, delivered before a crowded audience, at a meeting of the Society of Telegraph Engineers, a lecture "On the Development of a New Telephonic System." Starting with Page's early observation, that a bar of soft iron, when surrounded by a coil of wire conveying a current of electricity, emitted a sound whenever the circuit was made or broken; and that by the use of an automatic make-and-break sounds of a definite pitch could be obtained, Professor Dolbear traced the successive steps in the Evolution of the Telephone.

Passing from Page, the first name met with is that of Farrar, who constructed an electric telephone capable of transmitting sounds of different pitch. He modified Page's apparatus by the employment of a series of vibrating reeds as contact-breakers, and was thus able to transmit tunes, but he failed to transmit articulate speech. Next came Helmholtz, who, using a tuning-fork as contact-breaker, sent timed electric impulses through a wire, at the other end of which was an electro-magnet having for its armature a tuning-fork similar to that used as the contact-breaker. The electro-magnet being magnetised and de-magnetised synchronously with the making and breaking of contact, the tuning-fork at the receiving-station was caused to vibrate in unison with that at the transmitting station. By using many tuning-forks sounds of different pitch could be transmitted: musical notes, but not speech. After Helmholtz came Reiss, the merit of whose work has too frequently been under-estimated. It is well known that in an electrical circuit, where a contact-joint occurs, the current flowing depends upon the nature of the contact. Every beginner knows that to get his battery to work properly he must clean his binding screws and tighten them up well. This fact was applied in Reiss's transmitter. A small plate of platinum was attached to the centre of a diaphragm capable of vibrating, and placed in connection with one pole of a battery. A platinum point connected with the line-wire was placed in delicate contact with the platinum-plate. A current flowed through the line. On speaking to the diaphragm, the latter was thrown into vibration, the amount of contact between the platinum-plate and point varied, and consequently the current flowing through the line varied; an undulatory current was produced. Reiss at first employed Page's iron bar, mounted on a resonant base, as a receiver. The magnetism of the bar varied exactly as the current varied, and if Reiss had but discarded his clumsy apparatus in favour of apparatus of more refined construction, he would have succeeded in transmitting speech. Subsequently (in 1863) he adopted another form of receiver. The line wire was attached to an electro-magnet, before the pole of which was fixed an iron diaphragm. With this improved apparatus of Reiss', Prof. Dolbear has been successful in transmitting articulate speech.

In 1876, Prof. A. G. Bell, bearing in mind the truth that when a magnet is moved so that its lines of force are cut by a closed conducting circuit, a current is produced in that circuit, conceived the idea of speaking to the armature of an electro-magnet, which, of course, is itself a magnet by induction, and of listening at the armature of another electro-magnet placed in the circuit. He reasoned that the electromotive force caused by the motion of the armature of the first electro-magnet would cause a variation in the strength of the second electro-magnet, which, in its turn, would set up a vibratory motion in the armature of that magnet. He was successful in his experiment. The same year Prof. Dolbear suggested the use of a permanent magnet in place of the electro-magnet. This also was successful. But neither the Bell nor the Dolbear transmitter was sufficiently powerful. It was found necessary to return to the Reiss transmitter, which, however, had the disadvantage that its platinum was very liable to break and to fuse. Edison soon greatly improved Reiss' instrument by substituting plumbago, and afterwards lampblack, for the platinum of the original instrument; and Hughes, later on, perfected it by the further substitution of unconstrained gas-carbon for Edison's lampblack.

It is known that a Leyden jar, when charging or discharging, gives song. In 1863 Sir William Thomson noticed that the air-condenser used in connection with submarine cables, when charging or discharging, also produces sound. Dr. Wright and Mr. Varley have made somewhat similar observations.

When a current is sent through an electrolyte, decomposition takes place, and the evolved gas exceeds in volume the liquid from which it was produced. By varying the current the amount of gas evolved can be varied. By connecting two plates, one free to vibrate, with the poles of a battery and bringing them parallel to and near to one another with a film of electrolyte interposed, it was found that, when used as a telephonic-receiving instrument, the variation of amount of gas evolved produced variation of pressure and threw the diaphragm into vibration. Sound could be reproduced. But it was found that sound could be reproduced when there was no electrolyte in the apparatus. The explanation of this was not far to seek.

If an electrical machine is joined to one end of a wire, and a plate to the other, and a pith ball is suspended before the plate, whenever the machine is worked the ball is attracted. If the ball is substituted by a thin flexible plate fixed at its edge, that plate will be thrown into vibration, and if these vibrations are rapid enough, sound is emitted. But this arrangement is a condenser. To produce the maximum sonorous effect, the plate must have a certain amplitude of vibration; therefore packed condensers are bad. There must be no electrical absorption; therefore there is a limit to the size of the plates, and practice shows that small ones are best.

If a fixed point connected to a frictional electric machine is brought near to a diaphragm free to vibrate, and connected to a line wire having at its other end a Dolbear receiver, then on working the machine sparks will spring from the point to the diaphragm, and a current of high tension electricity will flow along the wire. On speaking to the diaphragm, the air-space will be varied, and consequently the current flowing through the wire. Substituting the secondary current of an induction coil for the charges of the frictional machine, and throwing a Reiss transmitter into the primary circuit of the coil, a telephonic apparatus is obtained, wherein the ordinary conditions of the electrical circuit are not necessary. The second plate of the receiver need not be joined to earth specially. It may even be dispensed with, when the instrument will work by virtue of the induction of the remaining plate upon the rubber case containing it. More surprising still, the line wire may even be cut, and although there is no connection with the receiver save through the air and surrounding objects, speech is still transmissible. It is sufficient to lead the end of the line-wire into a room, and anyone present may pull out his own pocket telephone, and, standing 50ft. away from the end of the line, hear everything that is said at the other station.

The resistance of the coil employed is about 2,800 ohms; the battery is a small bichromate cell. Speech has been transmitted through a line 256 miles long in rainy weather, and no induction troubles have been experienced.

Prof. Dolbear claims for his system that in its principle it is a distinct advance on that of Reiss, for whereas in the latter vibratory motion of the diaphragm produces alteration in the current which induces magnetism, which in its turn produces vibratory motion of the receiving diaphragm, in his own the alteration in the current directly produces the mechanical motion of the diaphragm.

Alfred W. Soward.

ORNAMENTAL SLIDE-REST.

[19872.]—I AM now about to describe a slide-rest which I have fitted up as an ornamental one for my lathe, but which, for those who only possess light lathes without back-gear, is capable of being used for light metal and wood turning as well, and for the latter purpose is a much better pattern than that shown in all books on turning, as the regular ornamental rest, and is just as convenient for ornamental turning. Fig. 1 is a general view of the rest; an ordinary fluting-stop, A, is shown in position at one end of the main slide, and there should, of course, be another provided to go on the other end; these consist of a brass casting chamfered underneath at each side to fit the slide of rest, so that it can be slid along to any part of it, and to which it can be clamped by the two vertical set-screws shown. The use of these stops is when fluting a piece of work with the drilling instrument or universal cutter in the tool-holder, they are set so as to limit the travel of top slide on bottom one, which travel can be nicely adjusted by the horizontal screw with milled head, and so make all the flutes on the work of the same length, if desired. The depth of cut is regulated by a simple form of stop, fitted to the top slide. It consists of an arm, B, which has a hole drilled through a boss at one end, to fit accurately on the rounded end of leading screw, but moves freely on it until clamped by the set-screw D. C is a steel rod which slides rather stiffly in a hole drilled through the side of seat of top slide. The way to use this stop is, the set-screw D being slackened, and the arm B resting on end of rod C, the first cut is taken by turning the leading screw E (which is left-handed in my rest) by a winch-handle not shown. When the desired depth of cut is taken, the set-screw D is tightened, which causes the arm B to revolve with the screw E, and the rod C is then shifted, so that on reversing the motion of screw E, the end of arm B will just clear end of rod C; but when the next cut is taken, the end of B will catch on C when the same depth of cut is reached, as E travels with the top slide while C is fixed. This is a form of stop which has not been given in any book on turning, to my knowledge, but is a thoroughly satisfactory one. The main, or lower slide, has on its upper face a scale of 20ths of an inch, which, to my mind, is preferable to having a divided head on end of leading screw, and allows you to have the leading screw of any pitch you like. The tool-holder G is a very convenient and efficient one: it swivels round to allow of the tool being set at either side or end of top slide, being clamped in position by the nut shown on top, and the tool then clamped by the two set-screws with square shanks. I may here mention that I have made all the set-screws, both in tool-holder and fluting stops, to fit the winch-handles which turn the leading screws, so that they act as spanners, and the winch-handle can be applied to either end of main leading screw F. Both my leading screws are ½in. with V threads, and are left-handed, though I don't think there is any particular advantage in having them so, and there is the disadvantage of requiring a special tap for the nuts; however, it is usual with lathe-makers to have them left-handed. The nuts are gunmetal, and in order to be able to take up any backlash caused by wear, they are made like H, having a lug cast on the side of them, which after the nut is drilled and tapped is sawn through, and a small screw is fitted through the two jaws thus formed, as shown in the cut H. and when it is desired to take up any end-shake the top slide is moved until the hole I comes over the little set-screw in nut, when, with a small screw-driver, the screw can be tightened and thus grip the threads of the leading screw tightly, for which the V threads are better adapted than square ones. There is a similar hole through bottom of lower slide for the purpose of adjusting its nut. Thus any wear caused by the strain of metal-turning can be fairly compensated for, and when the nuts get too much worn for ornamental work, they can be replaced for a few pence, as the gunmetal nut always wears and not the steel screws. The lower slide of this rest has a pillar projecting from it underneath, which is turned accurately to fit a socket in the sole, like that of a T-rest, and can be clamped in any position by the set-screw J. The top of this socket is graduated, so that it shows the angle at which the slide-rest is set, and there are marks by which it can be set true, either parallel or at right angles to the lathe-bed. If the rest requires to be set higher than usual, a washer of the required thickness can be slipped on the pillar, which is a steadier way than raising it by means of a screw-ferrule, as suggested in some books. The sole-plate casting should be made much longer than would be required, if only ordinary turning tools were used in the rest, as instruments like the eccentric and rose-cutters project much further than such tools. For want of space I have not shown the sole-plate in my drawing as long as it ought to be. The holding-down bolt, Fig. 4, has a cradle which has a tenon, L, that fits accurately between the shears of lathe-bed, and at right angles to it on top, two shears, K K, between which the sole-plate of rest slides without shake, and the ends of which shears rest on lathe-bed; the top of bolt has a flat oblong head which engages in a T-slot in bottom of sole-plate. The rest of the bolt, with its washer and nut, speaks for itself. This cradle is not absolutely necessary, as the sole-plate can always be set at right angles to lathe-bed by means of the blade of a square laid across; but of course tho cradle is more convenient. Fig. 2 is an end view of rest when arranged for what is called curvilinear work; and Fig. 3 is a top view of same arrangement. The upper leading screw of rest is removed by taking out the two binding-screws in its collar and unscrewing it out of its nut, and the slide is advanced instead by a lever M, Figs. 3 and 5, which has a slot that is placed over the stud N, Figs. 1 and 2, and which lever has a pillar O, Fig. 5. riveted to it, which fits into the hole P, Fig. 1. Q, Fig. 2, is a plate screwed on in place of the collar of leading screw, and through it is tapped a screw R with a milled head; the point of this bears against the edge of the sheet-brass template S, Figs. 2 and 3, which is secured to bottom of lower slide by a screw T at both ends. The edge of this template is cut into the desired shape of the outline of the work, and by keeping the tool pressed up to its work by the lever M, and at the same time turning the lower leading screw by its handle, the point of the screw R, Figs. 2 and 3, will follow the outline of template S, and, of course, the tool will also follow the outline of work which is chucked on mandrel of lathe. It will thus be seen that a piece of work, say a vase, can, with the universal cutter, be fluted horizontally (as it appears on lathe-nose) from top to bottom, provided your template is properly cut, which can be done by drawing the outline on a piece of paper and pasting it on the sheet-brass, and then filing out to shape. This slide-rest is not at all hard to make, as the castings can be got ready planed, requiring very little to de done to them in the way of getting the surfaces true. And the fitting of it up is, to my mind, far pleasanter work than doing the most elaborate ornamental patterns on wood or ivory, though I like all branches of turning. Would Mr. Evans give us an article on ornamenting curves with the dome chuck, as I have only used mine in producing and ornamenting squares and polygons.

F. W. G.

FIG. 4

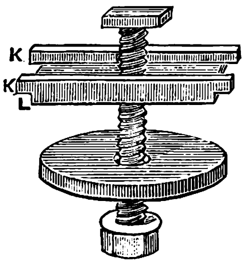


FIG. 5

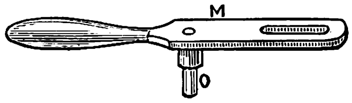
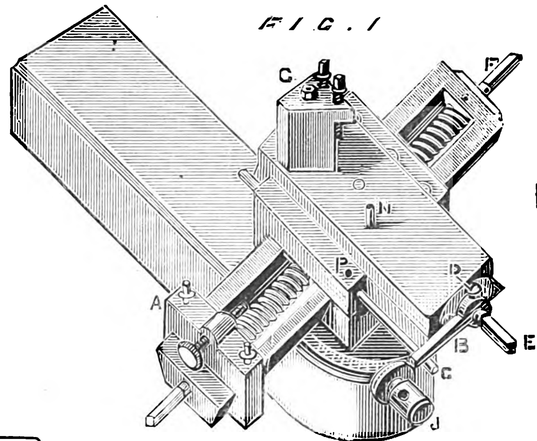
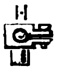


FIG. 1





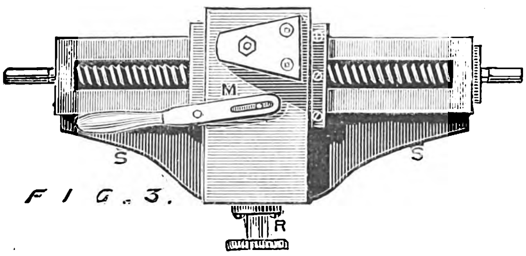
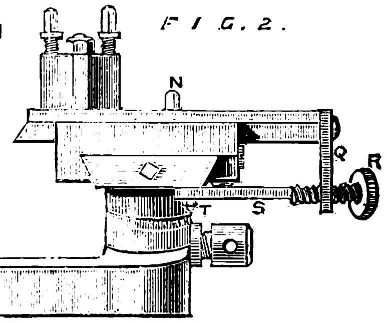


FIG. 3

FIG. 2



ORNAMENTAL LATHE-THREADS.

[19873.]—IN answer to "A Member of the Amateur Mechanical Society," 19831, I shall have great pleasure in answering his courteous request to the best of my ability, with regard to the nose of the mandrel on the lathes I am now making. I may almost say that there is scarcely any standard in particular, inasmuch as I make many different kinds. The old so-called standard 9·45 has been used for many years, but I always make them larger in diameter, viz., 7-8in., but I am now making several with an aliquot thread 10 to the inch, and the same diameter; I consider the original diameter, ¾, too small, considering the strain they at times have to bear. I have also some ordered to be made with a ⅞ Whitworth thread on the nose. I merely mention this as an example of the fact that there are various opinions upon this now important subject. I have for some time decided to gradually substitute the 10 threads in place of the 9·45; but I may point out that as all chucks ought to be made on their own mandrel, it does not materially matter, considering the means of cutting the chucks are provided in the shape of a taper and plug-tap, and I fear, from the remarks I have seen, that those who are possessed of these labour under the impression that the plug is intended to follow the taper. As a matter of fact, the taper is simply to mark off the thread as a lead; it should then be chased with an inside screw tool till the plug will just pass up the chuck. In other words, the last tap forms more of a cutting gauge than anything else. The diameter of the half-round bit used for finishing the hole should be rather smaller than the bottom of the thread, so as to allow a little for chasing. I trust our correspondent will find this sufficient for his purpose. If not, I shall be pleased to go more fully into the matter. **J. H. Evans.**

[19874.]—I REGRET that pressure of occupations, which, as I have before said, precludes my carrying on a correspondence, together with absence from town, have hitherto prevented me from endeavouring, in a concluding letter, to give Dr. Edmunds the final information he has courteously requested in your issue of the 10th inst.

1. The diameters of the external screws at the bottoms of their threads, to arrive at the sizes of the drills for the apertures for the taps? For this purpose every set of the taps and dies in question is provided with a corresponding and hardened gauge-plate, having a series of holes tapped with the plug taps. These screwed holes give the diameters asked for, with sufficient precision for practical purposes, and they will, in like manner, give the diameters of the drills. These latter, it may be said, should barely touch the threads in the gauge-holes, for the smallest screws have gradually more clearance with increasing sizes, until in the larger there may be a difference of, say, from two to four hundredths. What is required in all tapping is that the holes should be bored to receive the small ends of any taper or entering taps to a depth about equal to their diameters; this is easy of accomplishment, and the above general directions are both sufficient and more serviceable than a didactic list of diameters of the drills, which also, as everyone knows who is acquainted with the subject, would be incomplete for theoretical service, unless a digest of voluminous data as to the practice upon different materials, upon drilling and broaching tools, and the compressing and cutting action existing in different degrees in all taps and dies—all subjects of considerable interest. The diameters at the bottom of external screws may be calculated from those at the top mathematically; and there is another and perhaps readier method that is not without convenience, which is to turn down two or three threads of any screw of a known external diameter until they just disappear, and to measure the resulting cylinder.

2 and 3.—Shallow-thread screw-tools of all the previously-mentioned twelve threads are made and kept in stock. They are principally used for striking and chasing screws by hand or with the traversing mandrel, and either for the friable materials or for the harder or more compact, when of forms of thin tube-like character, many of which are met with in ornamental turning. Less frequently used in the diestock, both taps and dies are then necessarily of the shallow thread, and have corresponding gauge plates; therefore, supposing two bolts of the same external diameter, one of deep and the other of shallow thread, it is sufficiently evident that the aperture to be made for the tap for the latter would be larger than that for the former, from the difference in depth of thread, 60° instead of 50°. The small and nearly cylindrical end of the taper tap will again give its size.

On reperusal of a former letter, No. 19747, I find that Dr. Edmunds describes the attempt to cut a shallow internal thread in cast iron to fit an external deep thread, viz., the nose of a mandrel; this proceeding would be injudicious, because, as will be at once seen on drawing a rough diagram, from the difference of angle, only the extreme points of the external deep threads would be in contact with the internal shallow thread. The use of the shallow screw tool escaped me in my reply, and I should have explained the more correct course of action as follows:—The aperture would be bored a trifle larger than for brass or gunmetal, or bored the same size and then slightly enlarged with a turning-tool in the slide-rest, the enlargement in either case being but little, not to interfere with the action of the smaller or entering lathe tap in scoring the internal thread. The deep-screw tool would then be used, and when the thread was sensibly formed, but before it was cut up, the turning-tool would be again resorted to, to again enlarge the screwed aperture, so as to leave the taps of the threads truncated when finished by the subsequent use of the screw-tool.

4. The external diameters of the 5in. and 6in. centre-mandrel noses have already been given; premising, however, that such diameters may sometimes suffer accidental interference, the dimensions of the series asked for should be as follows:—4in. centre ·75, thread No. 4; 5in. centre ·8125, thread No. 3; 6in. centre ·9375, thread No. 3; and 7in. centre 1·125, thread No. 2. Some small variation in the diameters of the half-round bit used for the entering-taps is of no practical importance, while, as above mentioned, it may sometimes be resorted to; for general use with the above, it may be said that they do not exceed ·625 for the two first, and ·75 and ·95 for the two last, respectively. It should be mentioned, however, that 4in. height of centre so restricts the capacity of the apparatus and dimensions of the work that may be produced, that it cannot be recommended for ornamental turning, for which purpose also, for other reasons, the 7in. centre is as unsuitable.

My replies have been written simply for the pleasure of giving your correspondent the information he has asked for, much of which, being already within his reach by the exercise of a little thought, it is only fair to presume he only desired for confirmation; but I would now assure him, and without reference to any particular series of threads, that he will find in practice that nearly every difficulty as to convenience in repairs he can imagine will still exist with any. Screwing chucks to fit the mandrel is an operation of careful fitting, more under control with the lathe-taps than by other means, and the feat of damaging the nose of a mandrel, under the conditions he describes, would have been as readily accomplished, whatever that mandrel might have been; and I fear that Dr. Edmunds' desire to find a screw to replace any other in apparatus for ornamental turning at all ironmongers, will hardly be realised, under any circumstances, until such apparatus is as universally required, as such ordinary objects as gasfittings or other ironmongery.

64, Charing-cross. **John J. Holtzapffel.**

SCREW-THREADS.

[19875.]—IN my second paragraph, on p. 55, it would have been more correct to say that Whitworth's thread is rounded off till the whole depth is $\frac{2}{3}$ of the theoretical *depth*—not *pitch*. In Holtzapffel's book, note on p. 670, Vol. II., quoting from Whitworth, there is this passage—viz., "Making this deduction, the angle of 55° gives for the actual depth rather more than 3-5th, and less than $\frac{2}{3}$ of the pitch."

Now, 3-5 = 9-15, and $\frac{2}{3}$ = 10-15, so the real depth lies somewhere between 9 and 10-15th of the pitch of the screw, and if we take it as half-way between those, it would be 19-30th of the pitch. If you draw a square and bisect one side, and from the point of bisection draw lines to the opposite corners, you will find those slanting lines to include an angle of 55° very nearly, say 53°.

In this case we have a right-angled triangle, whose sides, which include the right angle, are as 2 : 1. If the hypothenuse is double the short side, then we get 30″ as the acute angle, as in Fig. 2.

FIG. 1.

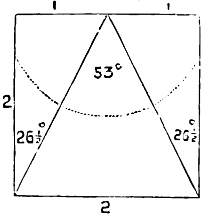
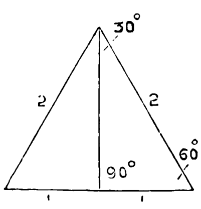


FIG. 2.



A mathematician would say thirty degrees is the angle whose natural *sine* is ·5. And 26° 34′, nearly, is the angle whose natural *tangent* is ·5, which is, say, 1° of arc different from the half of 55°.

I see I left off talking of "taps of other makers" when I had mentioned Clements's. Of Holtzapffel's, I only remark that I do not possess a single specimen, or even copy, though I have a set of seven pairs of his chasing-tools. I greatly prefer Whitworth's for holes in cast-iron, and for iron screws, and for machine tools and engines; but for small work connected with lathes, I think them too coarse, as, *e.g.*, $\frac{1}{4}$in. diameter, 20 threads to an inch, for the latter purpose would be better, 24, 25, 28, or even 32 to an inch, all of which sizes I have of Clements's threads. So, again, $\frac{3}{8}$in. diameter instead of 16 to an inch, might be 18, 20, or 25, as before, the last specially for leading screw of eccentric chuck.

I think Holtzapffel's threads are *in their proper place* only in such beautifully finished work as H. and Co. turn out, but that, on account of their great depth, they are quite out of place anywhere else. The time consumed in cutting such very deep threads, and the difficulty of keeping them truly upright, and the extra trouble in fitting, and hence the greater chance of not fitting accurately, and the fact of a non-fitting deep thread being ten times worse, from a practical point of view, than a fairly-fitting shallow one, most especially for slide-screws, make me entirely averse to the use of them myself, or to permitting their use in any but the very highest class of work, which alone can pay for their adoption. Of taps of "other makers," I think I may advise intending purchasers to *think twice*; but to send once and for all *for* Whitworth's *to* Whitworth's. As, in the first place, you get the genuine article, and in the second, I think I may say that the price is not so high as that of pretended copies.

J. K. P.

COMBINED OVAL AND ECCENTRIC CHUCK.

[19876.]—I WAS much interested in "F. W. G.'s" letter, No. 19833, giving an account of the way in which he combines the two chucks in one, though it seems to me that the removal of the arms may be attended by the risk that the nose of the chuck may be somewhat displaced from its true position when they are replaced.

It has, for some time, occurred to me that it would be possible to combine the two chucks by taking an eccentric-chuck and cutting in half the boss through which the leading screw passes; these two halves should then be mounted on a right and left-handed screw, so that they could be screwed clear away from contact with the leading-screw, and so allow perfect freedom to the slide.

The addition of the usual arms and ring would then make an efficient oval chuck of it, and there would be never anything to remove; the mere turning of the screw on which the halves of the boss are mounted, would suffice to change the chuck from one kind to another.

I should be glad to hear what "O. J. L." or other correspondents have to say about this proposal. **C. W. Bourne.**

LATHE AND LATHE-MAKING.

[19877.]—I THINK it would be more courteous in "J. K. P." if he would refrain from guessing at what he himself says he cannot understand (though the analogy between poetry and trigonometry is not very clear), as it may be just possible there are others to whom it does convey an idea. It does not appear to have occurred to him that there may be some value in showing what a thing theoretically *ought to be*, even though it cannot be exactly carried out in practice. The "nomenclature" to which he takes exception is certainly somewhat extraordinary, as the printer has expressed the fractions by sloping lines, which was not as I wrote them. I would also "mildly" suggest that it was not of the "shop" we were talking, but of certain *lathe-cut* screws used for ornamental turning, which are, or profess to be, always cut sharp "up," and not rounded off in the very useful but withal somewhat slovenly way adopted by Whitworth. No sensible amateur would buy an ornamental lathe with such a mandrel screw; indeed, I am at a loss to understand how such violations of the eternal fitness of things as threads of 9·45 per inch, *et id genus omne*, are tolerated for an instant anywhere except in the "shop," where I imagine it would never occur to anybody to ascertain what the pitch of a screw was.

I shall be very glad to do as Dr. Edmunds suggests; meanwhile I subjoin the differences in diameter, answering to a few angles as obtained by the aforesaid objectionable formula. D = diff. of diameter at top and bottom of thread, f = thread.

30° D = 3·732″ ÷ f
35° D = 3·172″ ÷ f
40° D = 2·747″ ÷ f
45° D = 2·414″ ÷ f
50° D = 2·144″ ÷ f
55° D = 1·921″ ÷ f
60° D = 1·730″ ÷ f

And if the angle = 53° 8′ 12″ we have D = 2 ÷ f, or the depth is equal to the pitch. Should there be any rounding off, this must, of course, be allowed for, and a slight allowance for unavoidable inequalities, or the male screw will not enter.

Scorpio.

CONTINUOUS BRAKES.

[19878.]—THE Continuous Brakes Bill, mentioned upon pages 562, 592, of last volume, was presented to the House of Lords by the Right Hon. Earl De-la-Warr on the 24th of February, and read a "first time." On Monday, March 20th, a large number of petitions were presented in its favour, and, after a short discussion, it was read a "second time" without a division. The Great Northern Railway Company has always opposed the use of automatic brakes, and consequently the Board of Trade conditions; therefore the chairman, Lord Colville, spoke against those brakes, and in support of his argument quoted "a recent accident in America alleged to have been occasioned by the automatic action of a brake." This statement was accepted as correct, as none of the noble lords present appeared prepared with a reply. It should, however, be clearly understood that *automatic action had nothing whatever to do with the accident.* The Spuyten Duyvil disaster (it was proved by the official inquiry), was caused by a tipsy passenger tampering with the brake, and pulling the safety-cord, thus stopping the train; the line was *not* worked upon the block system, and the guard or brakesmen neglected to perform the very important duty of going back and protecting his train by hand-signals. Safety cords and efficient communication between passengers, drivers, and guards are very necessary, but, of course, may cause very serious delays and even danger if improperly used, and most certainly the control over the brake power should not be placed in the hands of passengers.

Lord Colville has directed special attention to this American accident; but it is a strange fact that upon his railway (the G. N. R.) the following regulation is in force: –

"The guard's communication cord must be attached to the lever of the brake of the engine, and not to the gong on the tender of those engines which are fitted with the vacuum-brake."

The Vacuum-Brake Company claim for the system "that it can be applied by guards or *passengers* by means of the communication-cord." This statement is also repeated in the *Railway Engineer*, March, 1880.

It will, therefore, be seen that passengers on the Great Northern Railway *have* the power to apply the vacuum-brake, and, although it is non-automatic, a "tipsy passenger" may pull the cord and stop the train, and thus risk a collision precisely similar to the one at Spuyten Duyvil.

In a very interesting article, which appeared in the ENGLISH MECHANIC, Vol. XXXIV., page 225, reference was made to a so-called conference held at Euston upon the continuous brake question. As only those engineers were invited to attend who were well known to be strongly in favour of the vacuum system, the result was of course a foregone conclusion. On the 16th inst. another private conference was held, consisting as before of the advocates of the vacuum system; but in addition Mr. Tennant, of the North Eastern Railway, was invited.

Representatives from the Midland, Great Western, and Lancashire and Yorkshire Railways advocated automatic vacuum brakes. Mr. Tennant spoke most strongly in favour of the Westinghouse brake now fitted to a very large portion of the North Eastern Company's rolling stock. The meeting at once became discordant, and when Mr. Moon, Mr. Webb, and others expressed an opinion against automatic action altogether, it was seen that there was no chance of any unanimous decision being arrived at. The brake question is one of very great importance, and to obtain a correct conclusion, it is essential that the subject should be fairly and clearly discussed.

A committee of impartial engineers could easily settle *which is the best brake*, but unfortunately the difficult part of the question is how to overcome the crotchets and interests of certain officials. This is well known in railway circles, as the following quotation from the *Railway Review* will show:—

"Some engineers in the employ of the companies have entered the field as inventors, if not as speculators, and they naturally use their influence to promote that invention in which they have a direct or indirect personal interest."

For many years it has been known that the chain-brake which was adopted by the London and North-Western was very unsatisfactory; the Board of Trade reports have constantly called attention to its defects; but in spite of public opinion, the stock was fitted with it; now, after some £70,000 has been spent upon it, we are informed that this brake is discarded, and that it is to be replaced by a "continuous brake," and a North-Western train has been fitted with a vacuum brake which appears to be known as the Webb-Gresham.

The directors of the North-Western having wasted such an enormous sum of money upon the Clark and Webb brake, will, I think, carefully consider the subject before they adopt a new and untried system, which it is stated does not fulfil the Board of Trade conditions.

To adopt an inefficient brake would be a very unfortunate step, as it would delay the settlement of the brake question, and in a few years' time the additional expense would have to be incurred of changing again. In my next letter, I hope to refer to the subject of automatic air, and automatic vacuum brakes. **Clement E. Stretton.**

Saxe-Coburg-street, Leicester.

SCREW-PROPELLERS.

[19879.]—CAPT. CURTIS'S letter, 19841, surprises me. An efficient scull-propeller must not be forked, and need not be flexible. There is very little analogy between a fish and a steamship. The former is entirely immersed, like a torpedo, the latter has a great deal of freeboard to keep it from entire immersion. The stream lines following a vessel are very different to those following the motion of a fish, and require a totally different treatment, as I pointed out in my former letter.

Then Capt. Curtis says you *cannot go astern with it!* Why not? A steamship is not a dingey, with a half-round hole in its stern for a scull to work in. A large steamship would be fitted with one or two propellers (sculls), say 30ft. long, from the outer end of the blade to the journals; the latter would be about 2ft. in diameter, and the blade about 5ft. wide, at its widest part. It would be made of steel or phosphor-bronze, and cellular. Such a propeller would be capable of stopping the ship suddenly with greater power than the screw, and of driving the ship astern without any difficulty.

25th March. **Thomas Moy.**

MR. BENNETT'S BATTERY.

[19880.]—SEEING several correspondents have failed in making this cell work to their satisfaction, it may be interesting to them (and others) to know that, in reply to a note from me, Mr. Bennett says: "Wrought or cast-iron turnings may be used indifferently in my battery; there is a variation, it is true, but too slight to be noticed in practical working."

He very kindly adds: "You are at perfect liberty to send this reply to the ENGLISH MECHANIC."

Birmingham. **John J. Gilbert, A.S.T.E.**

LEGAL REPLIES.

[19881.]—INCOME-TAX (46365).—I am inclined to think the surveyor is right, and that "J. W." must claim a return of what he has overpaid upon the proper forms; but I do not pretend to an accurate knowledge of this special subject.

LEGAL (46439).—In this case the gift to B. and C. vested at once, so that the death of C. before D. made no difference. Therefore, C.'s will operates to pass his share to E., and the fact that E. is the issue of an illegal marriage has nothing to do with the matter. A person can give his property where he likes, and E. can proceed against the executor under C.'s will for an administration of the estate, either in the high court or, if the property be below £500, in the county-court. The executor ought to have proved C.'s will and acted under it, and he has no excuse for his neglect, as the reason he gives is wholly erroneous.

MORTGAGE (46453).—Without seeing the deed of mortgage, and knowing more about the facts, I cannot be certain in this case. But presuming that the mortgagee had a proper power of sale, and has used it legally, the only course open to "M." is to sue the mortgagee for an account. This could be done in the county-court, and might cost £20; but if he is right, these costs would have to be paid by the mortgagee. But this is peculiarly a case upon which I cannot advise without seeing the papers, as until then I could not say whether it would be taken up by a solicitor at his own risk, as seems to be suggested.

LANDLORD AND TENANT (46480).—A weekly letting can only be determined by a week's notice to quit; or by the parties agreeing to waive that notice. In this case it seems that the tenant has simply gone away without notice, and therefore he remains legally liable. Possession of a key is only evidence from which a tenancy may be inferred; but it is not conclusive. Coupled with the want of notice, it would, however, support an action for rent against the tenant who has gone away. "Householder" can certainly sue for the rent as against the person who had paid before; and if he wants to determine the tenancy he should give notice to quit, upon the expiration of which he can sue for the value of the key, if it be not returned.

LEGAL (46188).—The only remedy Mr. Babbage has is to bring an action for damages against the owner or occupier of the foundry, on the ground that the chimney is now a nuisance; and he should ask in that action for an injunction ordering its removal. Presuming the facts to show that the smoke constitutes a legal nuisance, the only possible defence would be that the foundry had been on the present site for over twenty years, and so had acquired a right to be a nuisance to its neighbours by prescription. But that right would only apply, as far as I can judge, to the chimney when it was 50ft. away, and the bringing it as close as 15ft. would probably be a good ground of action; but, of course, all must depend upon the evidence.

Fred. Wetherfield, Solicitor.

2, Gresham Buildings, Guildhall.

DYNAMO-MACHINES.

[19882.]—I NOTE "Humble Bee" (letter 19822) recommends the study of the laws of magneto-electric induction to those who would construct apparatus in which the said laws are involved. Now *I* "don't want to be rude" either, but it strikes me he would do well to inquire a little more closely into them himself.

He says I am under the impression that the bobbins of the Brush armature are only able to contribute anything to the current during a quarter of the revolution, when they pass from one pole to another, and that this portion of revolution is the weakest part of the field; also that the strongest part of the field is between the field-magnet poles. This is all perfectly true. But is "Humble Bee" aware that the currents induced in the bobbins are not necessarily most powerful when they are under the most powerful induction? It is a well-known law that currents are only induced in wires when the inducing-power either increases or decreases; consequently, no current would be induced in a bobbin when it was passing between two poles, even if they lifted a ton weight each, unless the power of the induction was made to increase or decrease by having the polar faces slightly sloped in such manner that the bobbins would gradually approach or remove from the poles as they moved round. In the Brush machine the bobbins practically remain at the same distance from the inducing-poles all the while they are between them. So the strongest part of the field is wasted.

I asserted, in my last letter, that I had designed a generator which was free from several of the main defects of other machines. The bobbins on my armature either approach or recede from the faces of the inducing-poles during the entire revolution; the armature is in the best possible position for utilising their inductive power. The heating of the armature through reversions of magnetism in the iron is entirely done away with. In all the annular armature machines of any note the iron in the armature takes little or no part in the generation of currents, whereby considerable power is lost. This is made evident by taking the iron core out of an induction-coil and interrupting the current by an arrangement worked by hand, when the coil will be found to have lost some little power.

In my machine the iron of the armature is so disposed as to be very powerfully magnetised, and it is through this chiefly that the current is produced. In the Gramme and Brush armatures the iron is too thin to help the current to any considerable amount, and, if made thicker, it would act deleteriously upon it.

My armature A (Figs. 1 and 2) consists of two

FIG. 1

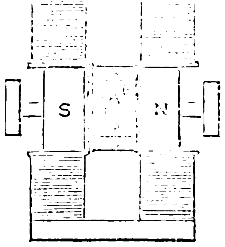
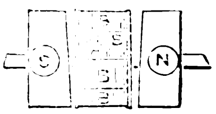


FIG. 2.



brass wheels, fitted upon a steel shaft, and carrying between their rims six or eight bobbins, B, of insulated wire, each with a round core of well annealed soft iron in its centre. Practically, they are so many small straight electro-magnets. This revolves between two field-magnets with opposite poles, N and S, on opposite sides of armature, the latter being placed as shown in Fig. 1. The ends of the iron cores of the armature bobbins project slightly through holes in the rims of the brass wheels, and it will be evident, on turning to Fig. 1, that these cores will be powerfully magnetised, as they are in the most concentrated field possible. The poles S and N are circular, and of same diameter as the armature, so that every part of the latter is under induction in every part of the revolution. Fig. 2 shows how poles are sloped so that each bobbin continually approaches till it reaches the lowest part of revolution; then, as the motion continues, it ascends and recedes till it reaches the highest. Thus, the power of the induction continually varies.

I now come to the point in which this machine differs from all others. It will be seen, on looking at Fig. 1, that the magnetism in the armature will never change during the entire revolution. All the poles of the armature cores next the north pole of field-magnets will become south by induction, and, as they never leave the north pole, but keep revolving before it, they never change their magnetism. In all other machines that I have heard of the poles in the armature must change twice every revolution, and, when it is rapidly rotated, the forced reversions produce much heat, injurious to the covering of the wire, and wasteful of power. Each bobbin is connected only with the diametrically opposite one, as in the Brush machine, and the commutator resembles the Brush, in having a separate pair of segments for each pair of bobbins; but it has no "insulators," as they would be quite useless. I fear I have taken up too much space already, or I would have sent a diagram of commutator, showing how bobbins were connected.

Conrad.

CHEAP DARK-SLIDES.

[19883.]—With regard to Mr. Fennessy's objection to the non-opacity of the shutters of the dark-slides described by me, I beg to inform him I have not experienced the difficulty he mentions.

I find that the application of one coat of Bates' black varnish effectually renders the shutter light-tight. **J. B. Stephen.**

Screw-Drivers. — Erratum.— A line was omitted in the print of Sir Edmund Beckett's letter about a screw-driver improvement last week. The second paragraph ought to have begun thus:— "All that is wanted is a short tube big enough to inclose the screwhead somewhat [loosely, and the screw-driver itself somewhat] tightly, but only spring-tight," &c.

REPLIES TO QUERIES.

**** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[45516.] — **Hand-Thresher.** — I hope that "Strathtay" will discover that the sketch has been placed upside-down by some mistake. I might also mention that the whole frame should be closed with five-eighths lining.—Was-heil.

[45687.]—**Throttle-Valve.**—To "Sunlight."—I did study your proposed circular throttle-valve, and felt satisfied that, if anything like a fit, it would be very liable to bind in the box. I advocated the use of one part cast iron, because brass on brass, especially when hot, has a tendency to stick, and not to work kindly together. I knew very well where the spindles would be placed on a large throttle-valve, but objected to your using the expression "spindles placed upon the ends of the oval" (see page 617), seeing that said axis goes angularly through the centre. When proposing the use of a wood chuck, I was addressing the model-maker, not alluding to large work; and, as to the drilling of the hole of square section, I ask any of "ours" to refer to said page 617.—J. J. A., Liverpool.

[45766.]—**Watch Fusee Chain (U.Q.)**—"Bazil Amo" will probably find what he wants on page 619, No. 881 of this paper, in answer to query 46027. Arthur Frogham's is best as far as it goes; the others give the remaining information asked for.—C. M. R.

[45864.]—**Universal Joints in Shafting.**—I am sorry to see that one part of my query was not clearly stated. I am about to put down a line of shafting on a very steep convex incline to drive a threshing-machine, at a distance of 270ft. from the water-wheel (a chain being previously used for driving it). Four Hooke's universal joints will be used on the different inclines at angles of 15° each. I am under the impression that it would take considerably more power to drive the shafting with two universal joints at angles of 40°. Would "J. T. M." kindly give a fuller description or a sketch of the "cup-and-ball" universal joint?—Ignoramus.

[45962.]—**To Mr. Allen (U.Q.)**—"M.I.C.E." has misunderstood this query. I believe the transparencies inquired about were carbon prints mounted on glass; such, at any rate, were the very beautiful transparencies shown at several British and French exhibitions.—W. J. Bashford.

[45964.]—**Glass Transparencies (U.Q.)**—A few years ago I used to amuse myself during the winter evenings in making glass transparencies in the following way, with very satisfactory results: Sensitize an ordinary collodion plate, and, after draining well in a non-actinic light, place it, face downwards, on the face of negative in an ordinary printing-frame, putting four small pieces of thin cardboard at corners, to prevent contact with the face of negative. Now all is ready for exposure. Don't place the printing-frame too near the light. I used a paraffin-lamp, with a medium-sized wick. Expose from half a minute to two minutes, as practice alone will show, and then develop, &c., in the ordinary way by a non-actinic light. I really forget whether I fixed the pictures or not; but this may be tried with a weak fixer. Then dry and varnish the plate, and you have a transparency which, I think, will meet with your approval.—W. H. Scriven.

[46018.]—**Turbine for Low Fall.**—If "A. L." will refer to Templeton's "Workshop Companion" he will find rules in it for calculating the power of turbines, and if he (or any other reader interested in turbines) intends visiting the Royal Agricultural Show this summer and advertises his address, I will send him my address, and will be most happy to show him two turbines at work and one idle, with a fall varying from 2ft. to 3ft. 6in. When the water is clear the wheel can be seen revolving round.—Stratheden.

[46077.] — **Enamel Paint.** — This is either ordinary paint worked up with varnish, or it is the cheap enamel used for covering ironware. In neither case is it proof against "acids."—J. T. M.

[46092.]—**Gas from Oils, Fat, &c.**—The gas is made in the usual way by distilling the substances and securing the hydrocarbon vapours. It would require specially-constructed plant, and is out of the question in this country where coal is so cheap compared to oils, &c. The only oils that would be used for the process are mineral oils, and gasoline is about the cheapest and best, all things considered. The air-gas will then cost about 6s. per 1,000 cubic feet.—S. Mayer.

[46093.]—**Gun-barrel Staining.**—The art of staining gun-barrels is very simple when you have had plenty of practice; but those who try for the first time must expect to make a mess of it. However, there are several recipes in back volumes; but, of course, you have not them. Dissolve quarter ounce of sulphate of copper in some rain-water (you will want nearly a pint altogether), add ¾oz. of sweet spirits of nitre, ¾oz. spirits of wine, 1oz. tincture of steel (ferric perchloride), and ½oz. of strong nitric acid. That will make a pint, say, and is enough for 30 or 40 barrels. Clean the barrel thoroughly (a good plan is to cover with wet lime and wipe off when dry); then, with a sponge and a stick, coat the barrel with the mixture, and put it in a warm place (80° to 90°) for twelve hours. Then scratch-brush, or go over with wire card, and let cool. Repeat this performance twice, barring the scratching, and only leave about six hours. Then immerse in boiling water till they are quite hot, and wire card again; repeat the coating and immersion as often as necessary, and when done wire card and oil. It will be understood this is a process of "rusting," and everything depends on the skill of the workman. A simpler process is to coat several times with a paste of butter of antimony and olive-oil.—Nun. Dor.

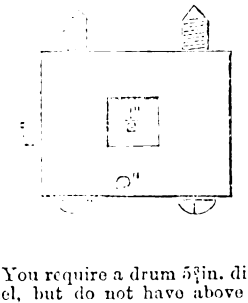
[46101.] — **Emigrants' Outfit.**—Clothes and tools are about the only things necessary to take out—a complete waterproof suit of oil-skin being a principal thing.—Ontario.

[46120.]—**Hand-Power Tricycle.**—The best way would be to send for the lists of the makers—*e.g.*, Bayliss, Thomas, and Co., Coventry, who make a hand-lever machine, and the Manchester Tricycle Co., Exchange Arcade, Manchester, who make a tricycle to be worked by hands only, using a crank-axle just in front of the rider.—B. U. B. T.

[46127.]—**Snails.**—I do not know that snails are of any great value medicinally; but they are considered a luxury by some—perhaps you would think so, too, if you were not aware of the nature of the dish. In several countries on the Continent snails are reared as articles of food, and I believe that, when boiled in milk, they are thought to be beneficial in lung-diseases. The cultivated specimens of Helix pomatia fed in the gardens of the merchants are very large, and fetch tolerably high prices; but, on the shores of the Mediterranean, what I may term the wild snails are considered to be excellent food. They are boiled in the shells, just as we cook "winkles."—Nun. Dor.

[46135.]—**Heinrich's Dynamo.**—I think I can answer this question. The machine is being experimented with on the Continent, and will probably be in full work when some of those now at the Palace are forgotten.—Nun. Dor.

[46148.]—**Fret-Saw and Lathe.**—"J." had better get four pieces of hard, dry wood, nicely squared up, and holes carefully put through for rods to work in. It is cheaper and quieter, and wants no oil; black lead only required; bearings are not an improvement; the upright can be cut off as high as you please; 3in. from table is enough. You require a drum 5¾in. diam. for your 29in. wheel, but do not have above a ¾in. throw for your under crank; short and quick stroke is best. I use steel staples, but have found the dust licks up the oil, and wood answers just as well for guides to the top and bottom rods; that is why I now recommend hard wood.—Wm. Hosken, Penryn.



[46210.]—**Wheatstone Bridge.**—I do not see why "Number and Angle" has selected from ½ohm. to 220ohms. for his coils; but perhaps he has some particular reason for these limits which he has not explained. He does not mention that he has prepared any coils for the two square branches of the "bridge," and I do not quite see what he can have done. Perhaps the simplest plan of explaining the matter may be to give a description of a set of coils I have been engaged on lately, and have just completed. They are arranged in three rows in the box thus:—

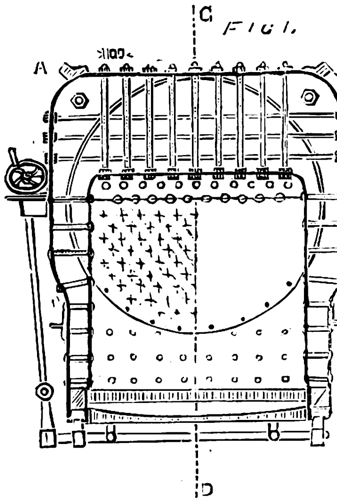
C { 500 – 100 – 20 – 10 – 10 – 20 – 100 – 500 A
D { ·1 – ·2 – ·3 – ·4 – 1 – 2 – 3 – 4 }
E 400 – 300 – 200 – 100 – 40 – 30 – 20 – 10 }
F B

The upper row forms the bridge; the plugs may be pulled out to put two ten ohms., or two twenties, two hundreds, or two five hundreds in circuit, according to the resistance to be measured; or the 100 plug may be pulled out on one side, and, say, the 10 plug on the other, when any measurements will be multiplied or divided by ten, according to the side from which the hundred plug is removed. The two lower rows form the third branch of the bridge, the resistance to be measured making the fourth. The letters A and B are the binding-screws for the resistance; C and D are for the battery, and E and F are for the galvanometer. In front of the three rows of plugs is placed the contact-maker, which is constructed as shown in Sprague's book, so as to first make the battery contact, and then the galvanometer ditto. The connections are as follows (I have not shown them, as if I had done so it would have required a block, which I wish to avoid if possible). Lead wire from between the two 10-ohm coils to E, also from between the 500 and ·1 ohm to C, the other 500 to A, and a branch wire from here to the battery contact-maker, from whence it goes to D. Lastly, connect the 400 coil to B, and lead branch wire to galvanometer contact-maker, from which it is led to F. It will be understood that the coils are inside the box, and the two ends of each one are connected to pieces of brass above, which are short-circuited by the brass plugs that are fitted in, and any coil will be thrown into the circuit by the removal of the plug above it. The galvanometer required for measuring resistances may be simple; there is no particular good in having a lot of different wires on the bobbins. Mine has about 150 turns of No. 18 copper wire, and I can read to the tenth of an ohm when measuring two or three hundred. But if making another, I should put finer wire, say, 400 or 500 turns of about 24 B.W.G. The great thing is to get the needles to move with the least possible current. They must, therefore, be as nearly astatic as possible, and be suspended by a fine silk fibre. I may mention that, if properly adjusted, they should swing very slowly, not more than five swings a minute, and it is important in using such an instrument to empty the iron and steel out of your pockets, or the needles will always move when you do. I find even my watch will deflect pointer two or three degrees if brought within a foot or so. It will be noted that such an instrument is simply a galvanoscope, and not, properly speaking, a galvanometer; that is, it simply shows that there is a current, but only gives a very general idea of its strength; when it is required to do this quite a different instrument must be used. I have made such a one on the tangent (and sine) principle, that I shall be pleased to send description and drawing of, if desired; it will measure with accuracy any current from about one thousandth of an ampère up to twenty-five to thirty ampères.—R. P.

[46320.]—**Motor.**—In reply to "Sunlight," I seek information as to the form of motor I could procure to work the machine. The machine is a model I wish to show at work in various places, and would not require it to work more than an hour at a time. As a regulated speed is desired, the motor must be under control.—Poor Peter.

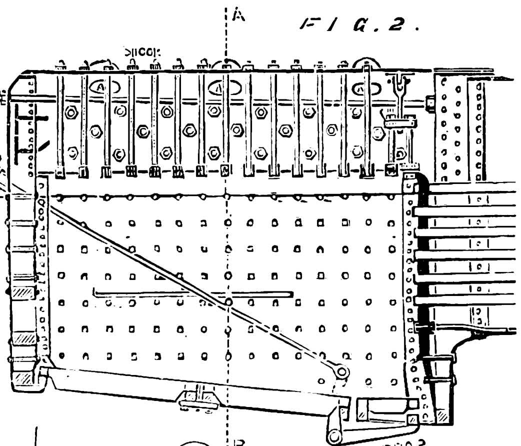
[46344.]—**Locomotive Matters.**—There are two peculiarities about the Belpaire firebox. They are not always met simultaneously, as on the annexed sketch. The first is the grate: my readers are well aware that for a many years coke alone was burnt in locomotives; when coal was first used many systems of grates were devised to abate the smoke. English coal was imported in France for railway locomotives from Cardiff, Newcastle, &c. But it was found more desirable and more economical to use French and Belgian coals. But these coals are still dear, especially if they are to be used in lumps; the cheapest sort, and by far the most considerable sort, is the "menu," or slack. This slack is not free from earthy matters, and in its divided state it will pass through the grate in no time. This is a waste. Moreover, it is not advisable to burn it in a deep fireplace. The layer of coals must be thin and uniform, the air-spaces very narrow, not more than 9 millimeters; the air is admitted at the level of this layer by openings in the fire-door; this opening can be closed at will. The bars are cast together, in parts, or, when of wrought-iron, so riveted. A drop apparatus is

FIG. 1.



SECTION THRO A.B

FIG. 2.



SECTION THRO C.D

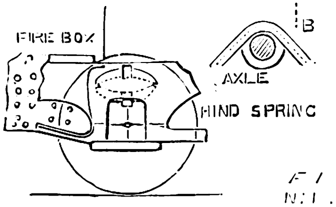


FIG. 5

FIG. 3 No. 2. 1877.

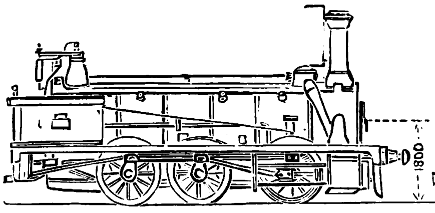
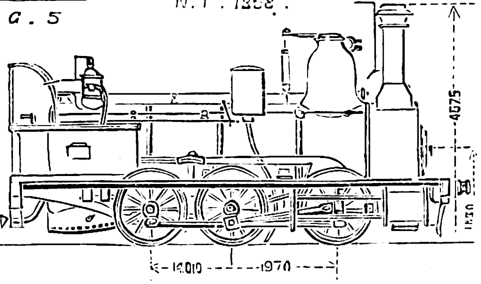


FIG. 4. No. 1. 1858.



provided to throw the fire. The firebox cannot naturally be made high, and it will be seen at once that the grate can be placed over the hind axles, this is a great advantage, favouring a good repartition of the weight. The length of the firebox is often 7ft. The second particularity is a mode of staying the crown-plate of the firebox. It is an extension of that adopted for the vertical side of the firebox. The origin of this new system of staying has been contested. M. Belpaire, however, may not have known that it was applied first by Crampton, on one of his celebrated engines. The late Mr. Bouch, engineer of the Stockton and Darlington Railway, also used a very similar staying of the crown-plate. From the sketch it will be seen that both crown-plates, outside and inside, are flat; both are strengthened by long steel, or wrought-iron screwed stays, a little over 1in. in diameter, pitched 4in. apart. They are hollow, but the end on the outer case is closed. The hollow through the stays is ¼in. in diameter. If one broke the steam or water would rush immediately into the firebox, thereby signalling the danger. These fireboxes must have their corners struck with a great radius. The unavoidable flat parts are easily strengthened by palm-stays or screw-stays, as shown on sketch. The latter sort is preferable for two reasons: a hole can be also drilled through them, or even managed when rolling the stays. The other reason is that the first sort of stays cannot be easily repaired, give no signs of failure, and, if not riveted, may work loose. The advantages of this firebox are: 1. Enlargement of steam-room. 2. The screw-stays do not oppose the rapid generation of steam that takes place there. 3. It is cheaper, and in the event of a failure, soon made right again. 4. The crown-plate is easily cleaned and examined through the little openings, A, A, A. In this country, the direct staying of the crown-plate to the outer casing has been also adopted, but in keeping the old form of firebox top this is not commendable. Keeping the old form of outer firebox requires a particular shape of crown-plate, for we know that the stays have to be normal to both plates. This condition is realised in the case of concentric cylindrical surface; but, should this become possible in locomotives, staying does not seem necessay; but it is impossible, owing to the diminution it will inevitably cause in the heating-surface. Curved surfaces, but not circular ones, are resorted to, and, for the purpose of keeping the stays normal to them, they are altered a little in shape at the place where these stays are screwed, and in such a manner as to secure the desired result. This is the practice on the L. B. and S. C. I do not think it is simpler than Belpaire's method. All fireboxes with direct screw-staying of the crown-plate have a disadvantage. The stays must not be too near the tube-plate: otherwise, on lighting the fire, the expansion of the tube-plate will often cause the plates and stays to become leaky. The best means to avoid this is to adopt the sling stays shown at that part on the sketch. Belpaire's firebox is adopted in name on the Chemins de fer du Nord, de l'Est, de Lyon, on all Belgian railways, by Borsig, of Berlin, and some other Continental railways. Bourbonnais type: The Bourbonnais type owes its name to the fact that, when first created, it was destined more particularly to work on some of the railway lines that are found in that part of France formerly called Bourbonnais. The first engines of this type were built in 1858 by Cail and Decrosne, from the designs of M. Houël, the principal engineer of that firm. They first worked on the Lyons and Roanne section; but, when the Paris, Lyons, and Mediterranean Railway received its present extension, through the amalgamation of different lines lying in the south-east of France, the system under our consideration was adopted throughout all parts of the *réseau*. The Bourbonnais type is an outgrowth of the long boiler type, applied to meet the requirements of heavy traffic. It is an outside cylinder engine, with inside valve-gear. Both firebox and cylinders are overhanging; but, abroad, this is not considered a fault when it is a question, as in the present case, to draw heavy trains at a slow speed. The P. L. M. Company possess to-day over 900 engines of this sort. They were built during the last twenty-five years by different makers, with slight modifications. I have given on the annexed sketches the diagrams of the first engine and of the most recent, to my knowledge. It must be remarked, by the bye, that the Bourbonnais type is fast being adopted by other railway companies. You will find it on the Alta Italia Railway Company, for instance. I have in my possession the auto-lithographic working drawings of some locomotives by various French companies, exactly similar to the Bourbonnais type, as far as regards mechanism. The engine No. 1 was considered as the most powerful six-wheeled engine for goods traffic that could be adopted safely on the normal gauge. Time, however, showed that this opinion was not strictly true. The engine No. 2 must be somewhat more powerful than No. 1. The latter was used on inclines of 18 to 20mm. per mètre (about 1 in 50). Here are the following changes occurred in the construction of these engines during the last 25 years. The services of these engines are now required for the passenger traffic. On inclines 1 / 200 they can draw 400 tons (goods) at a speed of 15·6 miles an hour, or 235 tons (passengers) at 28 miles. The pumps are now replaced by a single but powerful injector. It is, however, difficult to understand why two are not used. This injector (No. 9) can deliver over 25½ gallons a minute. All recent engines have a capacious dome against the smokebox. This dome carries the safety-valves, which were before on the firebox. There are, on each engine, a large dry sandbox of a peculiar construction, and a weather-board. The wheels are wholly made of wrought Iron, and with spokes, oval in section. The engines are fitted with Lechatellier counter-pressure brakes. In both old and recent engines there is a peculiar arrangement for the springs of the trailing-wheels. It was difficult to find room for them to be disposed in the same way as the other two pairs. The nearness of the fire-box prevented the engineer from finding the place necessary to give them the proper span. They were replaced by the kind of double spring of shorter span shown in one of the sketches. It is to be remarked that such engines cannot have their frames braced properly from the same cause; however, the cylinders are fastened to these frames, and secured together in a manner worth imitating. I should be glad to describe it here, but I am afraid to trespass on valuable space, as my description is already too lengthy. The builders of these 900 locomotives rank amongst the first on the Continent, and I give their names, as it may interest some readers: Cail and Cie (Paris and Oullins-les-Lyon); A. Kœchlin, Mühlhausen; Claparède, St. Denis, near Paris; Creusôt Works (Saône-et-Loire); Ateliers de Fives Lille (Nord); Ateliers de la Compagnie, P.L.M., Paris. The following dimensions are metric, of course, but I give the nearest English equivalent for the modern engine.

GRATE.

	No. 1 (1858)	No. 2 (1877)	
Length	1350mm.	1340mm.	4' 4·7"
Width	1010	1001	3' 3⅜"
Area	1363m².	1340m².	4' 4.7"

FIREBOX (INSIDE.)

Height	1504mm.	1520 & 1404 (back)	5' & 4' – 8·8"
Length (bottom)	1350mm.	1340	4' 4·7"
Width (bottom)	1010mm.	1001	3' 3⅜"
Sidesplates (copper)	13 thick	15	⅝"
Tube (copper)	25 thick	25	1"

TUBES (BRASS.)

Number.	197	177	
Diameter (exterior)	50mm.	50mm.	2"
Thickness	2·25	2	No. 14WG.
Length	4250	4262	13' – 11·7"

HEATING SURFACE.

Firebox	8·01m².	7·15	77 sq. ft.
Tubes	124·89	108·5	1158
Total	132·9	115·65	1235
Working pressure	8 atmos.	9 atmos.	132lb. sq. in.
Thickness of barrel plates	13mm.	14·5mm.	57"
Diameter of chimney (uniform)	450	450	17 3"
Diameter of barrel inside (greatest)	1357	1354	4' 4·2"

FRAMES.

Distance apart inside	1230mm.		4' 0"
Thickness	28		1⅛"
Wheels (diameters)	1260mm.	1300mm.	4' 3⅓"
Distance fron 1st to 2nd axle	1970mm.		6' 5·58"
Distance from 2nd to 3rd axle	1400mm.		4' 7·2"
Wheel base	3370mm.		11' 0·78"

The third axle has a play of 7mm. laterally, and there is a ball-joint articulation at the fore-end of the 3rd coupling-rod.

BEARINGS.

1st and 3rd axles	180*d* × 250mm.	7·08*d* × 9·8
Driving	190*d* × 250mm.	7·49*d* × 9·9

CYLINDERS.

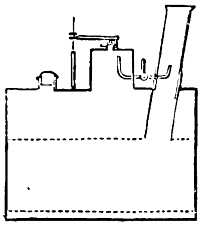
Diameters	450mm.	17·3"
Stroke	650	25·65"
Centre to centre	2090	6' 10·28"

WEIGHT IN WORKING ORDER.

1st axle	10880kilog.	11060kilog.	11 tons.	3 cwt.
2nd axle	10800	11800	11	7
3rd axle	10600	11800	11	2
	32280	34660	33	12
Tractive power (maximum)	6700kilog.	7290kilog.	16000lb.	

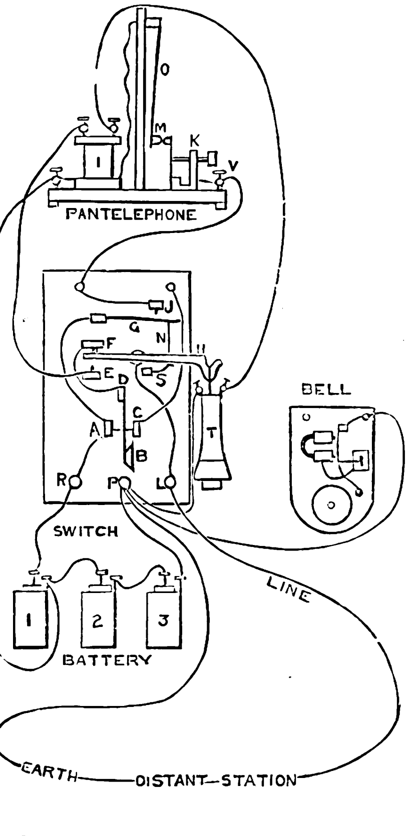
Kpd'l / D.—ED. GOBERT, B.Sc., Nottingham.

[46349.]—**Model Steamboat.**—The annexed sketch is the form of boiler required, the dotted lines showing section of firebox and uptake. It should be made of copper (a piece of 12in. sheet is most suitable) riveted, and of the following dimensions:—Length, 9in.; depth, 6½in., and 5½in. wide; diameter of firebox, 4¼in.; of uptake, 1¼in.; steamchest (which must be fixed with the flange inside shell of boiler), height, 2¼in.; diameter, 2in. (See below.) Firebars, 3in. wide, of ⅛in. iron wire, and long enough to reach to uptake,



where a bridge must be formed to within 1½in. of the crown. Steam-blast to be fixed as shown, with a nozzle just big enough to stick a pin into. A safety-valve is indispensable. A piece of tin or sheet-iron must be fitted into end of flue, and stopped with white-lead. With charcoal and small coal mixed, you can get a splendid fire and plenty of steam. A smaller boiler is utterly useless for a boat of such proportions. Firebox must be fixed ¼in. above the bottom of boiler.—J. H. G.

[46353.] — **Telephone Transmitter and Switch.**—I have found the pantelephone a good transmitter when combined with an induction coil, not without. The hanging plate I have made of pasteboard, also of thin wood, with like results, but have found the best effects when the contacts were of carbon only. I send a rough sketch of the pantelephone I made, showing the induction coil; also a sketch of a very useful switch suitable for



working the four instruments required in successful telephony—viz., the telephone, microphone, bell, and battery. This switch will be found useful to many of your readers, judging from the numerous inquiries on such matters. I have endeavoured to represent all connections, "make and break," as plainly as possible, so that but little description is required. I will first explain the way these instruments are brought into action, and in doing so will add the needful description. To call attention at the distant station, where it is assumed the same kind of instruments are in use, press the button B on switch for a second or two; this breaks contact with C, and makes contact with A. The current now flows from the battery, cell No. 1, through A to D, on to F, then along lever H to its centre, and down to post L, thence to line, and on to distant station, where it rings a bell; then to earth, and back again to central post P on switch, then to cell No. 3, and so completes the circuit. The "call" will be answered by the home bell ringing, produced by the same operation of pressing the button B at the distant station. This sends a current into the line to the home station, which, entering the switch at L, passes upwards to the lever H, along this to F, then to D and C, and upwards to one of the top parts, then out to bell, which it rings in passing, and on to centre post P, and back through earth to distant station, and so again the round is completed. Now remove telephone T from the hook H; the spring S at once lifts up this lever, and through the insulated connection (a silk thread), N, allows the spring G to make contact with J. Contact is also at the same time made by the lever with E, and broken at F. This operation brings the microphone or pantelephone into action. The current now flows from No. 1 cell only, this being sufficient to work the local circuit through the microphone. Its course is through A G J to pantelephone, which it enters at V, then passing by K through the loose carbons M to O; up this it passes by a wire, then down on the other side to the induction coil I, where it flows through the primary wire and back to the same cell No. 1, as shown. The secondary wire terminates in two binding posts shown on the top of the coil. This wire furnishes the current necessary to work the telephones. It starts, say, from the left-hand post and passes to E on switch, then along lever H, now in contact with E, and down to post L, thence through line to distant station, and through its telephone to earth, then back again it hastens to centre post P on home switch, and on through telephone to induction coil, whence it started. I may add that the microphone bell and switch are best combined in one instrument, though I have shown them separately the better to illustrate the action of each.—John C. Frank.

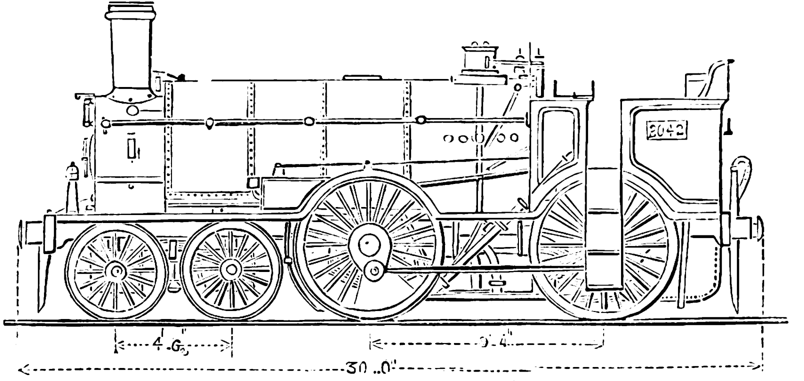
[46373.]—**L.S.W.R. New Coupled 6ft. 6in. Bogie Engines.**—There are twelve engines of this class; the numbers are 136 to 147 inclusive. The reason the numbers are so low is that the new engines have the numbers on them of old engines which have been broken up.—Clyde.

[46376.]—**Weight of "Grosvenor."**—The distribution of weight on the "Grosvenor" is as follows:—

	tons.	cwt.
On the leading-wheels	12	8
,, driving-wheels	15	8
,, trailing-wheels	9	4
Total weight	37	0
On the terriers:—		
On the leading-wheels	8	8
,, driving-wheels	8	12
,, trailing-wheels	8	6
Total weight	25	6

I don't know the weight of the "Grosvenor's" tender, but the wheel-base is—From centre of leading-wheel to centre of middle wheels, 6ft.; from centre of middle wheels to centre of trailers, 6ft.—Spike.

[46395.]—**G. W. R. Engines.**—In reply to "Stentor," I send sketch and chief dimensions of

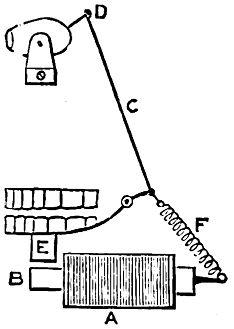


the 2042 class of tank-engines. The engines were built in 1867 by the Vulcan Foundry Co., Warrington, from the designs of Mr. T. Pearson, for the Bristol and Exeter Railway Co. A smaller class of the same type was turned out in 1862 by Bayer, Peacock, and Co.; and a larger type, represented by 2051, came, in 1873, from the Avonside Engine Co., Bristol. No. 2042 was No. 69 of the old B.E.R. Co. These engines have screw reversing gear, and they are fitted with the Saunders ejector for the purpose of creating a vacuum to work the brake on the carriages, but the engine is only fitted with the ordinary hand-brake, with wood blocks. The chief dimensions are as follows:—

	ft.	in.	
Cylinders	17in. × 24in.		
Coupled wheels	5	6	diam.
Bogie ,, ...	3	6	,,
Wheel base coupled	9	4	
,, bogie	4	6½	
Total wheel-base	19	8	
Length over buffers	30	0	
Length of saddle-tank	10	0	
Firebox (length)..........	4	4	
,, (breadth)	5	0	
Depth from crown to bars..	4	8	
Number of tubes	198		
Diam. inside	1¾in.		
Length	10ft. 3in.		

—Clyde.

[46380.]—**Electric Human Skull.**—I inclose sketch how to arrange the electrical part, which I



suppose you know something about. If not, take it to a friend or instrument-maker. A is an electro-magnet; B, pole of ditto: E, armature; F, spring for tension; C, lever for working the eyes; D, joint. A current being passed through A, B will attract E, and lever C moves eyes. If you want the teeth to chattter, place a contact breaker at D.—George Tolman.

[46386.] — **Cold - Air Engine.**—To "Sunlight."—I could not say if you would infringe or not, unless I saw the plans of the proposed motor. The chief cold-air patent is that of Giffard, which is considered a fine invention. But I have no practical experience of it, therefore could only give you a theoretical opinion that it is complicated with stuffing-boxes, and other parts not advisable in a motor of this class. As to a hot-air engine, that is another matter altogether. See my remarks on page 622 on the subject. But as far as I have gone in practice, I may tell you that the hot-air engine, in my opinion, is a far more reliable motor, if viewed from the point of actual use, than the cold-air one, and therefore I should not advise you to trouble yourself with latter.—Sunlight.

[46387.]—**Boiler.**—If an externally-fired one would suit you, and it is easiest arranged to burn coal, the size might be, say, 2ft. 3in. or 2ft. 6in. long, and 8in. to 9in. diam. If set in masonry, the grate should be 9in. by 9in. long, with a flash flue the length of the boiler, so that one-half its diameter is utilised as heating surface.—Sunlight.

[46390.] — **Turning Calender Rolls.** — I presume these rolls, or bowls, as they are sometimes designated, are constructed of paper which has undergone hydraulic pressure. Having an idea that these tools are numerous, and some of them kept secret, it would be more satisfactory to me, and also to "G. H.," to advertise his address. —Pattern Maker.

[46396.]—**To "Aldebaran."**—There are not only more lenses in a terrestrial than in a celestial eyepiece, but the principle is altogether different. In the former an inverted image of the object viewed is thrown directly in front of the first lens of the eyepiece (A, Fig. 1). This image, being considerably within the focus of the lens, causes the emergent rays to be much scattered, and, as will be seen by the sketch, a great portion of them to be wasted

FIG. 1.

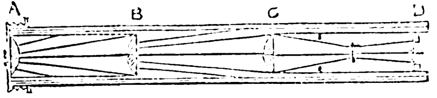
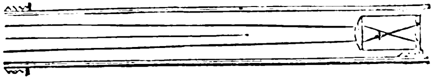


FIG. 2.



(a further loss of light being also caused by reflection from so many surfaces). The rays, after passing through the lens B, are more collected, but still divergent, and it is only when they have been again bent by C that they converge to a focus between C and D, and it is this focus or re-inverted image that, magnified by the eye-lens D, forms the field of view. The lenses B and C are not essential to the formation of an erect image, but are found necessary to correct the spherical aberration which would otherwise result. The magnifying power obtainable by an eyepiece of this description may be increased to an almost unlimited extent by separating the two pairs of lenses; but as such increase of power must always be accompanied by an actual loss of light, it is found preferable, for astronomical purposes, to adopt a modification of the pair next the eye (Fig. 2) known as the negative, or Huyghenian eyepiece, in which the cone of rays from the object-glass is bent to a focus midway between the two, and magnified as before by the eye-lens. An image viewed in this manner is, of course, inverted, but for celestial objects this is rather an advantage, because celestial scenery is usually depicted as it is seen in an inverting telescope.—Aldebaran.

[46397.]—**Slide-Valve.**—"To Sunlight."—The two slides are, next the cylinder itself the main slide, and on the back of that, the second or expansion valve. The main-valve, in this case, is not of the usual shape, but is more like a flat plate of some little thickness. In this thickness is cast through two ports or passages for the steam, and a recess only for the exhaust port; on the back of this main-valve is the expansion one, and it is a plate likewise, but thinner, and with ports cast through to match those in the main-valve. These two parts, sliding one on the other, bring the ports into position, so that at the commencement of the stroke the two ports come fair one with the other over the port that should admit steam to the cylinder. But as the main-valve moves downwards, let us suppose the expansion one is moving upwards, so that the port is closed doubly as quickly as it would be if but one valve was used; therefore by altering the relative position of the expansion-valve, the cut-off is easily caused to take place at the early part of the stroke or not, as the required grade of expansion may be.—Sunlight.

[46400.]—**Winter's Plate Electrical Machine—Coil.**—In reply to this I beg to state that I divided my coil into the three parts for experimental purposes, so that I may examine the effect of the primary on the different parts of the coil, which I can do by means of binding-screws on the different divisions (not shown in Fig.) In the coil I am binding I shall have not less than 150 of these vertical divisions, but of paraffined paper instead of ebonite. I believe you can get better insulation this way, and less liable to injury of coil by striking into the primary. I do not know a good winding apparatus. Mine was a very primitive one, consisting of a solid base and two uprights, to take the core and primary (the core projecting beyond the primary coil). A handle fixed to the core turned it round. I found I could soon wind it on after a little practice with the first two or three layers.—Thos. N. Andrews, Plymouth.

[46405.]—**Stains on Dry-Plate Negatives.**—To remove yellow stains, try soaking the plate in alum, 1oz.; citric acid, 2oz.; water, 1 pint. I doubt whether you will ever bring back your negatives to their original printing quality; you can try the following:—Remove the varnish from the plates and then give them a bath of hypo; now wash well and re-intensify as follows:—Place the negative in a solution of bichloride of mercury till it becomes white, well wash and immerse in water, 1oz.; ammonia, three drops. Leave the plate in the latter solution till it has become almost black, then well wash again. Do not omit to wash well after the mercury solution, or the plate will be spoilt.—H. G. M. Conybeare.

[46406.]—**Rainband Spectroscopy.**—Full particulars of the spectroscope employed for this purpose will be found in the "Plea for the Rainband," which has appeared in *Symons's Meteorological Magazine* (Stanford, Charing-cross), *The Observatory* (Taylor and Francis, Red Lion-court, Fleet-street), and has been noticed in your journal, and a reprint of which, in a pamphlet form can be had of Mr. John Browning, 63, Strand.—J. R. C.

[46415.]—**N.L. Tank Engines.**—I send dimensions of the outside cylinder tank engines, No. 1 class, the first of which came out in 1868. Cylinders, 17 by 24; driving-wheels, 5ft. 6in.; dia. of bogie-wheels, 2ft. 9in.; dia. of boiler (inside), 4ft. 1in.; 200 tubes, 1¾in. dia., ¾in. clearance; bogie-wheels, centre to centre, 5ft. 8in. The bogie-wheels are capable of lateral transverse movement 2in. each way. The boiler-pressure = 160lb; heating surface, 1,015 square feet. Weight in working order:—

	Tons.	cwts.
On bogie-wheels	14	14½
,, driving ,, ...	14	5
,, trailing ,, ...	14	12½
Total	43	12

When the engines came out, the average consumption of coal was 30·28lb. per mile with twelve coaches. The trains may be heavier now. I may add that the dimensions are those of the No. 1 class; I do not know whether they apply to the 70 class, which are of a later date. A sketch of these engines was given in one of the earlier volumes (I believe Vol. X.) I do not know dimensions of the inside cylinder engines; I have only seen them from a distance. Are they not painted black, and numbered from 101—110?—Meteor.

[46419.]—**Telescope.**—To "Aldebaran.—A telescope of the class described by "Wykehamist" ought to make a most excellent astronomical instrument, and as the process of conversion is exceedingly simple, it will be quite worth his while to do so. I should, however, advise him not to interfere with it as a day telescope, but rather to fit to it an additional tube for night work (as shown in Fig. 2, 46396), or if he wished first to test its capabilities as a night glass, he might unscrew the two pairs of lenses from the eye-tube, and replace the one next the eye by a celestial eyepiece such as described on page 608 of last volume.—Aldebaran.

[46424.]—**Circular Saw.**—It has most undoubtedly got buckled. Send it to a saw-fettler's; he will hammer it for you, and in future do not let it run hot, but give your teeth proper clearance, and be careful when filing and setting, and, above all, see that your guide is parallel with your saw.—Pattern Maker.

[46425.]—**Gelatine Emulsion.**—I inadvertently omitted to state the name of the acid in my reply of p. 69. It was *salicylic* acid.—W. J. Bashford.

[46425.]—**Gelatine Emulsion.**—I have kept emulsion for three months by allowing it to set in a bottle, and when set pouring in about ½in. depth of methylated spirit. I have not tried keeping longer. I have not tried keeping without washing. The best way to wash is to press through coarse canvas, when set, into water. The threads of emulsion thus produced should be kept soaking for one or two hours, the water being poured off and fresh added several times.—H. G. M. Conybeare.

[46428 and 46481.]—**Pumping.**—Square the diameter of plunger, multiply by ·7854, and by length of stroke, and divide by 277. This will give you the number of gallons each stroke (if single-acting) if the pump be full.—Stratheden.

[46428.]—**Pumping.**—Supposing the suction-pipe to be of ample size and the water to follow up throughout stroke, the pump would throw 34·28 gallons at each stroke. Thus: Diameter = 1ft. Square this and multiply by ·7854 (1 × 1 × ·7854) = ·7854 sq. ft. area of piston. This, multiplied by the stroke (·7854 × 7) = 5·49 cubic feet as the volume swept by piston at each stroke. As there are 6·235 gallons in a cubic foot of water at 62°, this volume represents (5·49 × 6·235) = 34·28 gallons per stroke, as stated above.—Glatton.

[46431.]—**Worsted and Woollen Yarns.**—A woollen yarn is stretched, not drawn. By this stretching process all the longest fibres take up a position, forming the core of the thread, and the shortest arrange themselves on the outside of this core at right angles to the thread's length. A worsted yarn, on the contrary, is drawn; all the different lengths of fibres are so mixed that no portion of the thickness of the yarn contains more long wool than another; both core and outside are alike as regards their length of staple, and all the fibres lie parallel to the thread's length. The difference between worsted and woollen is, I believe, not generally understood, some thinking that worsted yarn is made from long wool, and woollen from short. The difference is, however, in the construction of the thread, not necessarily in the material from which it is made.—Worsted Spinner.

[46432.]—**Spiral Spring.**—Wind the wire round a steel or iron mandrel whilst soft, carefully keeping the coils even and proper distance apart; or, wind two or three at once, according to the space required; then all you have to do is to wind them close together. I use steel prepared specially for watch and clock work. I temper as follows: (nothing but practice will, however, make you perfect in the art of tempering, and even skilled workmen cannot always get it right): Heat evenly all over to a red heat, taking care not to burn it, and plunge into tallow, lard-oil, or water; when cold, warm it until it will just melt tallow, and cover with same; now place in fire until the tallow takes fire, and burns without assistance from same; withdraw, shake in air and leave until cold. If you harden in water, spring will be harder than in oil or tallow.—C. M. R.

[46433.]—**Potato-Disease.**—To Mr. Adams.—The potash, in the form of kainit, and fine ground and sifted, should be applied in open drills, above the thoroughly-rotted farm-yard manure, along with an equal quantity of the superphosphate of lime. It is advisable to mix these minerals with dry earth or ashes, so as to dilute them, as we do, at least I, spirits with water; because, in their crude form, they have a withering or burning action on the tender rootlets, such as alcohol on the untanned human stomach. The analogy goes no further. The minerals are digestives to the plant; the alcohol, to the extent it burned off in the animal, is a heat producer. If the manure is not well-rotted, it is better to use none, giving, instead, the same money value in ground bones, bone meal.—W. Adam.

[46436.]—**Chemical Balance.**—"Agricola" cannot do better than get one of Becker's No. 27 balances. It can be charged up to 50 grammes in each pan, and is sensible to 1 milligramme. Price £1 11s. 8d. Becker's English agents are Townson and Mercer, 89, Bishopsgate-street, Within, E.C. Alfred W. Soward.

[46436.]—**Chemical Balance.**—The printer must have mistaken the word "grammes" and inserted "grains" instead. A balance carrying 50 grains would only be suitable for assay and blowpipe work. In Griffin's "Chemical Handicraft," second edition, there is a balance figured, No. 426, which carries 50 grains and shows 1 milligramme; it sells under the price mentioned in your query. A very cheap balance, manufactured by Becker, is advertised in the *Chemical News* every week; it carries 30 grammes, and shows ½ milligramme.—Arthur E. Morris.

[46437.]—**Soda-Lime.**—This is prepared by slaking lime with sodic hydrate in the proportions of 1 of lime to 3 of soda, drying in an iron dish, afterwards heating to redness in a clay crucible; the mass is then broken up and preserved from the air. The action soda-lime exerts upon nitrogen is to convert it into ammonia. This can easily be proved by heating an organic compound with a piece of sodic or potassic hydrate; if nitrogen be present it will be recognised by an ammoniacal odour. I have never known soda-lime from one combustion to be used again; should imagine it would be liable to vitiate the results.—Arthur E. Morris.

[46437.]—**Soda-Lime.**—Soda-lime may be prepared thus:—"Take solution of caustic soda, ascertain its specific gravity, weigh out a certain quantity, calculate the weight of the hydrate of soda present, add twice this latter weight of the best quicklime, allow the lime to slake, and then evaporate to dryness in an iron vessel. Heat the residue in an iron or Hessian crucible, keep for some time at a low red heat, break up the lumps, while still warm, in an iron mortar, passing the whole through a sieve with meshes 3mm. wide. Sift again with a mesh 2mm. wide. The grains which remain on the sieve, and the finer portions which pass through, are kept separately in well-closed bottles. *Tests:* Soda-lime must not effervesce too much when treated with dilute hydrochloric acid in excess; but, more particularly, it must not evolve ammonia when mixed with pure sugar and heated to redness. *Uses:* Granulated soda-lime forms an excellent absorbent for carbonic acid; the powder serves for the analysis of nitrogenous organic substances."—(Fresenius.) The use of soda-lime for such analysis depends upon the fact that most nitrogenous organic compounds, when treated with it, evolve ammonia or a compound of ammonia. The carbon of the organic body is oxidised to carbon dioxide at the expense of the soda, the hydrogen of which, being liberated at the same time, combines in the nascent state with the organic nitrogen, forming ammonia thus: $C + 4NaOH = CO_2 + 2Na_2O + 4H$; and $N + H_3 = NH_3$. Soda-lime is used rather than pure soda, because the former does not attack glass, and is not deliquescent. It may in general be used more than once.—Alfred W. Soward.

[46441.—**Vacuum Brakes.**—I think there is a book on the above by Michael Reynolds (Crosby Lockwood and Co.)—G.

[46442.]—**Launch.**—To "Sunlight."—Fig. 1 will give you some idea of the stern tube and the wood bearing on it. You will note that the shaft passes through first a stuffing-box, and then at the other end through the wood bearing. At that end the stern tube is cast with dovetail grooves in it for the length of the bearing. The dovetails slung up at such a height that there is at least a $\frac{1}{4}$in. between them and the shaft. In these grooves are fitted tightly strips of lignum vitæ which are also afterwards bored out so that there is about a 1-16in. play; the action being that the shaft, as it revolves, carries round a film of water, and hence only bears on the wood when at rest. The top edges of the wood packings should also be slightly rounded off so as not to scrape the water film off the shaft, if we may so express it. I should, for a 1$\frac{3}{4}$in. shaft, let the wood bearing be 8in. long. Next, as to the thrust bearing. I am a great believer in making parts adjustable to take up wear. And I designed the form shown at Fig. 2 to comply with that condition. It is as follows:—The length of shaft where the thrust bearing is to be fitted is turned up a little larger than the other part, and is screwed. In your case, I should let this part be screwed to 2in. thread. In the centre where the bearing comes it is, of course, turned down to 1$\frac{3}{4}$, so as to give a plain bearing. The plummer block is fitted with brasses of extra size in the flange, so as to give the surface required, and the faces of the brasses are also faced off carefully, exactly square and true with the shaft aperture. On the thrust shaft then is fitted two discs with bosses—made to screw on the shaft; whilst behind these go a couple of lock nuts. All being prepared, the bosses are screwed up on the shaft, until the brasses are held between them, and when adjusted the lock-nuts prevent their moving. The same oil-cup that feeds the bearing consequently supplies the thrust discs, and as the wear occurs—and it is remarkably little—it can be taken up by moving the discs and lock-nuts, thus allowing of accurate adjustment. With the usual form not unfrequently from the wear of the thrust bearing the crank shaft, as taking a large proportion of the end strain against its brasses. With this arrangement such need never occur, as the wear and length can be adjusted to a fraction. As to your other query—a screw outside the rudder is decidedly bad. In my opinion, wherever practicable, the screw-shaft should even have an outside bearing beyond the screw.—Sunlight.

FIG. 1

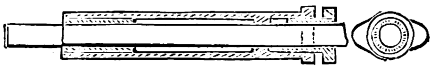
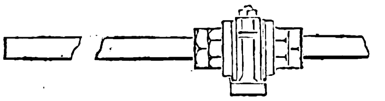


FIG. 2



[46443.]—**French Wire-Gauges.**—There are several French wire-gauges: I subjoin a table of the Limoges gauge, with English equivalents in inches, which I extract from D. K. Clark's "Rules and Tables":—

	Diameter.			Diameter.	
No.	Millimetre.	Inch.	No.	Millimetre.	Inch.
0	·39	·0154	13	1·91	·0752
1	·45	·0177	14	2·02	·0795
2	·56	·0221	15	2·14	·0843
3	·67	·0264	16	2·25	·0886
4	·79	·0311	17	2·84	·112
5	·90	·0354	18	3·40	·134
6	1·01	·0398	19	3·95	·156
7	1·12	·0441	20	4·50	·177
8	1·24	·0488	21	5·10	·201
9	1·35	·0532	22	5·65	·222
10	1·46	·0575	23	6·20	·244
11	1·68	·0661	24	6·80	·268
12	1·80	·0706			

—Glatton.

[46444.]—**Press for Moulding Blocks.**—I know of no press proper used in soap manufacture. There is a "barring and caking machine," however, consisting of a series of wire frames, through which the block of soap is forced, which would, I think, answer your purpose.—Glatton.

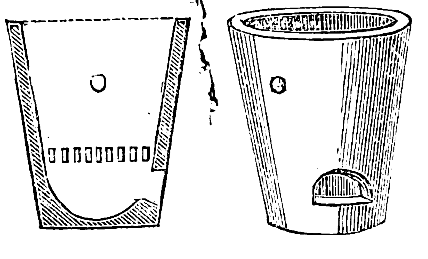
[46446.]—**Soda for Bennett's Battery.**—"W. W. H. G." has apparently purchased caustic potash prepared specially pure "for analysis." What he wants is "commercial caustic soda." I do not know where he can get it in small quantities for 2d. per lb., but have myself bought it at Hopkin and Williams, Cross-street, Hatton-garden, E.C., for about 4d. or 6d. per lb.; I forget the exact figure.—Alfred W. Soward.

[46446.]—**Mr. Bennett's Battery.**—"W. W. H. G." can procure commercial caustic potash from most oilmen for 6d. per lb., which is the price I paid for some. "W. W. H. G.'s" potassic hydroxide is no doubt a tolerably pure sample, quite unlike the dirty, impure lumps commonly known as potash. I set up one cell of Bennett's battery directly after I read of it in the Mechanic; it rings a 2$\frac{1}{2}$in. bell nearly as well as a quart Leclanché. I paraffined the porous cell about one-half from the top, and used an ordinary flat Leclanché zinc plate. The battery is in use, and rings the bell a good many times in the course of the day.—R. Horton.

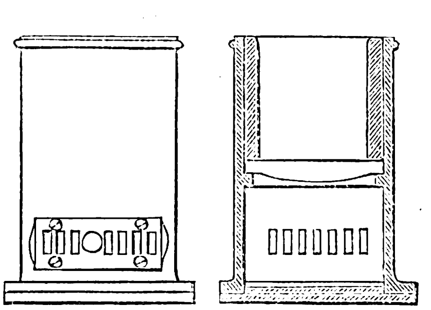
[46452.]—To "**Finem Respice.**"—The small size of camera and Darlot's portrait-lens referred to, would give a very unsatisfactory picture of the scenery named, but if a camera were made the same size as referred to in my later reply (35087, page 402, No. 718), it would answer well with an ordinary landscape-lens, and (though I have not tried it), I fancy the "meniscus" advertised in this paper by Mr. Lancaster for, I think, 5s., would give a very satisfactory picture; perhaps he will supplement this with a few words on it. (2) 1-32nd of an inch is quite thick enough for the size named; if well fitted, it would be light-tight; but in a 5in. one I made, I put a double tube for the front-piece for the back to slide between the tubes, fastening the latter together with solder, and a ring of wire at front end. (3) Darlot's 1in. portrait lenses can be purchased with rack and pinion, but are not fitted with stops. I do not think rack and pinion can be got separately.—Finem Respice.

[46460.]—**Tortoiseshell.**—Boiling would soften the shell, but it would become hard again when cold.—Glatton.

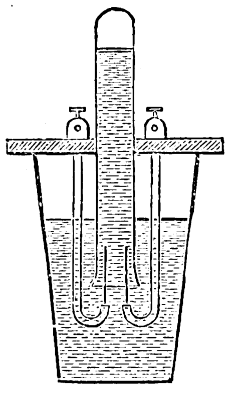
[46461.]—**Charcoal Furnace.**—A simple furnace can easily be constructed out of a black-lead crucible. Procure a crucible about 11 or 12in. high, cut an opening at the bottom of one side, as shown, also two round holes, about an inch in diameter, opposite each other, half-way up the sides; get a small grate, large enough to rest inside, just above the lower opening, and the furnace is complete. The sketch shows it both in perspective and sectional views. Using charcoal with this furnace all the ordinary operations of distillation, crucible work, and heating tubes can be performed. With such a one as just described I have melted silver, using a small ordinary bellows.—Arthur E. Morris.



[46461.]—**Charcoal Furnace.**—As the information may probably be of use to more than the original querist, I send a sketch of a form I designed originally for the use of a large college; it was one of the conditions that it should be of such a form that all necessary patterns should be made by the students, and that the castings should not require to be turned or fitted in any way. As such would, therefore, be similar to the requirements of many amateurs, I venture to crave the necessary space for it. As will be seen, the outside is a cylindrical pillar, with a bend, as a matter of ornament, at top, and a flange at the bottom. Inside there is a projecting ring, as shown in the section, cast in one with the body part. Resting on the ring is the circular firegrate. The upper part is lined with Fletcher's non-conducting composition, which not only keeps the outside cool, but also greatly economises the heat. Air is admitted through a series of vertical slits to the space underneath the grate bars. This was the design as originally proposed, but two further additions have been applied; one is that the air supply is adjustable. And this is done by a casting made to fit the curve of the furnace body, with slits in it that come fair with those in the ash-pit when it is to the extent of its traverse one way, whilst, if pushed the reverse way, the air is entirely cut off. This plate is carried by four screws passing through elongated or slotted holes, and screwing into the furnace-body. I now give form of handle to actuate it with; and a final addition has been made in the shape of a circular casting, as shown, to form a bottom to the ash-pit. It is formed with a slight projection, which, passing into the furnace-body, prevents any chance of slipping off sideways. If any reader would desire to make one, I shall be happy to give further details or information which may be asked.—Sunlight.



[46462.]—**Measurement of Electric Current's Strength.**—The strength of current varies directly as the amount of water it will decompose in a given time. Make a voltameter as follows: take two pieces of guttapercha-covered wire, solder a piece of platinum to one end of each, and with a hot wire spread the guttapercha over the joint, leaving the rest of the pieces of platinum clean; fill a test-tube with water, to which a little sulphuric acid has been added, and suspend it mouth downwards in a tumblerful of the same acidulated water. Bending up the ends of guttapercha-covered wires, insert the plates beneath the test-tube, but take care that they do not touch one another; pass a current from, say, a couple of Grove's cells from one wire to the other, and note how long the top level of water in test-tube takes to fall, say, $\frac{1}{2}$in.; now remove cells, and connect dynamo machine in their place. If the level falls twice as fast as before, the machine gives twice as much current as the two cells, and is equal to (2 × 2) = 4 cells, and so on. This is equally suitable for dynamos giving a continuous current or an alternate one.—Glatton.



[46464.]—**Steel Rails.**—The ordinary weight of rails now used on cross-sleepers is from 75lb. to 85lb. Generally the wedge is placed on the outer side of the line of way, but on some railways it is placed on the inner side. The latter position is to be preferred; for should the wedges from any cause drop out of the chairs, the gauge of the railway, which in that case is determined by the outer jaw of the chair, and not by the key, cannot be deranged by the wheels forcing the rails outwards. Platelayers also, in walking along the line for the purpose of examining the permanent way, can see the keys of both rails at once if they are placed on the inner side. Moreover, if the wedges are on the inner side, the outside jaw of the chair can be carried up well under the shoulder of the rail, and unyielding lateral support be thus given to the rail near its top.—G.

[46469.]—**Toning.**—There is no published mode of toning platinotype prints that is entirely satisfactory; but by modifying the heat of the developer, and especially if the negative be somewhat thin, the print partakes of a brown tint.—W. J. Bashford.

[46473.]—**Pressure of Water.**—The weight of a cubic foot of water at 62° is 62·35lb. The pressure then on a strip 1ft. wide and 8ft. deep varies from 0 to 8 × 62·35 or 498·8lb. per sq. ft. The mean pressure on this imaginary strip is 498·8 / 2 = 249·4lb. As there are 12 of these strips in the width of the gate, the total pressure is (219·4 × 12) = 2292·8lb. At 2ft. from the bottom or 6ft. from surface, the pressure per sq. ft. = 6 × 62·35 = 374·1lb.—Glatton.

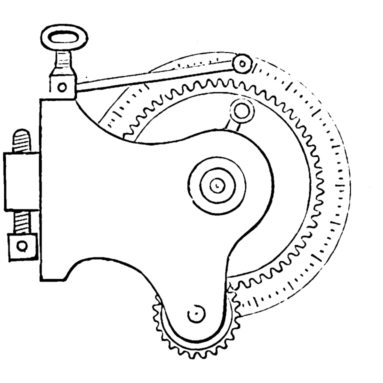
[46475.]—**L. & N. W. Engines.**—Atlas, Nov., 1874; Councillor, Nov., 1861; Wyre, 1878; Simoom, Sept., 1874; Vizier, Aug., 1874; Vulture, Nov., 1878; Viscount, Sept., 1873; Lawrence, Nov., 1880; Medea, May, 1879; Lapwing, Oct., 1878; Arab, Sept., 1874; Python, Oct., 1874. The others I do not know.—Diomed.

[46481.]—**Boiler-Pump.**—I fear that "Slocum Podger" will land rather wide of the mark by doing as he proposes; and even supposing his suggestion was to be followed, would his answer be expressed in gallons, inches, feet, or what? Perhaps the following rule will help him a little; but in addition to the length of stroke and diameter of ram, he will require to find how full the pump is at each stroke. (1.) Find the area of the horizontal section of the pump by multiplying the square of the dia. by ·7854. (2.) Multiply this by the number of inches in stroke. (3.) Multiply this product (2) by the amount the pump is full, and the result will be the quantity of water (in cubic inches) delivered at one stroke. For example: Pump, 2in. dia.; length of stroke, 6in.; pump, three-quarters full at each stroke. $2^2 \times \cdot7854 \times 6 = 18\cdot8496$ cub. in.; $\frac{3}{4} \times 18\cdot8496 = 14\cdot1372$ cub. in., or almost $1\frac{3}{4}$ gills at each stroke.—WAS-HEIL.

[46482.]—**Gregorian or Cassegrain.**—The radius of curve for the concave may be 54in., that of the convex 12in. This combination will have an equivalent focal length of 10ft. 9in.; therefore, with a 1in. eyepiece will be a power of 129, or with a 2in. eyepiece $64\frac{1}{2}$. My experience is that the "Cassegrain" is a most interesting form of instrument, but by no means easy to construct, so if you were about to make a telescope entirely I should say, have a "Newtonian"; but as you appear to have tube stand and adjustments, I see no reason why you should not try to complete it by adding the speculum. I am afraid you will not be satisfied with the performance of spherical curves; if not, you can alter them afterwards when you have more experience; the quickest way of getting a small convex is to buy of an optician a lens of the required radius.—A. N. H.

[46484.]—**Lathe.**—The way I should get over the difficulty you mention would be as follows:—Take off the speed-cone of the headstock, and turn off the edge that goes against the gear-wheel fixed on the mandrel, say $\frac{1}{8}$in., so that, if now replaced, there would be $\frac{1}{8}$in. space between the gear-wheel and the speed-cone. Your lathe being small, it is, no doubt, driven by either a V or round belt, so that you would simply turn away the blank part left at the end of the speed-cone beyond the largest speed. Next, get a piece of hard brass-plate, and fit it to go between the speed-cone and the gear-wheel, fastening it to the latter with screw-pins. It will, therefore, project into the space between the gear-wheel and the shaft over the back-shaft, and by cutting away part of the circular division-plate, the locking-bolt now in use need not be disturbed. You have now only to get the rows of holes drilled, and you are complete. I do not like the plan of clamping the speed-cone to the gear with a nut, as it is likely to slip, and besides, throws great longitudinal strain on the mandrel, which, if small, is sometimes sprung by it, and thrown out of truth.—SUNLIGHT.

[46484.]—**Lathe.**—To "E. F. C."—The best way of fitting division-plate on "E. F. C.'s" lathe



is to put it at the back of front gear-wheel, and let it project as far as there is room between lower edge of gear-wheel and lathe-head casting. The back of gear-wheel will have to be recessed the thickness of plate as far towards centre as the bolt which binds it to pulley will permit, and the pinion which gears with it will also have to be recessed at back, so as not to get foul of division-plate. The plate may be fastened to gear-wheel with either screws or rivets. My own lathe has its division-plate fitted thus, and the plate projects $\frac{1}{2}$in. beyond teeth of wheel, which is sufficient for one row of holes. But by having 360 or 240 holes lined off into tens and fives, it is sufficiently convenient. When using division-plate I always, beforehand, mark off with a white chalk pencil the holes I wish to use, so that I never make a mistake. If "E. F. C.'s" front gear-wheel has a wide enough margin inside teeth, it might be easier to divide it than to have a plate put on. Most certainly 3-16in. would not be sufficient space to put a nut behind pulley. I send a diagram of my arrangement.—F. W. G.

[46485.]—**Pedal Organ, &c.**—The pedals of an organ with one manual are usually made to bring down the keys of the lower or bass portion of the manual. I should decidedly conclude that if a set of pipes were added to an organ of the size you name, they should be of 8ft. pitch, open diapason, metal. If a 16ft. pipe were added, the treble would be overbalanced in an organ containing such a limited number of pipes. If you desire to have a 16ft. pipe on the pedal, it would be advisable to increase the number of pipes on the manual, more particularly in the treble portion.—G. FRYER.

[46489.]—**Bicycle-Making.**—If I was about such a job, I should make the parts a fair fit, and braze only. In some ways a pin would be a help, but if properly done, the brazing should run round in the joint, forming a solid metallic joint, nearly as strong as the iron, and would far rather spend the additional time in making a fair fit for brazing only than the reverse, and use a pin to make good what I knew was bad work in the fitting and brazing. What other parts do you want assistance as to the construction of? If you had gone the right way to work, you should have bought certain parts ready fitted. That is to say, I should buy the hubs in the rough, but all drilled for tapping, &c.—SUNLIGHT.

[46486.]—**Baking.**—A bakery capable of turning out 70,000lb. of bread a week, presupposes the consumption of between 175-80 bags, of 280lb., of flour in the same time. For a business of such magnitude, machinery driven by steam-power should be employed in kneading the dough. The mixing-machines are various in shape, as also are the mixers revolving, some single, some double, inside them. As these are generally known by the name of the makers, it would simply give men who are well able to pay, a gratis advertisement to name any of them. If Mr. [illegible] Washington will advertise his address in this paper, I will send him the names of several makers of baking machinery. The best style of oven depends on the style of bread to be baked in it. As to how heated, Mr. Washington will find in *The Miller* for April a paper from my pen on "Ovens Heated by Gas-Coke," along with working plan and section of a line of three ovens.—W. A. THOMS.

Prof Tyndall on Sound, Light, and Heat.—On Thursday week Prof. Tyndall delivered the second lecture of his course at the Royal Institution. The explanations given by Huyghens of the phenomena of reflection and refraction, as well as of the properties of convergent and divergent lenses had, he said, been fully verified by the progress of time and science. The lecturer showed that there are sound-lenses also, and that the wave theory affords a no less adequate explanation of their properties. He demonstrated by the test of the sensitive flame that cotton net, because porous, transmits waves of sound, while the interposition of a non-porous body leaves the flame unaffected. Just as the passage of light was hindered by clouds, although the air and light of which these are made up were alike transparent, so acoustic clouds obstructed sound. Acoustic clouds consisted of layers of heated air with intermediate layers less heated. The lecturer formed an artificial cloud of the kind, which was shown to intercept sound; the sound was thus thrown back in miniature echoes. Another analogy between light and sound was brought out by comparing the solar spectrum with a scale of notes produced by striking a graduated series of tuning-forks. To illustrate Dr. Wollaston's observation, that certain sounds are inaudible to many ears, Professor Tyndall blew a small whistle, whose low, though shrill, note instantly agitated the sensitive flame, while full half of those present, as a scientist had predicted in conversation with the lecturer beforehand, heard nothing. Resemblances were also pointed out between the absorption of light and that of sound On the sound struck from one tuning-fork being quenched, it was proved to have been not annihilated, but simply absorbed by an adjacent fork. In like manner the yellow ray in the solar spectrum was absorbed by sodium vapour as the metal passed under the eyes of the audience into that form, leaving the place of that colour in the spectrum marked by a black band. Professor Tyndall concluded with an eloquent and generous tribute to the memory of his predecessor in the chair of Natural Philosophy at the Royal Institution at the beginning of our century, Dr. Thomas Young, who not only put into Champollion's hands the key to the Egyptian hieroglyphics, but anticipated by a score of years Fresnel and Arago, as was urged in detail, in placing upon its true scientific basis the undulatory theory of light. The lecturer repeated Young's brilliant demonstration of the fact that the prismatic colours of the soap-bubble are in the exact ratio of the density of the film, ranging from the white light where the cuticle is thickest to the violet ray as it darkens to black just at the bursting point.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last "C. M. R." has replied to 45766; W. Bashford, 45962; W. H. Scriven, 45964.

45792. L. and N.W. New Tank Engines, p. 482.
45796. Snuff Mill, 482.
45799. L. and N.W. Engines, 482.
45809. Lunar Craters 482.
45810. Aperture of Object-Glasses, 482.
45820. Weaving, 483.
45839. Lighting Watchmaker's Shop, 483.

46062. Fireclay, p. 578.
46078. Shrink on Yarn, 578.
46079. Oiled Cloth, 578.
46086. Midland Railway, 578.
46102. Facing Plates, 578.
46105. Power from Falling Weight, 578.
46112. Percussion Action, 579.
46123. Electric Engine, 579.
46131. Sails for Fishing Boats, 579.
46134. Ladd's Dynamo-Machine, 579.

QUERIES.

[46492.]—**Horizontal Winding Engines.**—To "CARINO."—I am about to replace a pair of horizontal winding-engines, cylinders 28in. and 4in. stroke, and the boiler-pressure 60lb. per square inch, and working with slide-valves. Which type or class of valves would you recommend me to put to the new cylinders, as there are winding-engines at the present day working with slide-valves, Cornish, and piston-valves? Please favour me with your views of the object of putting piston-valves to winding-engines, and the durability of the same. Also, what should be the distance of slot-links, and the distance from centre to centre of the same for connecting the eccentric-rods on the same. The throw of the eccentrics is $4\frac{1}{2}$in., and the stroke of the valves $3\frac{3}{4}$in. I am working the above with weigh-shafts and levers, and the slide-valve boxes are on the back end of the cylinders. As I am about to replace the above, would you recommend me to put the nozzles on the side of the cylinders, and the slide-valves midway of the same, and to work them direct from the eccentric-rods, and to have the stroke of the valves equal to the throw of the eccentrics?—S. E. D.

[46493.]—**Lathe.**—I want a treadle-lathe to cut wrought-iron and steel, 1in. × 1in., as quickly as possible. Will "Sunlight" advise as to dia. and weight of fly-wheel, dia. of back-gear, gut or strap? Prefer gap and screwcutting.—LONG TOM.

[46494.]—**Deafness.**—I addressed a query to Dr. Edmunds on this subject, but I presume it escaped his notice. May I draw his attention again to my case?—I am afflicted with deafness of about three years standing, and during that period it has been gradually increasing. A London aural surgeon, after an examination, gave the cause as swelling of the aural tract on both sides. I attended a hospital here for six months; but without benefit. An incision was made into the tympanum, but no beneficial result followed. The medicines that were prescribed were tonics and alteratives; and I was told the cause was chronic inflammation of the tympanum, and an accumulation of mucus. As I derived no benefit from the treatment, I have discontinued attending for about six months; but I find that the deafness is increasing, and have exhausted all the resources for relief in this place. I trust that Dr. Edmunds will please to take notice of this, and reply.—AURIS.

[46495.]—**Silicate Paints.**—Will anyone that has had experience in using the transparent silicate paints for waterproofing porous stone or brick inform me what they think is the best method for applying it, and what they would recommend for stopping the joints, or any other information regarding the same?—M. P.

[46496.]—**Sewers.**—Would "J. C. S. B.," or any other, kindly give me the working, showing how the hydraulic mean depth in a sewer is arrived at? I am in a fix in working out answer to query 45569 in "E. M.," Feb. 17th, to formula—

$$V = 55\sqrt{R \times 2H}.$$

I shall be very thankful for an early answer to the above—SANITARY STUDENT.

[46497.]—**Fortified English Cities.**—I should feel glad if you or any of your readers could give me a little information respecting the towns and cities of England that were formerly fortified or surrounded by walls. We read of the walls of London, Chester, and one or two other places; but what I wish to know is, what other towns were similarly protected, when they were so surrounded, and when were they dismantled? In Leicester, I find there are reminiscences of fortifications by various streets having their names terminate by the word "gate," as Humber-gate, Belgrave-gate, &c.—ANTIQUARY.

[46498.]—**Cement for Glass.**—I am out of employment, and a gentleman has offered me three months' work if I can do it, that is, to fix upon windows glass coloured transparencies. What I want is, a cement to do the same. Will any kind reader oblige with recipe of a cement to fix coloured-glass transparent advertisements: one that will resist the condensation of windows and outside weather.—THOS. GREEN.

[46499.]—**Lathe.**—Having essayed to fit up an amateur lathe, I have bought, as a start, a crank 5ft. 3in long, $1\frac{1}{4}$in. thick, and 3in. throw, and a driving-wheel 2ft. 2in., and three grooves, with a smaller one near the boss. Now the hole in boss of wheel is not large enough to go on end of crank by $\frac{1}{4}$in., and there are transverse half-round notches on the front of boss of wheel, as if to receive studs through arm of crank to keep wheel on.

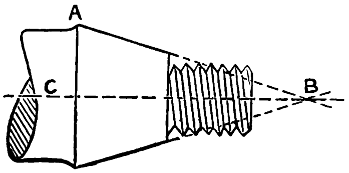
Now, would someone say whether that is the proper way to fix wheel on, or how otherwise? Also, whether my crank should run in metal bearings, or on steel centres? A six years subscriber would be obliged.—J. P. F.

[46500.]—**Cement for Cards.**—Can any correspondent oblige me by giving the composition of the cement used to cement the layers of cloth together in the cards or fillettings used for carding cotton, &c.?—F. L.

[46501.]—**Length of Exposure.**—What length of time should a gelatine plate be exposed when using a small stop on a landscape? Supposing I exposed a plate with full aperture for one second, using a Ross 8×5 lens, what exposure should be given with stop No. 5, and so on, up to No. 1.? I cannot find any instructions on this subject in any book I have seen on photography, and it would be rather an expensive experiment to determine.—Beginner.

[46502.]—**Proportioning Slide-Valves.**—Will some reader illustrate the application of Zeuner's diagram to cases in which there is *negative* inside lap? Also the diagram on p. 537, Vol. XXXIV.—Glatton.

[46503.]—**Jamming of Tapered Journals.**—The figure represents the tapered journal of a lathe mandrel. Assuming the angle of repose of lubricated steel surfaces to be 8°, what should be the taper of mandrel in order that it may be on the point of sticking fast? Should the angle A B C, or the angle A B D, be 8°?—Glatton.



[46504.]—**Air and Steam.**—Two empty vessels fitted with air-tight cocks are filled, one with steam at 248° Fahr., two-atmospheres pressure, and the other vessel is also filled under the same pressure of two atmospheres with hot air, which is also heated up to 248°. The two vessels are connected together by a tube, and the cocks opened. It is supposed that no heat whatever is lost through radiation. 1. What will be the pressure in the vessels after the communication is established? 2. Will there be any condensation of steam? 3. If the mixture of hot air and hot steam at 248° was compressed to, say, one-half or one-third of its volume, would there be any condensation of steam, supposing there is no loss of heat? Kindly explain and oblige—Total Heat.

[46505.]—**Movable Stage for Theatrical Performances.**—What would be the best way to construct a movable stage upon a series of tables as a foundation, but about 18in. higher, in a manner capable of being put together and taken to pieces with the least possible trouble, as it may be required but for one night, but oftener for two or three nights together? therefore, simplicity and strength are the chief points to be borne in mind. Size about 36ft. wide by 24ft. deep; and for convenience of storage, any kind of form or tressels should be dispensed with. If dimensions of the timber recommended, and probable cost could be given, it would be of great assistance to—Platform.

[46506.]—**French Polish.**—Will some correspondent kindly give me a few hints on reviving French-polished work? 1. How am I to repolish scratched furniture? Is it necessary to sandpaper to get the scratches out, and then repolish, when there is a good body on the work? 2. How shall I proceed when patches of polish have been removed, so as to bare the wood? Can I repolish the patches without having to go over the whole? 3. In bodying up work, can I use fine plaster of Paris or precipitated chalk to sprinkle over the work instead of pumice-powder? 4. What is used for the edges of fretwork when the wood has been polished before being cut? At present the edges look as if they were covered with dust.—Amateur Polisher.

[46507.]—**Wax.**—I should be glad if someone would tell me if there is a transparent wax [and if so, how is it made] which could be used for waxing fine-coloured silks without destroying the colours? What wax do anglers use for making artificial flies?—Silk.

[46508.]—**Lime-Burning.**—I have on my farm a quarry, from which we get a stone composed chiefly of small sea-shells, fossilised, which lies in ledges, and is got out with a pickaxe. Now as it is a long way and a bad road to a limekiln, I thought I would try some of our stone in the kitchen fire, which I did, and made very good brown lime, slacking to fine dust; but when made into mortar it did not dry as hard as might be wished, but still it would do. Thinking as we have much heavy land about here, that it would improve it if it was limed, and as it is out of the question to bring lime here, I might make some, I built a kiln to hold about a quarter, intending, if it improved the ground much, to build a larger one. The kiln was connected with the brewhouse chimney, to make a good draught and perfectly airtight. This was carefully filled with stones laid edgeways with coal between (as much coal as stone), with a hole all the way up middle for smoke. When lit, it burnt well—even roasting somewhat; but when emptied next day, the stones would not slack at all, appearing to be only blackened through, though very rotten. Will someone kindly give me assistance?—What are these stones: they appear to have been formed by the sea, as there is a long valley just below where they are found, as if washed out by the sea? I have tested the lime with spirits of salts, and it leaves a small residue. How can I find out what this residue consists of?—as it may be valuable as manure. What is the reason I can make lime in the grate and cannot in the kiln—is it too small? If so, what is the smallest quantity that can be burnt? Was not the heat great enough or not kept up long enough, as it was not burning more than six hours? What degree of heat is necessary, and what shade of redness is it? What proportion of coal does it take to stone? How long should it burn? Also, is there anything I could put with mortar, or do to make it harder? Any advice on above will be thankfully received by—Peter.

[46509.]—**Analysis of Soil.**—Will anyone please give me some plain directions to make a quantitative analysis of soil, and also say of what a good soil should consist? Is there any good work (not expensive) on this subject? I have a fair knowledge of the principles of chemistry; but the books I have on agricultural chemistry say but little on the methods of making analyses.—High Farmer.

[46510.]—**Photography.**—Will Mr. Lancaster, or any other kind friend, please give me instructions for making a very simple and efficient changing-box for dry plates? I want to use it when out landscape taking. All I require is some contrivance whereby I can take out two dozen plates at a time, and change them in the field. If possible, to be used with ordinary dry-plate slides, and have no elaborate mechanism, and be as inexpensive as is consistent with efficiency.—F. C.

[46511.]—**Stains in Dry Plates.**—How can I avoid or remove the dark yellow colour imparted to some negatives by the pyro-developer? I have lately heard that ordinary tin dishes are safe to use for developing in. Can anyone tell me if the chemicals chiefly used for developing have any effect upon tin, or tin upon them? As if not, it would be a very useful article to me to make dishes of for developing?—F. C.

[46512.]—**Boring Horizontal Bars.**—Can any reader inform the inquirer how ash horizontal bars are bored for inserting steel core?—Gymnastic.

[46513.]—**Drill.**—Would "Jack of All Trades" be kind enough to tell me what would be the best kind of drill to bore a ½in. hole 3ft. long in a wrought-iron bar? and oblige—W. G. S.

[46514.]—**Wood Turning.**—Will some correspondent describe a chuck suitable for boring the hollow in a wooden vase? As I am only a beginner in lathe work, a small sketch will oblige—Fond of Woodturning

[46515.]—**Cast Malleable, or Annealed Cast Iron Castings.**—What is the nearest approach to these (for toughness and durability) which can be cast direct from the furnace? Is it possible to mix malleable iron along with the cast-iron, and thus make a tougher and stronger job, and in what proportions should they be mixed? What I want cast is, a number of small hooks, section ½in. × ¼in., weighing each about 1lb.—Iron.

[46516.]—**Caledonian Engines.**—Will "Carstairs" give principal dimensions, dates of original construction, and makers' names of the different classes of tender engines used for passenger traffic on the Caledonian Railway? I observe in a former letter he gives the original Greenock-built engines as having 22in. of a stroke. I am under the impression that their stroke was only 20in. A detailed account of these little engines (should "Carstairs" or anyone be in a position to give it) I am sure would interest many of "ours."—Netherby.

[46517.]—**Preserving Wood Troughs.**—Will any reader kindly tell me of any substance better than paint for preserving wood-troughs 3ft. wide and 6in. deep, to carry waste hot-water?—Painter.

[46518.]—**Cotton Wadding.**—Will any reader kindly inform how to make what is sold in drapers' shops as cotton-wadding?—Painter.

[46519.]—**Kirk's Double-Expansion Compound Engine.**—Will someone explain the principle on which this works? How is it that expansion of steam in two cylinders is more economical than in one?—Shipowner.

[46520.]—**Gas-Engine for Launch.**—I notice in a circular recently issued by "Sunlight," that he says his gas-engine will, when running, by a small additional appliance, produce its own gas. Would not an engine of this sort be the very thing for a launch, as it would be about the same size as an ordinary engine, and would dispense with a boiler and its accompanying troubles? What does "Sunlight" say to this?—Cwmbu.

[46521.]—**Emigration, South Africa.**—I am thinking of going out. I am informed that Dutch is chiefly spoken. Would any kind reader advise a suitable book on that subject? Would a person having a fair knowledge of telegraphy have any difficulty in obtaining employment? Any relative information would be gladly received.—F.

[46522.]—**Oil-Extraction by Carbon Disulphide.**—Would any reader of the Mechanic favour me with a description of the plant most commonly used for the extraction of oil by carbon disulphide; and, if possible, with a diagram? Where can I find articles relating to recent improvements and inventions for the above purpose?—G. D.

[46523.]—**L. & N.W. Engines.**—Will some reader give the dates and sheds of the following engines?—Kestrel, Quail, Crane, Di Vernon, and Redbreast.—Diomed.

[46524.]—**Air Pump.**—I should be glad to know if there is any method of pumping air to a pressure of 15 or 30lb. to the sq. in. by means of water or mercury falling from a height through a tube, after the manner of a Sprengel air-pump? Also, could anyone give me plans or description of such an apparatus, together with a formula for determining the pressure, having the height of the fall?—Robur.

[46525.]—**Botanical.**—Could anyone inform me if there is any way to prevent flowers, such as the white water-lily, and various kinds of leaves, from becoming brown while being pressed for botanical purposes? In *Science Gossip* for last month, a solution of potash-alum is recommended for microscopical purposes. Would this solution prevent flowers and leaves from losing their colour while being pressed previous to mounting? I have tried a mixture of spirits of wine and water; but this does not answer very well. I should be glad to know anyone else's experience on this subject.—Robur.

[46526.]—**Removing Spots from Telescope Glass.**—The spots are of a darkish brown colour, and vary in size to about ⅛in. They are on the side of the glass which is opposite to the eye when viewing anything, and can be seen best by taking the glass out and looking at it sideways. The glass is 2in. in dia., and about ¼in. thick, and is marked "Bardow." As the spots are a great inconvenience when looking at anything, any information how to remove them will oblige—G. H. Corbett.

[46527.]—**Memorandum Tablets.**—Will anyone inform me of the process of coating cardboard with a surface that will take lead-pencil marks and also bear the removal of these marks by water? Tablets of this kind sold are covered with a creamy-white enamel.—Ixion.

[46528.]—**M.R. Locos.**—Can Mr. Stretton or any correspondent say which is the best—to have a bogie in front, or a pair of leading-wheels? Which do the Midland Railway find the best in ordinary working? An answer will oblige—F. C. B.

[46529.]—**Varnish for Violin.**—What should be mixed with fine pale French oil-varnish in order to bring it to the colour usually seen on modern French violins? I believe the cheaper kinds of these instruments are generally stained and then French-polished; but this is not what I require. Is there any dependence to be placed in violin dealers? The recent case of "Hodges *v.* Chanôt" would lead one to doubt it.—War.

[46530.]—**Rotary Water-Motor.**—I have been thinking of making one of these to drive a small lathe. I have a good water-pressure about 60lb. per sq. in.; but I should have to pay the Corporation for use of water, and I want to have a motor which will be most economical with water, and give good power. I think a fan would cause too much waste, and wish to avoid it. Hagg's motor is too dear; so I want to make something simple that will do the work. Can any brother-reader give me help? I can have ½in. or ¾in. pipe.—Bob.

[46531.]—**Yacht Deck.**—Can any person tell me what is the best wood for decking a 20-tonner? I have been advised to use yellow pine. Would not pitch be better? What would be the best size for the planks? What is the best way to fasten down deck?—Yachtsman.

[46532.]—**Confervæ on Portland Cement.**—What is the best way of preventing the growth of confervæ on the Portland cement lining the basin of a fountain containing gold and other fish?—E. M. Holdis.

[46533.]—**Coal-tar Soaps.**—To Dr. Edmunds.—What is the hygienic effect which these soaps produce? I ask, because I understand that, according to some, these soaps act as preservatives against infection, and as specifics in various skin-diseases. My difficulty is: How can soap produce any marked effect, when the greater part must be rubbed off in drying?—Housekeeper.

[46534.]—**Cod-liver Oil.**—To Dr. Edmunds.—I have seen it stated that "light brown" oil is much better than any other; and, on the other hand, have been assured that the cheap oil which is to be had at many fishmongers' is just as useful as the most expensive kinds. Which statement is correct? I have got more good from one bottle of De Jongh's than from a dozen of the other kind. Is this a matter of constitution, or an accident due to my having obtained inferior oil?—Delicate.

[46535.]—**Name of Star.**—In Gall's "People's Atlas of the Stars," there is entered, within the boundary of Cepheus, a fourth-mag. star, to which is assigned the number 4 β. In Mr. Proctor's atlas the same star is included in Ursa Minor, and numbered 2. Is the entry in Gall's atlas an error, or was this star formerly included in Cepheus?—Cepheus.

[46536.]—**Shaft.**—Having occasion to extend, I propose driving a shaft with belt off the main shaft. The main shaft is 10ft. above the other shaft; but I find they are not in line by about 30in. in 25ft. They are perpendicular or cross where I propose to put the belt on. Will the belt work? Perhaps some of your obliging readers can solve my difficulty.—G. O. W.

[46537.]—**Miniature Spectroscope.**—To Mr. Lancaster and Others.—Will you kindly tell me how to make a portable spectroscope which will show the double line D distinctly? Shall I require a compound prism, and is it possible to make one of Canada balsam? The ordinary balsam has a yellowish tinge, and is rather opaque—would it do? I should like a sketch of the arrangement of prisms, &c., inside the tube. The numbers of the "E. M." containing the instructions are out of print—Thylbe.

[46538.]—**Utilising Water-Power.**—To "Sunlight" and Others.—Given a spring running 2½ gallons per minute, fall 42ft. in about 300 yards of 1½in. pipe, what would be the best size for the fan-wheel of motor, speed of same, and diameter of jet? What would be power in foot-pounds per minute? Please give rule, or refer to some book. I have one of Weale's books on turbines, but it does not mention the "Thirlmere" class of motor.—J. Hezmalhalch, jun.

[46539.]—**Water Power and Electric Light.**—To "R. P."—"Sigma" thinks I asked too much in my last query. I, therefore, wish you to kindly read over the query appearing above this, and to give your opinion as to whether there is power enough to maintain one incandescent lamp by the use of a dynamo, with or without storage batteries? What horse-power is necessary for one incandescent lamp? I hope we have not heard the last from Dr. Caplatzi on this subject.—J. Hezmalhalch, jun.

[46540.]—**Infant's Food.**—Will Dr. Edmunds kindly state most suitable food for infant three to four months old in combination with mother's milk? Also, please state if a food composed as follows would assist in forming brain, bone, nerve, and muscle, say, in following proportions?—One part wheat flour, one oatmeal, one arrowroot, pinch of salt, boiled for quarter of an hour in sufficient water to form a jelly, afterwards fresh milk added to thickness of cream. Suggestions will exceedingly oblige—Sigvald.

[46541.]—**Ants in the Garden.**—I reside in Madrid, Spain, and my garden there is infested by ants, which I find most injurious to the plants, grass, &c. I have been recommended and tried a vast number of things to remove them; but without effect. Could you tell me of anything that would remove them altogether?—Negs.

[46542.]—**Broken Steam-Gauge.**—To "Sunlight" and "Jack of All Trades."—I have a steam-gauge. It has on the face, "Bourdon's patent, Schäffer, Budenberg," and the tube inside is split about 1in. down one side. Will you please say how I can mend it, or is it useless? Also, will you please give instructions how to make a mercury-gauge?—Gaugle.

[46543.]—**Executors and Legatees.**—To Mr. F. N. Wetherfield.—Some five years ago a widowed mother died, bequeathing all her property to her two daughters, the younger being then about 18 years of age, and the elder over 21. A distant relative, an uncle, was appointed sole executor, and it was provided in the will that he was to take charge of and be responsible for the younger daughter's half until she became of age. By this time she is, of course, 23 years old, and she cannot get an understanding at all with her uncle about her money; neither can she get him to give it up. About a year ago he gave her a piece of notepaper, signed by himself, saying, that on behalf of her deceased mother he held the amount due to her by the will. What I want to know is—(1) Should anything happen to her uncle, would she get her money? (2) Is the paper he gave her of any legal value? I should state that it is not witnessed by anyone, neither is it stamped. And lastly, what course is best to pursue under the circumstances? She has no brother, and only one sister, and is comparatively helpless.—A Deeply Anxious One.

[46544.]—**Glass rendered Dim by Fumes from Spelter Works.**—The fumes from a spelter works have caused the window-panes of our drawing-office to be covered with a yellowish film of some substance. It requires such scraping with a knife to get it off, that it makes it very laborious. Is there an acid that would remove it?—Engineering Student.

[46545.]—**Purification of Water.**—In last week's *Chemical News* an account is given of the somewhat remarkable results of a new mode of purifying contaminated waters, and rendering them absolutely pure and fit for use. Can any of your chemical readers give any further information on this subject, as to whether it is a secret or a patent, or whether the advantages of so great a boon are possible to be obtained in a locality where the water is far from pure and wholesome?—A. Lloyd.

[46546.]—**Moulds for Glass.**—Can any plastic material, such as fireclay, be used for pressing molten glass, or can any such material be used for backing a thin copper mould?—A. Trotter.

[46547.]—**Jewelry Repairing, &c.**—Will any of "ours," who have been so kind of late in giving us information on all kinds of jewelry repairing, &c., tell me the best way of removing old rivets from brooch joints? Also, how to enlarge holes in new pins, as I find them often much too small, and how to put good point on pin when obliged to shorten? Must I hard solder catch and joint on silver coins for brooches? If so, please tell me the best way, and what solder to use? Also, what kind of joints and catches?—Blue Gown.

[46548.]—**Coned v. Grooved Pulleys.**—Is it correct that round belts running in V-grooves transmit more power than flat ones running on coned pulleys? And if so, why are they not used for heavy machinery? What is the proper angle for V-groove, and should the belt bed to bottom of groove, or not?—M.

[46549.]—**Science Questions.**—Will one of your chemical contributors kindly devote a few leisure minutes to the solution of the following questions in honours?—1. A gaseous mixture consisting of the following constituents: Oxygen, hydrogen, carbonic anhydride, hydrochloric acid, carbonic oxide, and nitrogen. Describe minutely how you would determine quantitatively each of these gases. 2. Required the percentage of strontium in a mixture of the carbonate of strontium and calcium, 1·3332 grams of which yielded on treatment with hydrochloric acid 0·5104 gram of CO_2.—Test Tube.

[46550.]—**Instantaneous Photography.**—Many thanks to "Baboon" and J. Bushford for their replies. In speaking of photographing a train, I meant broadside on, and understood an express had been so taken. How about Mr. Muybridge's galloping horses? Now that you have settled the difficulty of very short exposure, will you kindly tell me if any plate can be made sensitive enough to produce a good negative with only 100th of a second's exposure? I should like to know what plates will do, as I have not been able to obtain a sufficiently-exposed plate, using Swan's 20 times, and taking off the cap and putting on again as quickly as possible? Is any special mode of development used?—F. C.

[46551.]—**Unseasoned Wood.**—Can any of our correspondents furnish a method of testing whether wood is unseasoned or not in furniture, &c.?—G. Fryer.

[46552.]—**Loosening Green Baize.**—How can I get off baize cloth that has been glued on the inside of a desk?—G.

[46553.]—**Riveting Copper Boiler.**—I am making a small riveted copper boiler, and have succeeded in riveting the body of the boiler and one of the ends. My difficulty is, that I see no way by which the rivets joining the other end can be held in place whilst they are hammered. Will some reader give instructions how to proceed? I may mention that the boiler is 7in. × 2½in.—E. Nunn.

[46554.]—**Plumbing.**—To Mr. P. J. Davies.—I want to make an underground brick cistern, lined with lead, for the storage of about 200 gallons of benzoline outside of building, with pipe attached to a beer-engine inside of shop for retailing. Being only an amateur at soldering, I would like some instructions as to the easiest way of making the joints; if round or square cistern is preferable, weight of lead, iron or lead pipe, and the way to proceed to make a good sound job? If not capable of doing it myself, I have a friend, a plumber, who takes great interest in your invaluable articles.—Oilman.

[46555.]—**Induction Coil.**—I have a large coil of the following dimensions:—Tube (ebonite), 20in. long, 2¼in. bore, ¼in. thick; primary, three layers of cotton cd., No. 10 cop. wire, length of core, 18in., length of secondary reel, 13in., all ebonite, divided by ebonite discs into 120 divisions, which are filled with between 6lb. and 7lb. of silk-covered wire, 2lb. of No. 40 in centre discs, and over 2lb. of 36 at each end. Primary and secondary have both been steeped in paraffin; armature on spring, 1in. dia., 1in. long; contact on spring is half between tension-screw and centre of armature. With five small Grove cells I get the following results: Thick spark like flame over 1in.; broken or divided sparks, 4in.; occasionally thick spark goes across 5in., but when I tighten the tension-screw on spring, so that the magnetism of core cannot draw it away, then push it regularly and slowly away with my thumb, I get nearly continuous sparks 5in., and occasionally a spark goes 6in. Now it occurs to me that when it gives 6in. sparks sometimes, that it should give them always. Is that so? Do coils sold as 6in. spark coils give that length of spark occasionally or continuously? If so, where is the fault in my one? I have tried weaker spring with same result. Are these results good for a coil of that size and construction? When sparks are not going across at 5in. and 6in., there is a constant brush discharge.—J. R., Dumfries.

THE "ENGLISH MECHANIC" AND ITS FRIENDS.

Some of our readers, perhaps, never pay much heed to our little notice at the head of this column just at the ending or beginning of a new volume. Many do, however, we are happy to say, and to their efforts, in a great degree, the constant increase in the influence and circulation of "ours" is due. Mr. J. A. Brashear, of Pittsburg, whose valuable letters are familiar to our readers, writes us as follows:—"I write to send you the list of subscribers to English Mechanic for the coming year that I have obtained. As they are mostly scattered over the country, I have not all their money yet, but send you their names, so we will not be late, and will send postal order for them all next week. I will be personally responsible for all. I have more than half of the money, but prefer to send it all at once. I was rather late in commencing, owing to being so busy. There are ten altogether. There are a number of others who will send their own names, whom I have written to, so you see I have been at work for the benefit, not only of you and the journal, but for the benefit of *those who are fortunate enough to get the paper*." Our best thanks are tendered to Mr. Brashear, and our best wishes for a few thousand more readers—each to do his best to send us ten additional subscribers for the volume just commenced.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

GOOD FRIDAY.

The English Mechanic next week will have to go to press some hours earlier than usual, and all *advertisements* for the *next issue* must reach the office by 5 o'clock on TUESDAY, April 4.

The following are the initials, &c., of letters to hand up to Wednesday evening, March 29, and unacknowledged elsewhere:—

J. K. Rutter.—J. H. Harvey.—J. J. Vanstone.—O. H. Cussen and Son.—R. H. Blyth.—J. Munden.—Prof. Cavalier.—Lurgan Mechanics' Institute.—J. H. Huxley.—Vitreus.—Beta.—W. Holmes.—Anxious.—West Yorkshire.—Ouvrier.—Buttershaw.—Elecho.—Plodder.—Metallurgy.—F. Cox.—F. C. S.—Elephant Bill.—W. J. Pollitt.—C. M. T.—W. H. Richmond, Jun.—P. J. Farrelly.—Centaur.—E. B. Fennessy.—J. C. King.—W. H. S.—Crutch.—W. Haines.—D.—Fellow Workman.—F. C. Putley.—C. Cutler.—F. C.—Orderic Vital.—V. Broughton.—Hebe.—R. T. B.—E. Hardcastle.—Summit of England.—F. W. G.

Thos. Neilson. (The variation at Greenwich for this year is 18°20′ W.; in 1816 it was 24°30′ W., the maximum, and in 1976 it will be 0. In 1657 it was 0, so that from true north to extreme west and back to true north will occupy about 320 years, when the same cycle will occur on the E. side of the pole.)—Index. (See pp. 141, 176, last volume.)—F. Nunns. (See p. 237, No. 844; p. 633, No. 789. It is really an old method improved. No injury to the original; copies keep for years.)—A. H. C. (No book on such a subject. See p. 406, No. 823. Any dealer in paint will supply suitable preparations. We think you will find one in Leith.)—Blowpipe. (See the indices of recent volumes—the last for instance.)—T. Hendrey G. Brown. (You do not give the diameter of cylinder. You want to know the proportionate sizes of parts, we presume. 2. Of W. Love, Argyll-street, Glasgow, price 4l.)—Intending Purchaser. (We believe we answered you some weeks ago. It is no part of our province to insert queries asking which is the best machine in the market. Write to some of the Leicester makers, and you will probably obtain a reply.)—A. S. R. (Nothing novel in the principle, and you omit details. How do you propose to work, electrically or mechanically, and by what means? On p. 23 we gave a brief description of such a system, which has been fully worked out. Five minutes' conversation with a lineman would give you an idea of the difficulties.)—W. B. (12s. 6d. post free, bound in cloth.)—Mac. (Rubber solution is the only thing; but it would need securing with wires as well as binding round with tape. Looking at the risk, it is better to have a new one.)—H. Stull. (Apply to the Registrar of the Pharmaceutical Society, 17, Bloomsbury-square, for the pamphlet giving particulars of the examinations.)—E. Baker. (There are many subjects that would bear repeating; but we cannot repeat articles on magic-lantern making at present. See Nos. 605, 608, and 611, in Vol. XXIV.)—H. Marshall. (Can you not send us a description of the plate? It is lettered, and we presume a description is available.)—Pragmatical. (So small a machine is practically useless, though with suitable arrangement it might be made to cause one incandescent lamp to glow, and to produce a feeble arc.)—Novice. (Several advertised. We believe that referred to is Griscom's motor. It is expensive as compared to steam power. Read up recent back numbers, and especially consult p. 356, No. 743.)—Heraclitus. (You can do nothing better than expose the matting to the sunshine.)—Henry Walker. (Use large bichromates, say, a couple of half-gallon jars. Two plates of carbon, one of zinc, placed in saturated solution of bichromate of potash, to which has been added about a tenth of its bulk of sulphuric acid. When the battery fails move the zinc up and down, and subsequently add more acid. See p. 65, No. 731.)—J. R. C., Rock Ferry. (Purely a matter of taste.)—Collodion. (Do you not see that the very fact you mention is a proof that the size, within certain limits, is immaterial? All that is needed is that the wires shall be of soft iron and made up into bundles as round as possible. The actual difference in size in the case cited is ·35 of a millimetre. The length has nothing to do with the matter. Nos. 16 to 22 will do for any length.)—Jno. Browne. (If your connections are properly made, it ought not to "flicker," though we scarcely understand what you mean by the term. No doubt it fluctuates. You will not be able to prevent that.)—Jumbo. (To what do you refer?)—J. H. B. (Yes; a battery will convert it into a motor; but as a generator it would need power to cause the armature to revolve.)—Battery. (Use dilute sulphuric acid, not common salt. It is probably due to crystals forming in the substance of the porous pot and disintegrating it. You should take pot out and soak in water when the battery is out of action. See the indices for many references.)—C. W. Shute. (See p. 630, No. 728, and many other places in back numbers. A series of practical notes on batteries will be found in Vols. XXVIII. and XXIX., fully illustrated. 2. Scour the zinc quite clean by washing in soda solution and rubbing with sand. Dip in a weak solution of sulphuric acid and rub mercury on with a wisp of tow.)—Starlight. (See p. 192, No. 736, for a simple galvanometer; p. 129, No. 707; p. 153, No. 708; or p. 298, No. 610.)—Vega C. (Nothing less than a 6in. in the best atmosphere; probably not less than 7in. Five can be seen with 4in., but the others are only to be picked up by the finest large instruments. You should see the Debilissima with your telescope; but why not look through your back numbers, where all your questions are answered? You should procure Webb's "Celestial Objects." 2. It entirely depends on the experiments which is "best" battery. For the electric light, there is nothing better than the Bunsen; but if you want it only for a few minutes, the bichromate is to be preferred. You will want about 30 quarts; but see Prof. Ayrton's remarks, p. 4.)—C. M. R. (The best way is to get hold of a good textbook, such as Thompson's or Sprague's, if you really wish to study the principles. For many instructions in making and working apparatus, see back volumes.)—A Young Beginner. (See previous answer; or, as you want experiments, get Tyndall's book, which Stanley, Railway-approach, London-bridge, sells, with a collection of apparatus suited to it.)—A Three Years' Subscriber. (See two previous answers. The books you name deal with principles. Several machines of the kind fully described in back numbers. For instance, p. 470, No. 826.)—Ayrshire Lad. (Have you read the contribution on p. 426, No. 850? One lens.)—Scotchman. (About 18s. a week, according to age. Two or three years. Apply to foreman of shed. Not much choice as to line, and most have a number of boys waiting for promotion.)—G. C. M. Hall. (Not yet, we believe. Of the Queen's printers, East Harding-street, E.C.)—James Withers, Jr. (It will certainly be a difficult matter, for the reasons stated: but still you might find some one willing to take you for the one year, and then as an improver. Try the small shops, where they do general repairs. You will learn more in them.)—W. H. Binns. (Do you mean for pictures or cuttings from papers? If the latter, see pp. 153, 178, 203, 278.)—J. M. (Bury them in an iron box containing bone-dust, burnt leather, parings of horse's hoofs, or animal charcoal alone, and keep at a red heat for one or two hours, according to size; then turn out into water.)—Pliant. (Mix the rubber with sulphur in quantity according to the purpose, and then submit to steam heat in a vulcaniser.)—John. (See p. 210, No. 763. Use emery and oil, and run the blades backwards.)—Yoshi. (Described in No. 819, p. 396.)—H. Y. Powell. (We can only repeat our previous answer. We have no space to spare for such queries. See review on p. 582. The theories there mentioned are based on observed facts, and if you have any facts to bring in opposition to them, we might find space for them, but not for the fact that you "feel misgivings" You say "it seems improbable" that the entire globe weighs "more than twice that of granite," but you do not tell us what is the weight of a cubic foot of granite 20 miles beneath the surface. As to the other query, we say that the error is slight compared with the enormous difficulty of assigning any distance at all, and ask again, What has it to do with eclipses or the periods of comets? You have read your elementary books to little purpose.)—

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

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FRIDAY, APRIL 7, 1882.

ELECTRIC INCANDESCENT LAMPS.

JUDGING from the numbers of incandescent lamps which are now made every week, it is evident there must either be a very great demand for them or they must be very short-lived, for, if rumour is to be credited, one factory alone is turning them out at the rate of several thousands a week. There are at present five competing patterns, which differ from one another only in details, though some of them are very important, while others are mere matters of choice. From time to time we have given particulars of the various patents which have been taken out in connection with the "bridges" or threads of carbon which form the incandescent medium, and the method of preparing which seems to be the only real point of novelty in connection with the lamps. The early experimenters speedily discovered that even with a so-called perfect vacuum the carbon filament rapidly gave out, owing to the gases occluded in the pores of the carbon, and whilst some sought for special fibres, others endeavoured to so prepare the better-known materials as to overcome this difficulty. Hence, while Edison has, according to rumour, scoured the world and settled upon bamboo fibre, others have contented themselves with more easily-obtained materials, and have endeavoured to prepare what is needed by treating ordinary substances in such a manner as to render them practically homogeneous. Without attempting to give the dimensions of the outer shells of the lamps, which are really of no particular moment, it will suffice to say that they all consist of oval or globular glass envelopes, with more or less elongated stems, and a tubulure at the other end which is left for connecting with the vacuum-pump. The carbon thread, mounted with its wires in the stem-block, is passed into the shell and hermetically sealed by melting the glass around it, and the "lamp" is then placed in the vacuum-pump and submitted to the special treatment which the rival inventors or patentees favour. In Edison's case the thread is raised by degrees to a high state of incandescence while in the "pump," cooling being allowed after each passage of the current. By this means the occluded gases are believed to be eliminated, and certainly the fibres are submitted to a greater trial than they will experience in their future life as lamps. Of course, many of them fail, but the process secures the survival of the fittest, for it is only those which stand the test that are finally sealed up as practically perfect. Other inventors prefer to submit their carbon threads to a high heat in the presence of hydrocarbons, by which means they fill up the pores of the fibre with carbonaceous matter, and make the threads nearly or, it may be, perfectly homogeneous. In any case the final exhaustion is carried as far as possible before the lamp is sealed and passed as ready for use. At the Crystal Palace five different patterns are shown: the Swan (the earliest), Edison's, Maxim's, Lane-Fox's, and the British, and in appearance there is little to choose between them. The real test of superiority is, of course, durability, and of that we have no particulars, save that while at first the life of the lamps was reckoned only in hundreds of hours, it is now reckoned by thousands. Just as in the arc lights, the positive carbon wastes more rapidly than the negative, so in the incandescent threads it is found that there is a transference of carbon from one end of the bridge to the other, and although in the newer devices this defect has been partially remedied by making the thread thicker at the negative end than at the positive, it is obvious that it practically determines the life of the thread, which sooner or later must give out. We hear of threads lasting 4,000 hours, and even longer, which, for practical purposes, means a year of lighting without requiring new lamps; but we imagine that in making an estimate it would be preferable to reckon the life of a lamp at 2,000 hours, which will probably cover contingencies. Besides the carbon thread itself, an important point is the means of connecting it with the wires, and here we find the chief divergence between the different systems; for while Edison prefers, or, at any rate, uses platinum junctions coated with copper, Lane-Fox coats the ends of his filaments with platinum, and dips them into globules of mercury. Maxim's, Swan's, and the British, all use platinum connections slightly varied. For the filament itself, Lane-Fox uses the fibre familiar to housekeepers as bass-broom, the British Company use cocoa-nut fibre, Maxim and Swan prefer paper, cardboard, or cotton, and Edison, as mentioned above, bamboo. The latter, in fact, professes to have tried all sorts of substances, and to have found in certain species of bamboo just the kind of fibre he requires, both for uniformity of substance and for the facility with which it lends itself to the necessary manipulations. On page 462, Vol. XXXIV., we illustrated and described Edison's latest method of making and arranging incandescent lamps, and it will be sufficient to say here that the bamboo canes are first cut into lengths, then split through the centre, and each half further divided into three. The hard flinty shell is then removed, and the pieces planed down to uniform thickness, when they are placed between metal blocks and subjected to forcible compression, leaving the press as fine threads of bamboo with thick ends. They are then ready for the most important stage in their preparation. This consists in bending them to the required shape by forcing them into grooves in a nickel plate, which is then covered by another plate of the same metal, and the two being clamped tightly together, are raised to a red heat in a furnace. The filaments are thus carbonised, and are attached to the platinum wires in the glass foot or stopper of the lamp (see p. 462, Vol. XXXIV.) by a copper film deposited by electrolysis. The foot being blown into the lamp, the latter is put in the pump, and while the exhaustion is being carried on a current is sent through the bridge of bamboo fibre, which is allowed to cool down several times, while it is raised by degrees to the highest state of incandescence. It is believed that by this means the occluded gases are completely eliminated, but other researches have shown that it is extremely doubtful whether any natural fibre or other form of carbon can be altogether freed from hydrogen, and Mr. Edison acknowledges that, in the present state of the art, it is impossible to construct a lamp which shall have an indefinite duration so far as the carbon thread is concerned. The vacuum in the lamps is produced with ease by means of a modification of Sprengel's pump, a tube being left projecting from the top of the shell, which is connected to the pump-tube. The required vacuum having been produced, the tube is sealed near the joint with the pump, and the lamp being thus separated, the final closure of the shell is made in the form of a bulb fused on the end of the tube, which in the finished state is little more than a projection from the surface of the shell. The lamps hitherto shown by Edison are pear-shaped, but other forms have been made, that most liked by the inventor being a cylinder with rounded ends. In all, however, the finishing or connecting terminal is a screwed piece in which the platinum wires are secured respectively to a screw and a cone in thin brass (the latest are of thin copper), which are insulated from each other by plaster of Paris. The socket, which has the "lead" and return similarly connected to a cone and a female screw, thus makes perfect metallic contact with the lamp as soon as the latter is screwed home. The details of this arrangement have been modified in some specimens, but in principle they are the same. The large-sized lamps have a resistance when hot, of 130 or 140 ohms; the smaller or 8-candle half-lamps, as they are termed, have a resistance of about 80 ohms.

The description above given of the manufacture of the carbon filaments applies with some alteration of detail to all the lamps mentioned; but all the inventors have not been so successful in devising an easy means of securing perfect connection with the main lead and return. Edison uses a filament with a plain bend, Maxim bends it twice on itself so that it represents the letter M, and Swan, as we have previously shown, uses either plain loops or coils. The Maxim lamp is fitted into a socket containing two insulated springs as terminals to the conducting wires, so that perfect contact is maintained by their pressure. These details, which are really of considerable importance, will no doubt be improved; but at present the plan adopted by Mr. Edison is by a long way the most simple as well as efficient. The arrangements for turning out a lamp are practically the same in principle and can be readily understood. The tap, which resembles nothing so much as a gas-tap, in one position is in contact with the lead, lamp, and return, and in the other with only the lead and return, so that no current passes through the lamp when the tap is turned sufficiently to break the circuit with the lamp. Edison uses a split cone, which is, by means of a quick screw-thread on the tap, drawn into connection with two metal blocks, to which the wires are secured. In these simpler arrangements it will be understood that the light given by the lamp depends on the machine generating the current; there is no means of reducing it by turning the tap, which, as before explained, either makes or breaks circuit; but amongst Mr. Edison's devices there is one by means of which the amount of light can be regulated within certain limits. That he accomplishes by means of a rheostat composed of a number of vertical rods of carbon, resembling an elongated lantern-pinion. By turning the base of the box the resistance offered to the passage of the current can be increased or diminished, and within those limits the intensity of the incandescence of the carbon filament can be regulated. The display of incandescent lamps at the Crystal Palace, the steadiness which is their peculiar property, as compared with the arc lights, and the facility with which they lend themselves to all purposes of domestic lighting, have made them the popular favourites; and, we understand, that one factory is selling them at the rate of several thousands a week. The duration of any of these lamps is determined practically by the durability of the carbon filament, though occasionally the glass envelope fractures; but the problem to be solved is the possibility of so preparing the threads and so shaping them that they may have an indefinite life, for it is

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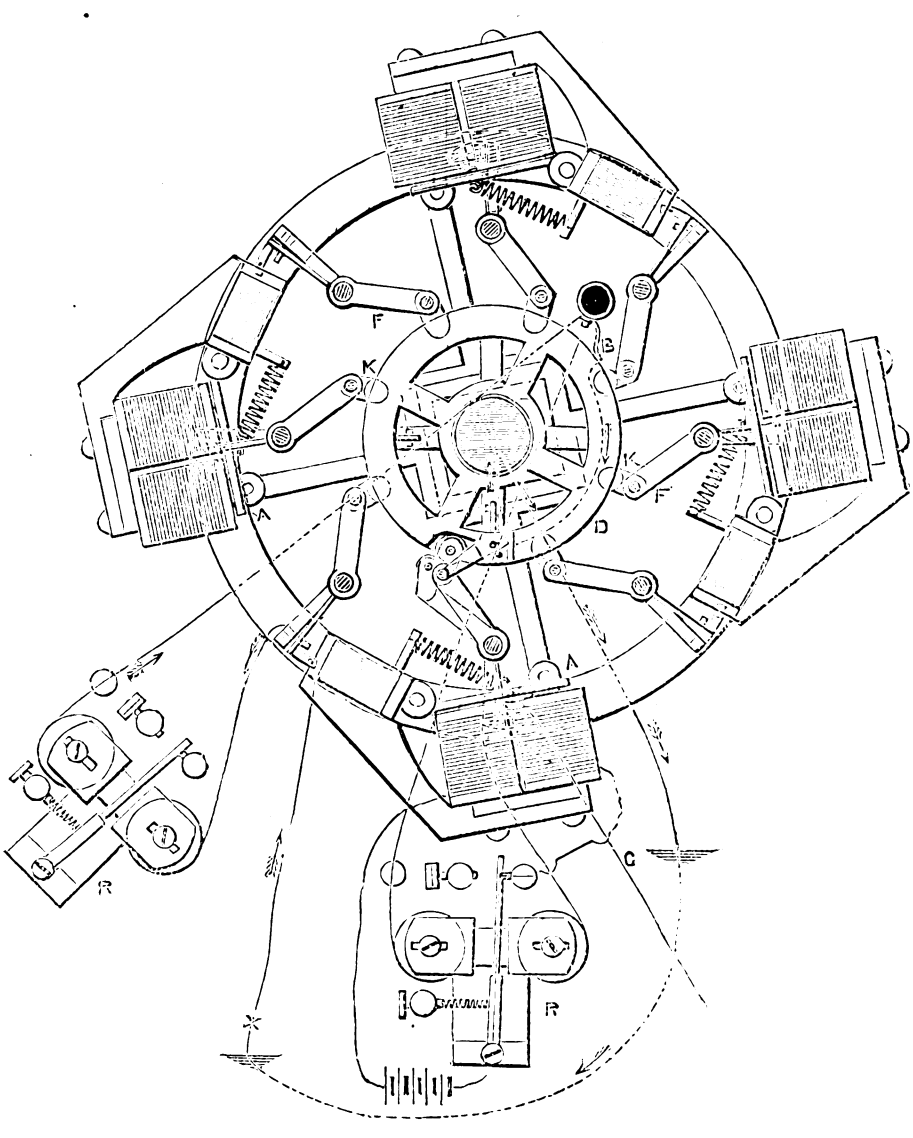
clear that if any serious expense is incurred in replacing broken or worn-out lamps, the incandescent system, already more expensive, from the photometric point of view, than the arc lights, will be severely handicapped. That many inventors are turning their attention to the production of superior carbons, our columns testify, and probably in some such direction as that taken by Mr. Crookes (see p. 247, Vol. XXXIV.), the greatest measure of success will be attained.

TELEPHONE EXCHANGE APPARATUS.

THE Telephone Exchanges have scarcely done more than elaborate, and make fairly complete, the systems of switching for use in central stations, before an ingenious inventor comes forward and provides an arrrangement by which any subscriber can connect his telephone with that of any other member of the exchange by means of an automatic instrument in the central office, thus dispensing with the services of an attendant. This apparatus has been patented by Mr. T. A. Connolly, of Washington, and has been recently patented in this country as well as elsewhere. To give a full idea of the various ways in which the invention can be worked would occupy more space than we can spare, but with the assistance of the annexed engraving we shall probably be enabled to render the principal features clear. The apparatus at the central station is of an upright cylindrical form carried on a base with the binding posts to which the various line wires are attached. The engraving is a horizontal section, showing, as if they were on one plane, the electro-magnets, the pivoted armatures of which are connected to escapements or ratchet and pawl devices, for converting the motions of the armatures into the rotary motion of a ratchet wheel. The magnets are really in separate planes or tiers as we may say; they receive current from the central battery, and normally the circuits are open. The closing of these circuits is effected by means of relays R in the normal circuits of the subscribers' or members' lines; these relays are responsive to the impulses transmitted from the subscribers' stations, hence each pulsation of an armature A is in keeping or correspondence with that of its relay. These relays are polarised, and preferably of the form known as "Siemens'," and are adapted to close the circuit of the magnets when the current which energises the said relay is passing in one direction. The current in the reverse direction may be utilised for signalling purposes without effecting any operation of the central machine. The magnets and their ratchet appliances are employed to effect the rotation of the rings or wheels D, one of which is allotted to each line. In addition to a ring each line possesses a "contact bar" or frame F; these frames are pivoted either inside or outside the ring, or outside of the wheel; they are arranged at regular intervals around the rings, and are parallel with the axis thereof. Each bar traverses the whole series of rings, so that all the rings have a similar relation to each and every frame. A connection of any two lines is effected through the ring of the operating or calling line and the contact bar or frame of the called line; for this purpose each ring is furnished with a coupling or connecting device, which in the arrangement under consideration consists of a "tripper" or toggle lever; this lever, as a ring D rotates, comes in contact with the several frames, and rotates the same on their shafts or bearings; at the same time the tripper or toggle, which is normally tangential or inclined with reference to the periphery of the ring, assumes a different position, that is to say, it straightens out, and if then the movement of the ring is discontinued, the tripper and frame remain in their conjointly assumed positions. The object of moving the frame is to isolate it, so that when engaged by a line no other line can obtain connection with it; for this purpose the conditions are such that in its normal position the outer end or head of the tripper does not project sufficiently far beyond the ring or wheel to touch the frame or contact bar when moved or turned by an engaged tripper or toggle.

A line when not in use, or when employed in effecting connection with another, completes its circuit to earth, or to a common ground or return through its tripper or toggle. When engagement is made with a line, this ground or earth connection is broken by the movement of the tripper under the toggle action of a frame or contact bar, and the circuit is completed through the line in which the frame is located. Speaking more specifically, each ring or wheel consists of two plates or rings of metal separated by an insulating filling; the lower plate is in constant contact with the frame of the central machine which communicates with earth, or return, either through supporting rollers if a hollow ring is used, or through a central shaft if a wheel with spokes is employed.



The tripper or toggle lever consists of a finger pivoted to the upper plate of the ring or wheel, and formed with a shoulder abutting against a stop, which limits its movement in one direction, and against which the tripper is held in impingement when not engaging with a contact frame by an easily yielding spring. A spring tail piece or continuation of the tripper or toggle impinges against a bent metal pin, stud, or block extending upward from the lower plate of the wheel or ring, and travels thereon during a portion of the movement of the tripper on its pivot. Thus the operating line which leads into the upper plate and thence to the tripper or toggle makes ground through the said pin, stud, or block, until in engaging with a contact frame such ground connection or contact is broken by the tail-piece leaving the same, when the circuit is diverted into the contact frame to be thence led to the line thereof. As above stated, the tripper or toggle lies normally in an oblique or tangential position, as shown; its outer end is formed with a slight concavity or recess, by which a contact frame in its path is caught and held in effecting and maintaining engagement therewith. As the tripper passes each unoccupied contact frame, momentary engagement and conjoint movement ensue, and the diversion of the circuit from central ground to the line of the engaged frame follows. The circuit or contact is made with the ring from the line thereof by means of a brush or rubber B in the path of the same line insulated from the main frame. A wire leading from the said brush connects with a binding post or cup to which is led a return wire from the relay of the same line. The main line wire G from a station leads to connections in the central machine, thence to the relay, and from the relay by the return wire to the binding post. This circuitous path is provided in order that the relay of a called or passive line may be cut out, so as to reduce resistance, but principally to prevent such relay from being operated by the current of the operating line. Thus when a contact frame is engaged, the circuit with its line is made directly from the outer segment to the line without passing through the relay, the latter being in the branch circuit connected permanently with the inner or shorter segment. It has been explained that when a contact frame is swung out to its limit and engaged by a toggle or tripper, the toggle or tripper of another line will pass by without coming into contact therewith, thus preventing disturbance of the communication through the frame of the called line. Engagement, however, with the frame of an operating line is not thus provided against, but such provision is necessary to prevent the operating line from being broken. For this purpose each contact frame is furnished with an arm K supporting an anti-friction roller, which rides on the periphery of the insulated filling of the ring of the same line. A cam recess in the said filling adjacent to the tripper receives the said roller when the ring is home, but as the latter begins to move the roller is pressed outward to the periphery of the insulated filling. By this operation the contact frame of the operating line is swung on its pivotal points sufficiently to avoid the contact of the passing trippers, but not far enough to break the circuit through the segments. It is, therefore, only when a line is at home that its contact frame can be caught. The term "home" is used to indicate the normal position of the tripper, that is to say, the position it occupies when it coincides with the contact-frame of the line to which it belongs or pertains. A contact frame, however, is not to be pushed out by its own line tripper, otherwise the tripper of another line could not engage it. To avoid such a difficulty each contact-bar is notched or recessed at a point opposite or on the plane of its line tripper, so that when the latter is home it projects into the notch or recess and does not touch the bar.

The operations of the central line connecting apparatus are responsive to electrical impulses sent over the lines from the local or subscribers' stations. These impulses are produced by the intermittent closing of a normally open battery circuit which correspondingly closes the relay at the central machine, and thus brings into action the power whereby the mechanical switching operations are performed. Each local or subscriber's station for this purpose is furnished with an independent battery or generator which has one pole grounded or in connection with a return common to all the lines. The local subscribers' station apparatus for giving control of the central devices pertaining to a given line are for convenience enclosed in a case to which are connected the necessary devices pertaining to the usual telephonic transmitter and receiver. From the battery the line and ground conductors lead to a reversing key, which is carried by a toothed disc or wheel, whose teeth correspond in number with the number of impulses necessary to effect a complete revolution at the central machine of the carrier of a contact making finger or tripper. The said disc or wheel is caused to rotate by suitable clockwork mechanism, and its teeth successively pass a contact-making spring or arm which completes or closes the open line circuit, and sends an impulse through.

The disc or wheel is covered by a dial, upon which the several lines of the exchange are indicated by suitable numbers or letters at regular intervals completing the circle. Holes are bored through this dial in coincidence with the said numbers or letters for the reception of a transferable plug. A stud on the disc or wheel comes in contact with this pin on open circuit, and arrests the movement of the wheel at any given number opposite the pin, whereupon the operations of the devices pertaining to the operating line at the central apparatus cease, the operating line being then in coincidence and circuit with the line at whose number or letter the pin is placed.

To provide for a reversal of the current after such circuiting has been effected, the line and ground wires from the local station battery lead to the reversing key through brushes touching insulated collars on the disc-shaft, which collars communicate with the terminals or contact points of the reversing key. The latter has an elongated arm, which, as the disc comes to a stop, touches and bears against the pin when the same is at any but its home position. Under such conditions the direction of the current while the disc is rotating is such as will effect the operation of the relay, but when the arm of the reversing key strikes the pin the direction of the current is reversed. The hole for the reception of the pin when at home, that is, at the number on the disc or dial of the station to which it belongs, is out of the circle of the other holes. Hence when the disc arrives home the arm of the reversing key does not strike the pin, so that no reversal takes place. The object of the reversal is to provide for calling a distant station by an operating line without operating the relay of the latter. This calling is performed under the reversed currents by means of a circuit-closing key or push in a branch or shunt line which is normally open. Now when a line is at "home" and a pin in a "home" position it is in a condition to be called, but at no other time is it in such condition. Then when a calling current is received, the relay of the called line is cut out, as previously explained, so that the calling current cannot affect it as it otherwise would, the direction being suited to such operation. Having been called, a call is returned from a distant station by simply pressing the push button at the latter. The return call current is then in the normal direction, that is to say, in the direction under which the called line relay would operate were it in circuit, but it is the reverse direction relatively to the relay of the calling line, or in the same direction as the calling current of the latter, and hence has no effect on the relay. This automatic method of reversing the current is desirable, so as to obviate the possibility of mistake in making and returning calls growing out of the necessity of calling up a line and returning a call, of having the currents in the same direction, notwithstanding the peculiar relations of the two lines, the one operating and the other passive. But for such automatic contrivance relieving the callers of the necessity of exercising selection in manipulating their calls, it would be necessary to provide an independent reversing key which the caller would have to shift after obtaining a line while the person called must leave it alone. In this case, if the caller were to accidentally or inadvertantly omit such shifting he would operate his relay, while if the called subscriber should shift his reversing key he would also operate the caller's relay, and so destroy the conditions obtained at the central apparatus as well as the unison of the local indicators and the central devices. The machine is practically a combination of devices through which electrical circuits are determined and produced, and such circuits may be used either for telephonic or telegraphic purposes. The only requirement when the machine is used for telegraphic purposes is that the signals shall be sent by currents running in one direction only, so that such signals shall not affect the polarised relays.

WATCH-CLEANING AND REPAIRING.

By "A Fellow-Workman."

(*Continued from page* 74.)

FIG. 30 is the clickwire fitted in the pinvice so that you can see how the pivot is got. B is the *dog*, and A is the tail of click, which should rest against the outside of the countersink in fuse-wheel. The square will sometimes get worn so small that a key soon gets worn out.

FIG. 30.

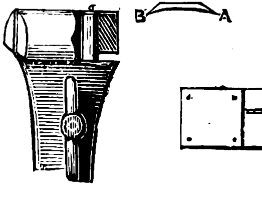


FIG. 31.

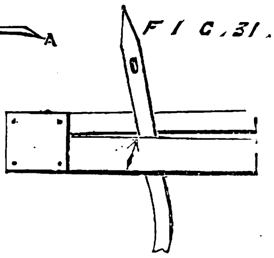


FIG. 33.

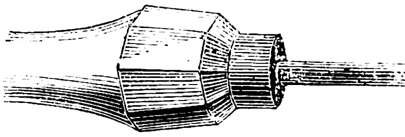


FIG. 32.

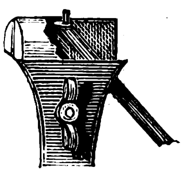


FIG. 34.

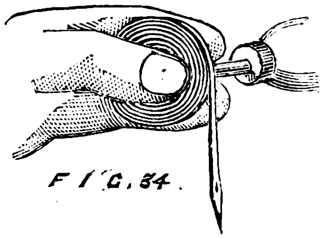
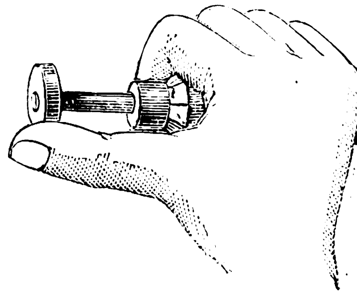


FIG. 35.



The easiest way that I know of to repair it is to file it up square, fit on the pipe of a watch-key, soft solder it on; put on a brass rose to protect pivot while you fill up square. To get a square you must take your pinvice as a guide.

Barrel.—The holes of the barrel in old watches sometimes get worn; you can make them smaller by punching round the hole on the inside, and then rimer them out with a round rimer. If you have a proper turn, you can fit a new bush.

Mainspring.—When a mainspring breaks, the barrel reverses; this generally unhooks the chain, which is almost a sure sign. If it breaks on the outside coil, the watch will sometimes go for two or three hours. This will sometimes deceive you: when a watch is brought to be repaired, you will think it wants cleaning. You can generally find out, by poking the barrel to see what strength the spring has got. Select a mainspring as near like the old one as you can. Some jobbers tell the strength by laying the spring on the first and second finger, and pressing their thumb on the middle, having the old one in one hand and the new one in the other. Then they reverse them. A gauge is easily made by two pieces of brass being riveted and soldered together (Fig. 31). First get width with your callipers, then thickness with Fig. 31. Having selected your spring, get length by old one; soften the outside end about an inch, file it, and make it weaker. Now taper the end and punch for rivet (see Fig. 31); now file up a piece of soft steel wire, size of hole in barrel; cut off inside after allowing for rivet; then place it in your pinvice and file up as shown (Fig. 32). Chamfer the inside of the hole in the spring; now place rivet in the vice. Put the spring on it; see that you have got it the right way; now with a small hammer keep tapping round the outside of the rivet. Don't touch the middle. As soon as it gets oval, file it flat. In this way you will make a good strong rivet. Leave it a *little* oval at the finish as a support to the outside; now cut off about the length required for the barrel—you can measure from the outside; file it level and polish the end. You can buy a mainspring winder for about 1s. 6d., but you can make a simple one (Fig. 33). Place the spring between your fingers, as shown in Fig. 34; put the winder between your fingers; when you have got it wound up, place your thumb upon it as shown (Fig. 35); pick up your barrel and put in spring. If you can't do it this way, you can do it by putting the outside end in its place in the barrel, and work it in, coil after coil; but this way will sometimes break highly-tempered springs.

(*To be continued.*

THE APPLICATIONS OF ELECTRICITY.*

I WILL endeavour, in two lectures, to review the principal applications of electricity, which you have seen working in the recent remarkable exhibition of the Palais d'Industrie. From a practical point of view we may divide electricity in two chapters: statical electricity, which is produced by friction; and dynamical electricity, which is obobtained by chemical or by magnetical action. Statical electricity has so very few applications that I may almost pass it over in silence. I will only remind you that the old-fashioned frictional machines are now superseded by dielectric machines, such as Holtz's and Carre's. At the exhibition you may have noticed machines with several dozen plates turning simultaneously, and giving very powerful effects.

We will at once turn our attention to voltaic or dynamical electricity, which has received an endless number of applications, among the most important of which are telegraphy, telephony, and galvanoplasty, which will form the subject of my first lecture.

The source of electricity generally used in these branches of the science is chemical action. You remember that Volta's pile was composed of rounds of copper, wet cloth, and zinc, always piled up in the same order; a short time afterwards he arranged plates of copper and zinc is glass cells, containing water acidulated with sulphuric acid, and connecting the copper of one cell to the zinc of the other by a wire. When the two extremities of such an arrangement are put into communication by a conductor such as a copper wire, a current of electricity flows from the copper or positive pole to the zinc or negative pole. You will not have omitted to notice the interesting collection of these piles and batteries in the retrospective part of the exhibition. The strength of these batteries very soon falls, on account of the hydrogen which goes to the copper plate. In order to avoid this, Daniell placed the copper in a solution of sulphate of copper contained in a porous cell. By this means the hydrogen could not reach the copper; but reduced the metallic solution, and precipitated copper on the positive copper pole. This battery, and various modifications of it, are much employed where constancy is required. Bunsen absorbed the hydrogen by nitric acid, and formed a stronger, but less constant, battery.

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* Lectures delivered by C. Detaille, at the Palais du Trocadéro, Paris.

In the Leclanché battery the carbon is inclosed in a mixture of carbon and manganese dioxide. In the new form of the cell, of which we have here a battery constructed by M. Barbier, the porous cell is done away with, and replaced by plates of the agglomerated mixture of carbon and black oxide of manganese on each side of the positive plate.

Having reviewed the chief kinds of batteries, let us now examine and apply the properties of the electric current. We have here a long strip of steel, magnetised and freely suspended by a silk thread. When left to itself it takes a fixed direction, and points in the magnetic meridian—*i.e*, nearly north and south. Let us now take this wire in which the current flows, and approach it to the suspended needle; you at once observe a deflection, either to the right or to the left, according to the sense of the current. This simple experiment at once leads us to Wheatstone's single-needle telegraph, which is not used in France, but is much employed in England. It simply consists of a magnetic needle, which may be deflected either to the right or to the left by a current flowing in a coil of wire. The alphabet is spelt out by the deflections of this needle. Thus, if we wish to send the letter F we send the needle twice to the left, once to the right, and once again to the left; for the letter T we send it once to the right, and so forth. This telegraph is very simple, but requires much practice for sending and receiving quickly. Another very interesting application of the deflection of a needle by a current is Sir William Thomson's reflecting galvanometer. The needle is suspended horizontally and inclosed in the bobbins, through which the current flows; a small mirror is attached to it; a beam of light thrown upon this and received upon a screen makes the slightest deflections visible; messages are thus sent by deflecting the spot of light to the right or to the left; the same alphabet is made use of as with the single-needle telegraph. This instrument is used on the Transatlantic cable. It requires very experienced clerks to read the messages on account of the irregular movements of the light; this is very fatiguing work for the eyes, and much impairs the sight. Sir William Thomson has recently invented a very delicate instrument named the siphon-recorder, which leaves a permanent record of the message, and thus supersedes the reflecting galvanometer. It consists of a coil of wire placed between the poles of a powerful magnet. It is deflected by the current either one way or the other, and communicates this movement to a siphon which spurts ink on to a moving strip of paper. The siphon makes a series of zigzags which are above or below the middle line, and vary in number according to the letter which they represent. The siphon is made of a very thin glass tube only weighing a few grains, and the ink is forced through this capillary canal by means of statical electricity from a small machine.

(*To be continued.*)

MECHANICAL HARDENING AND MAGNETISM.

IRON and steel can, of course, be hardened by mechanical operations, such as hammering, drawing, and bending, as well as by the common thermal process. The influence of such treatment on their magnetic properties has been lately investigated by Herr Cheesman, in the laboratory of Prof. Kohlrausch. The research is described in a recent number of the *Annalen der Physik*.

The materials used were the English "silver steel" of commerce, in wires of 330mm. length, and of three different diameters (1mm., = about ·04in., 1·2mm., and 1·6mm.), as also in a few bars, and a long annealed iron wire, 1·6mm. in diameter. All the material was carefully annealed before use. Various degrees of hardness were imparted to the annealed wire by beating, bending, drawing through holes, and stretching, and their influence both on the permanent magnetism with strong magnetising forces, and also on the temporary and permanent magnetism with forces of various strength, was examined.

The magnetisation, in the case of strong forces, was done with permanent magnets, and the magnetism measured in the magnetometer. These experiments proved, in the case of iron wires hardened by hammering and stretching, that a greater specific magnetism was produced than in the soft state, the increase, in one case, amounting to nearly three-fourths of the original value. When the iron wires were drawn through a various number of holes, there was also, though not in a very regular way, an increase of the specific magnetism with the number of holes through which the wire was drawn. The difference between the wire drawn six times, and the soft wire, was about 60 per cent. Lastly, when iron wires were stretched with increasing weights, the value of the specific magnetism increased regularly with the hardening produced, this increase amounting to about 70 per cent. A cast-iron bar, 102mm. long and 7mm. diameter, showed as specific magnetism, in the soft state, 40·1, and after hammering and remagnetising, 44·1.

Similar experiments with similar steel wires yielded quite a different result. The soft steel wires showed a greater specific magnetism than the hard ones, and it was smaller the harder the wire. These experiments with iron and steel were frequently repeated, but always with the same result. Mechanically-hard iron seemed to be always capable of taking more magnetism than soft, while the reverse was the case with steel.

This behaviour of steel, however, is not universal; it is very materially influenced by dimension. A steel bar, 117mm. long, and 7mm. diameter, after being hardened by hammering, showed, in specific magnetism, an increase of about 33 per cent. A similar increase, after hardening, was observed in other steel bars of like dimensions. This phenomenon, occurring where the length is comparatively small in relation to the diameter, and its converse, in the opposite case was in agreement with facts observed some time ago by Herr Ruth, and attracted further investigation.

The experiments now showed distinctly how the magnetic moment of steel depends not only on the state of hardness, but also on the ratio of axes (a); below a certain value of a, the hard wire has greater moment than the soft one; and this value, at which the magnetic moment was independent of the hardness, was, in all those experiments, very near 41. Though iron was experimented with between similarly wide limits, no corresponding behaviour was observed.

The results, thus far, are summed up as follows:—"Using strong magnetising forces, within the limits of investigation, iron is capable of taking, in the mechanically hard state, more permanent magnetism than in the soft; on the other hand, the magnetic moment of a steel magnet in the mechanically hard state is greater or less than in the soft state, according as the ratio of axes is less or greater than a certain transition value."

In the further experiments, the question was considered, how far mechanical hardness presents a resistance to magnetising force; and for this purpose measurements were made both of the temporary and of the permanent magnetism from magnetic forces of various strength. Magnetisation was here done with a magnetising coil, and each time the author successively observed the indication of the magnetometer with open circuit, and that with closed circuit and the magnet in the coil; then the strength of the magnetising current was read off on a galvanometer, and lastly the indication of the magnetometer with open circuit and the magnet in the coil. The results of the measurements are given in tables and curves, and they teach the following:—

"Comparing together the curves corresponding to temporary magnetism, both of iron and of steel, it appears that the soft wires, for the same value of separating force, have a greater moment than the hard; hence, as was to be expected, mechanical hardness has an action of restraint on the rotating of the molecules. From the curves of the permanent specific magnetism of iron, the conclusion is to be drawn, that only with very small values of the separating forces is the moment of a hard iron magnet less than that of a soft one. In steel, on the other hand, the influence of dimensions appears; for in bars with a great ratio of axes, the specific magnetism, both for weak and strong forces, is greater in the soft than in the hard. In those bars, on the other hand, in which the ratio of axes is small, the harder of them, for all forces except the very weak, has the advantage."

These results correspond fully to the behaviour of bars hardened by heating, as observed by Herr Ruths and others.

"Though in magnetic relation," says the author in concluding, "the two kinds of hardness (the mechanical and the thermal) show many similarities, they present, in other relations, many differences, and seem to be quite different states. With regard to conductivity for electricity, e.g., this comes out most strikingly. The conduction resistance of drawn iron and steel wires has been given very differently by different observers. some have affirmed an increase of it, and others a decrease, with hardness; but in any case it changes very little. On the other hand, according to data by Barus, the specific conduction-resistance of steel is altered by heat-hardening nearly threefold. The differences in magnetic relation by no means correspond everywhere to this great difference.

"A comparison of the specific gravity of the wires hardened by the two methods with the corresponding magnetic moment, leads to the same result. By quenching, it is known, the specific gravity of steel is diminished, and it reaches its smallest value in the quenched state. According to Fromme's results, the specific gravity increases again in annealing, but the magnetism decreases, so that for a small ratio of axes, the smallest specific gravity would correspond to the greatest specific magnetism. The magnetism of a steel bar (with small ratio of axes), hardened by hammering, steadily increases, on the other hand, with the specific gravity, as I have often convinced myself by experiment.

"It may here be pointed out that the specific gravity appears generally not to be indicative as to the magnetic state. For even if other circumstances did not show this, it is not conceivable that the specific gravity of the steel bar, whose ratio of axes is great, should decrease through hammering.

"The verification of Ruths' affirmation of the dependence of the specific magnetism of steel on the ratio of axes, for mechanically hardened wires also, proves the importance of this point for the magnetic state. As to the behaviour of iron in this respect, the possibility is, of course, not excluded that a value of the ratio of axes exists, at which the moment is independent of the hardness; only, according to the experiments made, the value must be different from that for steel. With the present defective experiments as to this point, it may be difficult fully to explain these phenomena. I hope, however, shortly to investigate the behaviour of hard and soft iron with very large and very small ratios of axes, as also, generally, the dependence of a on the variables which determine it."

THE HIBERNATION OF ANIMALS.*

DON'T black bears sleep through the winter? questioned the writer of an attendant who was dealing out mid-day rations of bread and milk at the park. "That's the general impression," was the rejoinder, "but we have never noticed any attempt at hibernation here. Bears are unusually lively during the cold months, and demand their food as regularly as do the lions and other feline animals. I don't know that any observations of value on this question have ever been made on animals in confinement. I have had some experience with outside animals, and a great many go through what is called a winter's sleep; and in warm countries there is what might be called a summer sleep. Bears begin in the fall to look out for a soft nest; and if it's possible for them to eat more at one time than another they do it then, and when the cold weather sets in they are fat and in prime condition. According to some authorities, the fat produces the carbon that in some way tends to induce somnolency. The stomach of a bear at this time becomes empty, and naturally shrivels or draws into a very small space, and is rendered totally useless by a substance called 'tappen' that clogs it and the intestines; this is formed of pine leaves and other material that the animal takes from ants' nest and the trunks of trees in its search after honey. They lie asleep in this condition for about six months, generally snowed in; but you can tell the place, as the heat of the bear, what there is left, keeps an air hole up through the snow. The bear seems to live on its fat, the tappen preventing its two rapid consumption; and if you run across them during this time—even along in March just before they wake up—they are about as fat as when they went in. I have taken a slice of fat from a black bear six inches thick—regular blubber. I remember," continued the man, "one winter I was 'log hauling' in the western part of this State. We had our eyes on a big tree, and one morning, when it was about ten degrees below zero, I tackled it to warm up. I hammered away for about five hours at it and finally started her, and over she came—slowly at first, and then as if she was going right through The snow was nearly three feet deep, and as the tree struck it flew up for about twenty feet and half blinded me, and when I came to there was the biggest black bear I ever saw standing along side of me, looking about as mixed as I did. I had lost my axe, and the first move I made she started, and on taking a look I found that she had a nest in the trunk and had probably turned in for the winter.

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* By C. F. Holder in *Forest and Stream.*

It was about twenty feet from the ground, and was built with moss, leaves, and all kinds of truck, and as warm and as snug as you please—a good place to spend a winter in."

The brown and polar bears have the same habit of lying up for the winter. An Eskimo informed Captain Lyon that in the first of the winter the pregnant bears are always fat and solitary. When a heavy fall of snow sets in the animal seeks some hollow place in which she can lie down, and remain quiet while the snow covers her. Sometimes she will wait until a quantity of snow has fallen and then digs herself a cave; at all events it seems necessary that she should be covered up by the snow. She now goes to sleep and does not wake until the spring sun is pretty high, when she brings forth two cubs. The cave by this time has become much larger by the effect of the animal's warmth and breadth, so that the cubs have room enough to move, and they acquire considerable strength by continually sucking. The dam at length becomes so thin and weak that it is with great difficulty she extricates herself, which she does when the sun is powerful enough to throw a strong glare through the snow which roofs the den. Then the family comes out, and will take anything that comes alone in the way of food. During the long sleep the temperature of the bear's blood is reduced to almost that of the surrounding air. The power of will over the muscles seems to be suspended, respiration is hardly noticeable, and most of the vital functions are at a complete standstill—the entire body sleeping, as it were. The male grizzly bear never hibernates. The young and the females, however, build nests, one of which measured ten feet high, five feet long, and six feet wide.

Bats are great winter sleepers, and in most of the known caves they can be found during the cold months clinging to the walls and to each other. During hibernation their respiration ceases almost entirely, and only the most careful use of a stethoscope can reveal it. The air that has surrounded numbers of them has been carefully examined, and not the slightest evidence found of its having been breathed; and, stranger yet, they can exist in this condition in gas, that, were they awake, would prove instantly fatal. A machine has been invented to examine these and other animals while in this condition. A delicate index records the slightest pulsation, while a thermometer shows the rise and fall of the temperature at every moment during the period; and by an arrangement of the wing, the circulation of the blood is recorded. A more delicate experiment can hardly be imagined, as a strong breath, a sneeze, or a footfall will cause the subject of the experiment to recover enough to respire several times; and the effect of this on the machine can be imagined when it is known that, though, while in this condition, they produce no effect upon the oxygen of the air about them, they consume when respiring more than four cubic inches of oxygen an hour.

The common marmot is a great underground sleeper. They build large storehouses, sometimes eight feet in diameter, and from the latter part of September to April they lie in them, and, like the bears, give birth to their young during this period.

The dormouse is a remarkable sleeper. Even in their ordinary sleep they can be taken from the nest and handled without waking them. Towards winter they acquire a great deal of fat, and stow away a vast amount of provision around about their nest, and then go to sleep within; but they rarely awake to use this food unless a very warm period comes around before the regular breaking up of cold weather.

The hedgehog is a sound winter sleeper, and has been the subject of an infinite number of experiments while in this condition. One experimentalist, believing that cold was the cause of their curious condition, surrounded one with a freezing mixture, and froze it to death. By increasing the cold about another that was already hibernating, it was made to wake up; and walked off.

If an animal is suddenly decapitated while in this hibernating condition, the action of the heart is not affected for some time, a second life seeming to outlive the one taken. An experiment has been made in which the brain of the sleeper was removed, and then the entire spinal cord, but for two hours hardly any change was noticeable upon the action of the heart; and a day after that organ contracted when touched by the operator.

The writer has the winter nest of a family of ants. A piece of fence rail was found beneath an old pile of boards and brought into a warm room for the sake of a rich fungus growing upon it, and several hours after the table and chairs were found to be covered with ants. Where they came from was a mystery, until the old rail was accidentally jarred and a number fell from it. A section was cut down through it, and the winter home of the tribe destroyed—probably the work of weeks, perhaps months. The interior of the wood was completely riddled by tunnels and passages, some being large and holding several hundred ants, while others contained only a few. In some of the interior passages the ants had not been affected by the heat, and were packed in great masses and evidently fast asleep; they soon recovered, however, and walked off slowly in different directions, as if wondering if an earthquake or spring had come.

A great number of insects go through a period of hibernation, especially spiders. The young of the latter are often covered by the parent; first, by course strings of silk, as if to hold them in place, and then by a white, silvery web worked over them, which forms probably a sure protection from wind and weather.

The writer has a cherry-stone in which is coiled up an insect, best know as the sowbug. A squirrel had probably eaten out the meat and opened the way, and in this snug retreat we found the little hibernater snugly rolled up, as is also its habit when alarmed. The mouth of the hole was stopped by black soil, but whether from accident or by the animal itself we could not tell.

Some fishes and reptiles are hibernaters. Frogs and toads sleep out the winter at the bottom of ponds or in holes in the ground. Tree toads, if kept in a cage in the winter and provided with soil, will endeavour to cover themselves with it, showing how strong the instinct or habit is. Some fishes are so insensible to heat or cold that when in this condition they can be frozen and carried for a number of days and then be brought back to an active condition. The pond snail passes into a winter sleep as soon as the temperature of the water is below 57° Fahr., that is, they will not digest food or grow until the temperature of the water is at least up to 59° Fahr. Those who have watched the Harlem River from McComb's Dam Bridge cannot have failed to notice the curious appearance of the muddy shores of the river and creeks at low tide. If the sun shines brightly, the dismal beach seems to quiver and scintillate in a most beautiful manner, reflecting the light like so many diamonds. If we draw nearer, this shore is seen to be entirely covered in places with little snails, that, left by the tide, are forging through the mud to regain the water, and the sunlight striking on them is reflected by the glass-like secretion with which they are covered, producing the curious effect noticed. This could be seen in the warm months, but now, not a snail of the countless millions can be seen. They have gone down in search of "hard-pan," there to hibernate until next April. The land snail (*Helix pomatia*) sleeps four months during the year, and does not throw off the calcareous lid that protects it during this time until the day temperature has reached 53° Fahr. Prairie dogs feel the effect of temperature as low as this.

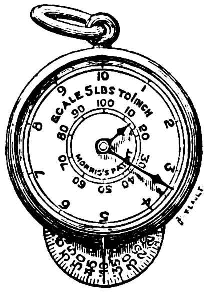
In Cuba reptiles hibernate between 44° and 73° Fahr., according to the species. In warmer countries, snakes, lizards, frogs, etc., fall into a state called chill coma, that precisely resembles winter sleep, but their temperature is far above that at which hibernating animals of the north are still active. The state of hibernation is not the direct result of an extreme of heat or cold, but rather is caused by a departure from the optimum. In the snail its normal temperature is about the same In as the water, and being a poor heat producer, it is not surprising that when the water grows colder the animal is forced to succumb; but it is a remarkable fact that warm-blooded animals like many of the above mentioned, whose bodies are maintained by internal processes at a high temperature of 79° to 100° Fahr., are incapable of resisting the lowering influence of cold. The fall in temperature in some is wonderful; as an example, the high body temperature of warm-blooded animals may be said to oscillate between 97° and 110° Fahr. (this includes man). Experiments made with the zizel show that during hibernation this animal's temperature is only 36° Fahr., the lowest known; and a thermometer introduced into the animal indicated the same, showing that warm-blooded animals in hibernating become truly cold-blooded animals. If a rabbit's temperature reaches 59° Fahr., it will die. The germs of bryozoa or of the fresh-water sponges resist any amount of cold, but the full grown forms die at the first cold turn. Insects are destroyed, but their eggs live, though of the greatest possible delicacy. Salmon eggs have been carried from this State to Australia, and there hatched. In fact, some animals live in the ice, as the glacier flea and several others.

As it is not the direct result of extremes of heat or cold that produces sleep, neither is the awakening from hibernation directly caused by a rise of temperature. In experiments made upon weasels, which are sometimes caught asleep, one came to life in about three hours, during which the temperature of the room remained the same as it had been during the entire hibernation, viz., 50° Fahr. In another weasel, during the awakening, the body temperature rose very rapidly—and more so in the second part of the period than in the first, In the first hour and fifty-five minutes of the awakening the body temperature rose 11·8° Fahr., and in the following fifty minutes it rose 30° Fahr. This remarkable increase took place without any vigorous movements on the part of the weasel. Even its breathing showed no increase in proportion to the rise. These cases show that though, at certain seasons, animals relax as it were and lie dormant, and recover, seemingly at the will of the weather, yet, in point of fact, the rise and fall of temperature has no direct effect upon them. The cause is an internal one, awaiting discovery.

INDICATOR DIAGRAM MEASURER.

Mr. E. RUSSELL MORRIS has invented a handy little instrument (on the principle of the Wealemefna, which, in the absence of a special instrument, is freely used by engineers for the purpose), designed to provide a means of measuring steam engine indicator diagrams with rapidity and accuracy.

The instrument is the exact size of the illustration. By passing it over the (ten) ordinates of a diagram, the *mean pressure* in pounds on the square inch is indicated, the 1-100ths and 1-10ths of a lb. on the roller, and the pounds and tens of pounds by the hands on the dial. Thus the mean pressure indicated in the above illustration is 13·40lb.



The standard of the instrument is 5lb. to the inch. This standard is convenient as, in the first place, being a factor of the Admiralty scales of 10, 15, 20, 25, and 30lb. to the inch, it is merely necessary, when measuring diagrams on these scales, to multiply the result by 2, 3, 4, 5, or 6; and in the second place, each of the divisions representing 1-100lb. (mean pressure) on the roller is a fiftieth of an inch, which is as fine as is consistent with distinct and easy reading. When dealing with scales of which 5lb. is not a factor, the simplest way will generally be to multiply by double the scale and advance the decimal point one place.

The rollers are machine-divided, and the workmanship and finish of the instruments very good.

TELESCOPES AND TELESCOPY.

By Dr. Royston Pigott, F.R.S.

THE following is the substance of a lecture delivered last week, to the Young Men's Christian Association at Eastbourne, by Dr. Royston Pigott.—Long before the telescope was invented the Wandering Stars had been noticed, and at length received the name of planets. But whether the earth was the centre of motion round which all revolved, or whether the sun was a centre, remained for thousands of years an unfathomable mystery. But Daniel arose and confounded the astrologers of the Medes, about the time that Pythagoras first promulgated the true astronomy. This hoary philosopher also taught a plurality of worlds. The earliest recorded eclipse happened in 720 B.C., observed at Babylon. During the Mosaic era clocks, probably water-clocks, were used in astronomy, and Moses was learned in in all the wisdom of the Egyptians. The lunar phenomena were made to regulate the Jewish festivals and years. But I must rapidly pass on to more modern times. Great names begin to illuminate the scene—Copernicus, Tycho Brahe, Galileo, Kepler—Kepler, that man whose grand soul pierced through some of the most abstruse and tremendous facts of the astronomy of to-day. Science now began to dawn. Galileo produced the first telescope and incurred the persecuting spirit of Rome in its most revolting form. Carried away by a most consummate genius he dedicated his life to scientific research, and was utterly victimised by Inquisitorial punishments. He was made to declare on his knees—"I abjure, curse, and detest the error and heresy of the motion of the earth and promise never more to say or assert that the sun is the centre of the world and immovable." For three years he was condemned to recite the seven penitential Psalms.

We can imagine the intense delight of this astronomer, who first applied a telescope to observe the heavenly bodies. Jupiter yielded four moons to his astonished gaze. Saturn appeared in his imperfect glass triple. The moon unveiled her gorgeous mountain scenery. The milky way resolved itself into glittering hosts. The Pleiades, or Seven Stars, became forty. The whole heavens seemed suddenly bespangled with multitudes of stars, hidden for ages from the gaze of mankind. The sun showed his spots, and declared also its rotation—a grand new fact of astronomy. He detected the revolution of Jupiter's four satellites and their eclipses. He announced their grand utility for determining the place of a ship at sea, and formed a table of their movements. His invention of the telescope led him to construct a microscope—he devoted twelve years to its improvement. Schottus, in his "Magic of Nature," mentions a strange fact. A Bavarian philosopher died on a journey. In his box was found a small microscope containing a flea magnified. On looking into the glass they were struck with terror at the sight of a gigantic animal. The philosopher was pronounced a sorcerer unworthy of Christian burial.

But Galileo's tube prospered; good men and true began to think. The visible course of Jupiter's moons analogued our own. The motion of the earth was declared by bigotry to be blasphemous. By one of the greatest mathematicians of the age the altars of Aristotle were endangered. The ruin of Galileo was attempted by false representations to the Grand Duke. Seventy years old was Galileo when the Inquisition pounced on the new hero of scientific research. "What a spectacle," says Bailly; "an old man, whose hairs were blanched with study, watchings, and benefits to mankind, on his knees before the Sacred Scriptures, abjuring the truth in the eyes of Italy, which he had enlightened, in opposition to the testimony of his conscience, and in spite of the manifestations given by Nature through all her works." The States of Holland, aware of the immense value to navigation of Galileo's researches, sent their two astronomers to present him with a gold chain, and to encourage him to persevere in his labours.

Science is also everlastingly indebted to this great and good philosopher for the discovery of the vibrations of the pendulum, on which all modern astronomy wholly depends, as also for the discovery of the law of falling bodies. The hallowed interest in the sorrows of Galileo lies for ever embalmed in the memories of grateful manhood. Bayer named the stars by Greek letters for each group. Hevelius, a rich citizen of Dantzic, devoted his life and fortune for forty years to star studies. He made exquisite drawings of the phases of the moon. Towards his latter end telescope finders or sights were used. In old age he lost all his MSS. by conflagration, but re-commenced, using, however, only plain sight on his instruments. His rival, Halley, used telescopes, and Hevelius the old method, with equal dexterity. Telescopes, just after the Great Fire of London, were now first regularly applied to astronomical instruments. From that day forward the modern astonomy made rapid and gigantic strides. Cassini arose, and in France, at least, re-created the science; the Paris Observatory was placed under him in 1670

Newton now made a reflecting telescope, still preserved by the Royal Society. The largest and best are still called Newtonians. He despaired of destroying the colours produced by glassy refraction. His discoveries have immortally rendered his very name a household word. The telescope, by its revelations of exact movement, enabled him to announce a universal law of gravitation dominating in the heavens; but it was reserved for another century to develop the greatest astronomer that ever lived, Sir William Herschel, who demonstrated that the laws of gravitation also were in full force among distant suns and revolving systems of suns.

Mr. Hall, a gentleman of fortune, discovered in in 1723 a property in crown and flint-glass which destroyed the colours of refraction. Dollond re-invented in 1758, and was afterwards made a Fellow of the Royal Society, for his achromatic telescope. At the present day even his glasses are much esteemed. Mertz, Steinheil, Cook, Dallmeyer and Grubb, of Dublin, now construct them in great perfection; but, perhaps, of all these, Wray surpasses every other maker in the colourless purity of the final image. The moon looks like frosted silver, and Saturn like white marble on black velvet. Then we must not forget the giant tubes made by Alvan Clark, nor the delightful reflectors now constructed by Calver. A mirror by this maker, 37in. in diameter, enabled Mr. Common to photograph Jupiter and his moons, and this instrument, I hear, displays minute stars invisible in the American giant, notwithstanding the splendid skies of the Western continent. Nor must Lord Rosse's magnificent reflectors be omitted, nearly 60ft. long, and above 6ft. in diameter.

But it ought to be remarked that the principle of telescopes was first invented in Old England by Roger Bacon about 1250, and that Leonard Digges, who died about 1573, is said to have arranged glasses by which he could examine very distant objects.

The common principle of these instruments is that of bending the rays of light more or less which emanate from a distant object by means of a reflector or lens. The less the bending of these rays the more distinct is the so-called focus where the distinct image is formed and the larger it appears. The longer the tube, therefore, the more perfectly sharp appears the image. Accordingly, telescopes 150ft. long were constructed. One of 123ft., constructed by Huyghens, was used by the Astronomer Royal Pound to measure the diameters of Saturn and Jupiter. The object-glass was mounted on a tall pole, furnished with a ball and socket joint, a long rod carried a magnifying glass, and the thing was directed by means of a long string.

I must now say a few words on the powers of the telescope. It penetrates space. A 6ft. mirror penetrates about 200 times deeper into space than the human eye. One 19in. in diameter penetrates forty times further. Long after the steeple of a distant church became invisible, such a glass enabled Sir Wm. Herschel to read the time by the church clock. This property is of the greatest possible value in astronomy. Starry universes are fathomed; the glittering glories of these realms of resplendent beauty start forth and astonish our bewildered vision at the awful and the unfathomable depth of the abysses of creation.

Galileo had proposed a new question—the velocity of light. Baffled in finding the eclipse of a satellite of Jupiter happening later than it ought, Cassini and Roemer concluded that it depended on the distance of Jupiter being much greater at one time than another from the earth. Thus the telescope led to the actual discovery of the velocity of light—one of the most important in the whole range of science. Cassini relinquished the problem as hopeless, but Roemer persevered until at length he demonstrated its velocity to be such that it passes across the diameter of the earth's orbit—*i.e.*, through 180 millions of miles in the short space of eleven minutes. This grand fact again suggested light-emission, or emanation, to Newton, but Huyghens suggested undulation like the waves of sound. Hence arose a grand theory of waving oceans of luminiferous ether pervading all space. And, latterly, this sublime idea seems destined to be swallowed up in another, teeming more richly still with wonders and energy, viz., a combined action of electricity and magnetism. The electro-magnetic theory of the universe now being developed, without the telescope, Jupiter's satellites could not have revealed the progression of the days of light and its velocity, and a luminous ether would probably have still remained in Roman darkness. Another still more wonderful outburst of light for the intellect of man to revel in—by the aid of the telescope—is to descry the chemical elements of distant suns, stars, nebula and systems, as well as to detect the millionth of a grain in terrestrial bodies close at hand—I mean the prismatic telescope called the spectroscope. A fine slit in brass pours through it a beam of light. This little slit is spread out 30,000 times by a battery of prisms, and lo! an infinite number of lines and colours mark the chemical components of the light, as seen by the telescope. To read the stars, to read, perhaps, a poison in the glass, to survey equally well the glowing flame of furnaces, and see the carbon dying out—the exact instants for saving millions of pounds worth of Bessemer steel—or to detect the minutest trace of a glowing gas in a burning world—a world on fire—to declare what is glowing to be a gaseous or solid—I cannot recount the wonders of this new application of our noble instrument, surely the gift of God to open the eyes of mortals to the inscrutable wonders of Nature and the infinitudes of creative powers.

Turn we now to some of the overwhelming wonders of the heavens. The telescope has enabled astronomers not only to weigh the earth, the sun and moon, but even the planets and satellites, and the starry attendants of distant suns. The exact observation by telescopes, furnished with the most *recherché* contrivances for precision of measurement, have accumulated data for all time. Unknown planets have been predicted to exist at a certain point in their revolution—from the minute perturbations they produce in neighbouring planets. The gorgeous varieties of system on system; prodigious star clusters, thick with mighty orbs—thicker than the sand on the sea-shore; their silent march along their appointed path; their distance from us, at the clear conception of which the stoutest brain reels and staggers in despair; the rush of comets and the rain of meteors—perhaps such a rain destroyed Sodom and Gomorrah,—all these and a thousand other wonders open up their tremendous meaning to the patient watcher at the telescopic tube.

But human nature, at least, could never have reached the heights of heaven without a rule of measurement. The earth's size was gained by the telescope. Then the moon's, next the distance of the sun and an eight minutes' journey for his rays. What shall we name, then, for a span measure of the stars? The speed of light is the only measure by which we can conceive an adequate idea of telescopic distance. Eight minutes' to the sun! Let us mount a fairy car borne on the wings of light. In two seconds we pass the moon, or, starting from our sun, we reach Jupiter in 40 minutes, Saturn in 80, Uranus in 2½ hours, and Neptune, on the verge of our huge system at last, in four hours and forty minutes. But let us onward in imagination—the nearest star is reached in three years and a half. A speed of 190,000 miles per second gives us 16 thousand millions of miles daily journey on a sunbeam to this Alpha Centauri, the nearest fixed star. The wings of light carry us forward to Sirius in twenty years; to the pole star in an old man's lifetime. But passing beyond the little glittering cluster in which we spend our pigmy lives, the telescope reaches other climes of such stupendous depth in space as baffles all human intellect to grasp the growing greatness. Behold the Nebulæ and their clustering glories, the gigantic groups of blazing suns compressed, as it were, into one huge heap of star dust, each star a thousand millions of miles, at least, apart from the next.

But the prismatic telescope reveals greater wonders than the composition of distant stars and luminous ether; it tells us the rate at which we are receding or advancing in space towards distant suns in miles per second. Further, it startles us with the awful fact that our sun and all his planets are rushing towards the constellation Hercules, and probably wheeling in one mighty orbit around the Pleiades or Seven Stars. Perhaps there is some grand hidden meaning in that sublime passage, "Canst thou bind the sweet influences of Pleiades or loosen the bands of Orion? Canst thou bring forth Mazzaroth in his season, or canst thou guide Arcturus with his sons?" (Job 38, 31.) Knowest thou the ordinances of heaven? Canst thou set the dominion thereof in the earth? Canst thou send lightnings that they may go and say unto thee, here we are? . . . Where wast thou when I laid the foundations of the earth, or who laid the foundations thereof, when the morning stars sang together and all the sons of God shouted for joy?"

ELEMENTARY LESSONS IN DRY-PLATE PHOTOGRAPHY.—V.*

Second Lesson in Development.

THE photographer has now, we shall suppose, returned to his dark room. He may lay his dark slide, still wrapped in the cloth, on a shelf, and turning up the white light, make the following preparations. He lays his three flat dishes in a row along the front edge of the table, the one to the left opposite the red light, the others to the right of this one. We shall call the dishes Nos. 1, 2, and 3, beginning at the left. Into No. 2 he pours two or three ounces of the alum solution; into No. 3 about the same quantity of the "fixing" or "hyposulphite" solution. Now he takes the four-ounce measure, and pours into it exactly two ounces of the potassium oxalate solution. To this he adds half-an-ounce of the sulphate of iron solution. The whole will immediately assume a beautifuly ruby red colour; to it he adds about 20 minims of the one per cent. solution of bromide of ammonium. He will now have about 2½ ounces of developer. This is an extravagant amount to use for a quarter-plate, and, if the photographer continues to use ferrous oxalate, he must reduce it to one-half; but at first it is best to use a good dose. Everything is now ready. The white light must be entirely extinguished, and the red light lowered as much as possible, till there is just enough to see by. The plate which has been exposed must be carefully removed from the dark-slide, and laid—film side upwards—in dish No. 1, which is still empty. Now the dish with the plate in it is taken in the right hand, and the measure with the developer in the left. The developer is poured rapidly, but gently, over the plate, the dish being waved or rocked to make the liquid cover any corner which it may incline to avoid, and the whole is placed again in front of the red light. And now (if everything has been rightly done) will commence one of the most wonderful of the phenomena of science or nature which man has been given the power to control—a phenomenon which is always new and always beautiful—the "development of the latent image." Let the beginner watch it closely. The plate had no indication of having been acted upon at all before the developer was poured over it. After, perhaps, ten or twenty seconds there is a slight darkening of some part. When this becomes distinctly visible the light may be somewhat raised, for the plate has become less easily affected by it. It will now probably be seen that the brighter parts of the landscape have become quite visible. In *negative*, be it remembered, the sky will be represented by blackness. Now is the time when we can tell whether or not the exposure has been correct. If it has been, the development will progress with beautiful regularity. The bright parts (or high-lights) appear first; then slowly, but steadily, more and more of the half-tones, or less brightly lighted parts, come out; and at last every object and shade except the deepest shadows have their counterpart in the negative. In other words, the plate should be darkened to a greater or less extent in all parts except those few which represent the part of the landscape which appears to the eye quite black, and this should come about in between one and two minutes. If the plates have been under-exposed it will be longer before the high lights appear, and very soon after they do the action will stop, no more detail coming out, but large patches of the plate remaining white as before. If, on the other hand, it has been over-exposure, the high lights will appear a little sooner, and almost immediately afterwards the whole of the plate will be covered with detail, no part remaining white.

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* Condensed from the *Photographic News*.

The final result of incorrect exposure is, with under-exposure, a hard picture with contrasts over-marked, and with deep heavy shadows in which none of the detail which is visible to the eye is represented; with over-exposure, a flat, uninteresting looking production, showing all the detail which there is in the original, but lacking the bold contrast of light and shade.

We shall suppose the happy medium to have been hit, if not at the first attempt, after a few more plates have been exposed. The development is not of necessity finished when, looking on the surface of the plate, all action seems to have ceased. We have still to wait till the "density" is sufficient.

It must be understood, that as long as the plate lies in the developer, the density continues to increase, and we may say at once that the most difficult thing of all to judge of in gelatine dry plate work is when the required density is gained. So difficult is this, that even the most experienced photographers may occasionally fail. The reason of this is that the after-processes very much modify the apparent density of the negative, and not only that, but in every different make of plate the apparent density is modified to a different degree. We must make it appear far denser than it is eventually to be. It is only by experience that knowledge approaching to exactness can be gained on this point. We will merely indicate the manner in which it is usual to judge of the density. The red light must be turned pretty high. The plate must be lifted from the developer and held, with the film side towards the observer, for a second only, close to the light, and between the light and the photographer. He must rapidly judge whether or not the density is correct. We may say roughly that, as a rule, the densest parts should appear almost, if not quite, opaque. If they do not, the plate must be returned to the developer.

We shall suppose the correct density to have been gained. The time taken with the developer we have given will probably be from two to five minutes. The developer is now poured back into the measure. If used within an hour or so, one or two more plates may be developed with it. The plate is now thoroughly rinsed under the tap, either held in the hand, or left in the flat dish. After this, as much red light may be admitted as is required. Then the plate is laid for five minutes in the alum solution, to harden the gelatine film. It is again thoroughly rinsed, and placed in the fixing solution. It will have been observed that up to this time the plate, looked at from the back, still appeared white. This is because the sensitive salt of silver which was not acted upon by light still remained in the film. On placing the plate in the hyposulphite, this whiteness will gradually vanish. When there is no farther appearance of it from the back, white light may be freely admitted. The plate must still be left a few minutes in the fixing solution, after which it must be most thoroughly washed. It should remain at least half-an-hour either under running water or in frequent changes of clean water. After that, it is reared up on edge to dry, when the negative is complete. Heat must on no account be used in drying.

Our legal correspondent, Mr. F. Wetherfield, has commenced the publication of a monthly magazine called *The Law* containing monthly notes on legal matters and a digest of commercial cases for men of business. The price is a shilling, and the April number contains articles on Debt Recovery, The Employers' Liability Act, The Mayor's Court, London, What is a Bill of Exchange? Bills of Sale Amendment, County Court Jurisdiction, The Debtors' Act, 1869, Liquidations and Compositions, and an appendix of cases. The magazine is useful, handy, and cheap, considering the character of the information.

At a recent meeting of the Académie des Sciences a new pump for compression of gases was described by M. Cailletet. A special feature is the presence of mercury above a plunger piston, with which the mercury moves. An hour's work will give 400 or 500gr. of liquid carbonic acid or protoxide of nitrogen. The author stores compressed gases in bundles of metallic tubes communicating with each other, and each holding about four litres. Pressures of several hundred atmospheres are attained.

SCIENTIFIC NEWS.

The Dun Echt Circular, No. 49, gives elements and ephemeris of the new comet (Wells) calculated by Mr. Hind. He makes T = June 15·0345 G.M.T.; π = 49° 8′ 24″, ☊ = 205° 19′ 46″, i = 73° 45′ 1″ app. equinox 1882, March 21; log. q = 9·003769. The position on April 15 he gives as R.A. 18h. 53·2m., N.D. 52·1° for Greenwich midnight. The brightness will increase until June 14. The same circular contains elements deduced by Dr. M. W. Meyer, of Geneva, which are T, July 15·040 Berlin M.T., π 307° 43·8′, ☊ 205° 28·2′, i 70° 47·9′, log. q 0·31522. Circular No. 50 contains elements, &c., calculated by Dr. Oppenheim, and another calculation by Mr. Hind. The latter gives T = June 12·07195, π 52° 6′ 33″, ☊ 204° 59′ 33″, i 73° 42′ 44″, log. q 8·870371, and has the following remark:—If I on March 19 = 1, on June 12 I = 2105 "? a daylight object at this time!"

The eclipse expedition to Egypt will consist in all probability of the following gentlemen:—Mr. Lewis Swift, of Rochester, New York; M. Thollon, of Nice; Mr. Ranyard, Mr. Lockyer, Capt. Abney, and Mr. Black. M. Thollon goes at the expense of M. Bischoffsheim, who has chartered a special steam-vessel from Cairo, and has invited Mr. Ranyard to accompany his party, which will include a professional photographer. Mr. Ranyard takes the large camera of 13in. aperture which he used in the American eclipse of 1878, and several others. Mr. Lockyer and Capt. Abney will probably represent the Royal Society.

The Observatory of Popular Astronomy, established in the Trocadéro, Paris, will, it is stated, be transformed into an institute for general popular education in the sciences.

The following are the lecture arrangements after Easter at the Royal Institution:—Mr. Edward B. Tylor, four lectures on "The History of Customs and Beliefs," on Tuesdays, April 18th to May 9th; Prof. Arthur Gamgee, four lectures on "Digestion," on Tuesdays, May 16th to June 6th; Prof. Dewar, eight lectures on "The Chemical and Physical Properties of the Metals," on Thursdays, April 20th to June 8th; Mr. Frederick Pollock, four lectures on "The History of the Science of Politics," on Saturdays, April 22nd to May 13th; and Prof. David Masson, four lectures on "Poetry and its Literary Forms," on Saturdays, May 20th to June 10th. The Friday evening meetings will be resumed on April 21st, when Prof. Dewar will give a discourse on "The Experimental Researches of Henri Ste.-Claire Deville."

At the meeting of the Institution of Naval Architects, held last week, the views of Sir W. Armstrong on smaller vessels and unarmoured cruisers were criticised in the course of a discussion on a paper by Mr. Samuda, in which that gentleman, supported by Admirals Hornby and De Horsey, Captain Noel, and Mr. Barnaby, held that even thin armour was of value, while an unarmoured cruiser was practically of no use at all against an ironclad. Mr. Barnaby also spoke of the size of vessels, and pointed out that a vessel of 8,000 tons and 8,400 horse-power could steam as fast as the *Mercury*, which has the enormous proportion of 2 I.H.P. to each ton of displacement. Amongst other papers read was an interesting one by Mr. Parker "On Compound Engines," which gave rise to an animated discussion.

The Naval and Submarine Engineering Exhibition, to be held at the Agricultural Hall from the 10th to the 20th inst., promises to be one of the most attractive shows ever held in the building.

In the south nave at the Crystal Palace, Messrs. Hammond exhibit a printing-machine driven by a Brush dynamo. Some little interest has been created by a new storage battery, known as the Sellon-Volckmar, which, we understand; is a modification of Mr. Swan's device. Gerard's "slide-lamp," said to be of 400 candle-power, attracts much attention.

Concluding his lectures last week at Owen's College on the "Ancient World and the Appearance of Man," Prof. Boyd Dawkins said that from the standpoint of the present he turned to the past, and saw that man, by continued struggles with nature, had developed his powers until he had come to be what he was; and he looked forward to the future in the belief that in the ages that were coming man would be lifted up above the present level of culture as high as we were removed from the state of savagery of the primæval hunter.

The homœopaths assert that a discovery has been made of a means of checking an attack of typhoid fever. The new drug is called baptisia, and is obtained from an American plant of the order Leguminosæ

We have the Annual Report of the Manchester Microscopical Society, and are pleased to see that the number of members is steadily increasing, and that the funds show a "balance" on the right side.

The properties of the Kola nut, so largely used in Central and Western Africa, where it has a *rôle* similar to that of *Maté* and *Coca* in America, have been lately elucidated by MM. Heckel and Schlegdenhauffen, who, in a paper to the French Academy, give an analysis of the substance. The cotyledons of the seed are the only part the negroes use. The effects are those of a stimulant and tonic; and impure water is rendered agreeable by previous use of the nut. The analysis shows that the Kola nut has more cafeine than the best coffees, and that that substance is wholly free, not combined, as in coffee, with an organic acid. The action of the cafeine is aided by a considerable quantity of theobromine present. Next there is a notable amount of glucose (of which there is none in cocoa). The nut contains thrice as much starch as is found in seeds of Theobroma. There is little fatty matter, and a special tannin, together with a red colouring matter, are present. As a remedy, the Kola nut is appreciated by the Africans in affections of the intestine, liver, &c.; it may be ranked medically with Coca and like matters, over which, however, it has an advantage in possessing so much tannin, which gives it precious astringent properties.

For observation of the transit of Venus this year, the French will have eight stations as follows:—In the north, Florida, Col. Perrier; Cuba, M. d'Abbadie; Mexico, M. Bouquet de la Grye; Martinique, M. Tisserand. In the south, Santiago du Chili, M. Leclerc; Santa Cruz, M. Fleuriais; Rio Negro, M. Perrotin; Port Desiré, or Chubutt (Patagonia), M. Hatt. These missions will start in July. Each will have two equatorials, one 8in. and one 6in. Photographic methods are to be very limited this time; the French will employ them at only two stations, and the Germans not at all. For micrometric measurements, double-image apparatuses, adaptable either to the object-glass or the eyepiece, were recommended by the Conference. Observation with filar micrometers or micrometric network, or with instruments having divided circles, was to be reserved for stations where the stability and regularity of motion of the telescope were sufficiently assured. Careful definitions were given as to the contacts. According to *Les Mondes*, 38 transit expeditions have already been projected, not counting those of Italy, Austria, and the United States, which are not yet fully known.

According to a German paper, the United Königs and Laura Foundry has, within the last two years, been largely supplying pavement made of cast iron and steel, which is valued for its small weight, together with remarkable durability, and finds manifold applications, as for bridges, courts, quays, &c. A pavement of of the kind, on a much-frequented carriageway at the Laura works, has fully answered the requirements, without wearing out or deformation; and the same with some bridges over railways, on which the pavement has been tried some time.

It appears that the German emigration last year to lands beyond sea amounted to 210,547. Of this number 98,510 went by Bremen, 84,425 by Hamburg, 2,434 by Stettin, 26,178 by Antwerp. For 206,189 the destination was the United States, for 286 British North America, for 26 Mexico and Central America, for 58 the West Indies, for 2,102 Brazil, for 762 other parts of America, for 314 Africa, for 35 Asia, and 745 Australia. In the last eleven years the number of emigrants has been, roughly, as follows (in thousands): 76 in 1871, 126 in 1872, 104 in 1873, 45 in 1874, 31 in 1875, 18 in 1876, 22 in 1877, 24 in 1878, 33 in 1879, 106 in 1880, and 210 in 1881.

An elevated electric light is regarded as a great desideratum for the busy crescent of New

Orleans harbour, and a project of the kind by Mr. Golding is illustrated in the *Scientific American*. The tower would be some 500ft. high, and carry a light of 40 thousand candle-power. It is a guy-supported cast-iron cylinder built up of short sections, and reared by additions made at the bottom. A hydraulic lift raises the upper sections till a new section (say 5ft. long) can be placed underneath. The lamp trimmer would mount on a circular platform, forced up as a piston, by compressed air. The cost of a tower, without the lamp, would be about 30,000 dollars. The sharp bends of the river at New Orleans result in a pretty rapid displacement of the river bed; thus the bank at Carrollton Bend has receded about 500ft. in 20 years. It has been attempted (since 1878) to meet this evil by a system of mats of brush ballasted with stone. A board of engineer officers, however, has lately pronounced this a failure, and advised that it be discontinued.

The sickness of persons rapidly transported to an elevated position is probably due to diminution of the quantity of oxygen in the blood, the tension of this gas in the surrounding air being lessened (a condition of the system called by Dr. Jourdanet, *anoxyhæmia*). Those who live on in such places get acclimatised, and the descendants prove quite indifferent to a state of things which gave the first inhabitants much discomfort. What is the nature of this acclimatation? M. Bert has lately tested the view that the blood comes to contain more of the substance called hæmoglobin; it is supposed there is less oxygen for a given quantity of this, but the larger amount of hæmoglobin makes up. He had an opportunity of examining the blood of various animals (vicuna, lama, alpaca, stag, sheep, &c.), living above Paz, a place in Bolivia more than 12,000 feet above the sea; and he finds that, when agitated with air, it is capable of absorbing from 16 to 21 cubic centimetres per 100cc. of air, whereas the maximum of oxygen absorbable by the blood of herbivorous mammalia, in low regions, under the same conditions, is only about 10 to 12 per cent. Thus the hypothesis is verified. Animals in high positions have blood with a higher capacity of absorption for oxygen than that of animals at the sea-level. It is allowed that there are some other elements in the complex problem of acclimatation, but they are probably quite subordinate.

The activity of some humane sportsmen may now perhaps take a new direction, as M. Marey has lately contrived an instrument which, pointed at a bird in flight, like a fowling-piece, and let off, gives easily twelve successive photographic images of the bird. The exposure for each image is 1-700th of a second; but on a bright day it may be reduced to 1-1300th. If the series of images be arranged in a phenakistiscope, the aspect of a flying bird may be reproduced in such a way that the motion may be easily analysed. The principle of the contrivance is the same as that of the *photographic revolver* which M. Janssen made for observation of the transit of Venus.

In the purchase of seeds, so common at this season, one is apt to be deceived. A correspondent of the *Journal d'Agriculture Pratique* recommends a test which he has used for many years with complete success. It is that of *fire*. Take at random a number of seeds from the bag, say eight. Put some live coals on a shovel, and deposit each of the seeds successively on it. Blow the coal, and watch how the seed behaves. If the combustion is slow, merely giving off some smoke, you may conclude that the seed had a damaged germ; if, on the other hand, the seed leaps and turns about on the coal, producing a dry sound (tac), proportional to the size, it may be inferred to have good germinative qualities. In this way the proportion of good and bad seeds may be ascertained. As for the larger seeds, such as acorns and chestnuts, it is sufficient to throw them into a fire, and keep them in view. If the quality is good, this will be indicated ere long by detonation of the seed.

The Boston Manufacturers' Mutual Fire Insurance Company has sent its members a second circular on electric lighting, in which confidence is expressed in the safety of the arc-light "rightly put up and adjusted within the limits of a mill-yard, under control of the manager;" but the policy-holders are advised "not to allow any public telegraph, telephone, or electric-light wires to be attached to their buildings, or to be so placed in or across their mill-yards as to expose their property to the possible danger of diversion of a current of a public electric arc-light wire outside their own control, except such wires as are needed for their own use, in connection with the general service." The circular advises that telegraph and telephone instruments should be placed on a base of glass, marble, or other insulating and incombustible material, so disposed as to catch the drops of metal melted by an accidental overcharge; and suggests that, as its agents have often observed marks of scorching or burning of wood-work round the switches by which electric currents are turned on and off, such switch-boards should be made of terra-cotta, porcelain, or glass.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

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WELLS'S COMET—THE PLANET MARS—VARIABILITY OF γ VIRGINIS—TELESCOPES BY THE OLD MASTERS—FORTIFIED ENGLISH TOWNS—REMOVING SPOTS FROM THE LENSES OF A TELESCOPE—2 URSÆ MINORIS—GETTING RID OF ANTS.

[19884.]—It may not be uninteresting to learn the Wells's Comet, to which you devote the first paragraph of your "Scientific News," on p. 78, will be about 7° north of Vega on the night of the day (April 7th) when this appears.

With reference to Mr. Webb's exceedingly interesting letter (19858, p. 79), I would say that the idea of a very close analogy between our own Globe and that of Mars is one that I fancy but few working astronomers have entertained for a long time. That land, water, and polar ice and snow figure among Areographical detail, I feel pretty well assured, from a long course of personal observation of the planet. When, however, we come to study their distribution, we do find a very marked distinction between the condition of things on the Martial surface and that obtaining here; for whereas little more than a quarter of the area of our world is composed of land, it is water which is in defect in Mars. Speaking roughly, we may call the Earth one of Islands, while Mars, on the other hand, is a home of inland seas. The so-called "canals" of Schiaparelli certainly seem to have no terrestrial analogue so far as their real character can be deciphered. I gather, from what Mr. Webb says, that these are as permanent as the other markings on the planet.

Apropos of variable Stars (letter 19860), will Mr. Baird Gemmill look at γ Virginis? The components are rated as being practically equal; but we may assume that the position angle has been measured in the usual way—*i.e.*, that the Star which has the advantage, however small in magnitude, has been selected as the initial point. This, then, would be the Northern one according to the most recently published position angles. Last night, however (March 30th), the Southern Star of the pair seemed to my eye certainly to be *just* the larger of the two.

I do not know whether "L. L. L." (letter 19863, p. 80) is aware that the famous 3¾ "Beauclerc" achromatic was in the possession of the Rev. A. F. Padley, of Lincoln, in 1861, in which year that gentleman advertised it for sale. Tulley's chef-d'œuvre, his 6·8in. achromatic (*Memoirs* of the R.A.S., Vol. II., p. 507) is now in the possession of Mr. C. Leeson Prince, F.R.A.S., of the Observatory, Crowborough Beacon, near Tunbridge Wells.

To answer query 46197 (p. 90) in extenso, would involve an amount of research and investigation which, writing on Friday afternoon to catch the post, it is out of my power to bestow upon it. Speaking, though, off-hand, London was a fortified City, while among fortified towns were St. Alban's, Chester, Hull, Lewes, Shrewsbury, and Great Yarmouth.

Mr. Corbett (query 46526, p. 91) can himself do nothing to remove the spots of which he complains on his telescope glass. From his statement that this is "2in. dia.," I gather that it must be the object-glass of the telescope, and not one of the lenses of the eyepiece. But if this be so, I cannot understand how or why "the spots are a great inconvenience, when looking at anything," inasmuch as their sole effect under such circumstances would be to cause the loss of an inconsiderable amount of light. Any spots which show *as spots* in the field of view must be in the eyepiece. New soft wash-leather will probably remove the particles of dirt producing this undesirable effect; but the objective must be repolished by an optician.

In reply to query 46535 (p. 91) the 5th magnitude star approximately in R. A. 0h. 52m. 49s., and Dec. 85° 37′ 25″ is quite correctly designated 2 Ursæ Minoris in Proctor's "Atlas," and so appears in the Greenwich Catalogue. β Cephei is nearly 20° from this, and 4 Cephei further still. Probably the compiler of Gall's "Atlas" has been misled by the sprawling of the constellation figures in the older ones. In Bode's "Atlas," for example, Cepheus is actually kicking the Little Bear in a fashion of which I need say no more than it is the most insulting that can possibly be conceived!

Has "Negs" (query 46541, p. 91) tried castor-oil?

A Fellow of the Royal Astronomical Society.

SELENOGRAPHICAL—PLINIUS.

[19885.]—On comparing the three drawings you have lately published of the walled-plain Plinius, one cannot but feel the importance of studying this formation more closely. It is impossible, it seems to me, to conciliate Schmidt's drawing with those of Elger, and also with mine, were I to send the one I took on March 25, 1882. Elger's two drawings agree fairly well. The western crater is entire, or nearly so, and the eastern one is open towards the south, though somewhat broken on the north. My observations agree with Elger's, with these small differences: 1st, the N. borders of both craters are formed by separated masses of rocks disconnected on each side from the rest of the craters. 2nd. The plateau N. of these craters is wider, being two-thirds of the width of the two craters. 3rd. The E. border of the W. crater does not run straight S., giving to this crater the form of an inverted ɑ; but turns to the right and partly encompasses the eastern crater, leaving an opening of only about one-third of its circumference. These differences can very easily be accounted for. But what of Schmidt's drawing? No doubt it was exact when made; but could Plinius be thus drawn at present? Both craters are quite open on the N., both are thickly bordered on the S., and neither is connected with the plateau on the N., which plateau has quite lost its present shape. It is to be hoped that observers will have an eye on this object. I may add that the "small, but very distinct craterlet," spoken of by Mr. Elger in his letter 19814, was seen by me for the first time on May 25, 1871. It was also well seen on January 25, 1882. It occupied the place of figure 4 in Mr. Elger's drawing of January 25, 1882.

C. Gaudibert.

[19886.]—On Jan. 26, 1882, the cleft ϙ was seen running from cleft Ariadæus, passing *s.p.*, crossing craters *a*, *b*, and *s*, and reaching, in a straight line, the E. branch of Hyginus cleft. From the valley where this branch of cleft, Hyginus, is generally seen to end, it was seen climbing the E. side of the mountain, crossing the plain, and was lost among the rocks beyond. The cleft δ Triesnecker reaches the prolongation of Hyginus cleft, where it crosses the plain.

Feb. 22, 1882.—Observed Messala. Found a ring on centre, three small craters S.E. of centre, three hillocks W. of centre, and a ridge running from centre southward. Various other hillocks, two craters on the S.W., and a semi-ring on the S.E., whose floor was whiter than the floor of Messala.

February 23, 1882.—Observed Atlas. The cleft which crosses slantingly the S.W. portion of the floor was seen prolonged, in a nearly straight line, about as much outside the crater as it is long inside. The northern cleft was seen running from a crater on the N.W. of the floor to the eastern rampart, and having the form of an S. This is really a cleft, and is quite distinct from a ridge running along a portion of its N.E. side. A good many other details were seen on the floor.

C. Gaudibert.

POSITION OF FLAT.

[19887.]—I should be the first to acknowledge that the more perfect "all the adjustments" are, the better. I was anxious, however, to point out that there was no optical necessity for the flat to be in the exact axis of the tube, but that this was nevertheless its proper place. I beg to thank Rev. N. D. Godfrey (19862, p. 80) for his method of perfecting this, that the reflection of the flat should be central in the mirror, and also central when a stop is used. Mine are perfectly so, and also when the stops are in a frame 6in. beyond the tube, which I find is better than in the tube itself. If this is Mr. Haren's difficulty, he cannot have a better mode of overcoming it.

Fordingbridge. **T. Westlake.**

ASTRONOMICAL—DOUBLE STARS: β DELPHINI, PIAZ. XXIII. 100-101—ζ CANCRI—THE GROUP OF STARS 2 CAMELEOPARDI.

[19888.]—Allow me to tender my thanks to Mr. Burnham for correcting me in my observation of β Delphini. It is plain this double is far beyond the capabilities of any 8½in. mirror or refractor at the present time. I have a few observations of Piazzi xxiii. 100-101. I give them as inserted at the time of observation, hoping they may be of some interest to some of your readers. "Oct. 17, 1881. Air frosty and fluttering, but clear. I carefully examined this group, and obtained the following results:—A*a* was seen as a double; but only, I suppose, because I knew it to be so. B C was seen double with some difficulty, owing I suppose, to the duskiness of the companion. F, D, and E were easy. G was seen only at times; but no mistake about its existence. I used a single lens, power ± 200. Dec. 15, 1881.—101 Cassiopeiæ: The companion to A was well seen before dark; position ± 330°. A Barlow eyepiece helps much. A light fog, air very good. Powers 250, 550, 735, and 900 +. Dec. 16, 1881.—Air frosty and tremulous. 101 Cassiop., companion to A, seen nearly as well as last night, *p.* 330°. +. The *n.p.* star of 7·5, mag. 14, was seen at 5h. 30m. local time—*i.e.*, before dark. January 10, 1882.—The companion of A seen; so also the companion of B.

Pending the answer of Mr. Webb to the question of Mr. Mills (let. 19488, No. 872, p. 326, Engl. Mech.) with regard to ζ Cancri, I give to Mr. Mills the results of my experience. March 11, 1882.—ζ Cancri divided with 5½in. aperture. March 15, 1882.—3½in. side aperture, star not round; 4in., star egg-shaped; 4½in., well elongated, nearly in contact; 5in., divided with a very fine black line between the discs. Air very good.

The group 2 Cameleopardi. "B. M." (Eng. Mech., No. 874, p. 375), gives a field of the group. I observed it with the following results:—Dec. 4, 1881.—Saw 2 double; 6 was doubtful. There were sparkling here and there, between C, D, 6 and 5. Where "B. M." has placed a cross near B I saw a star, 8, and on this occasion I record 8 as easy as 5. Dec. 8, 1881.—Saw 2 double, 6 doubtful. Sparkling here and there between C, D, 6 and 5. 8 was as easy as 5. Dec. 24, 1881.—Observed the group 2 Cameleop. The air was so bad that neither of the two doubles were seen as such. It was difficult to find a focus. I saw C, D, 1, 2, 3, 4, 5, and 8. With me 6 is very doubtful, with any power. B has a companion *n.f.*, and 2 is double, *p.*, ± 60°, 6 or 7. **C. Gaudibert.**

RULES FOR FINDING THE FOCI OF LENSES.

[19889.]—If we have a convex lens, our first wish is to know its focal length, or the distance of that point behind it in which the rays it transmits are compressed into the smallest possible compass. The most natural way of finding this quantity is to take a card, hold the lens in front in sunlight, and slide it to and fro until the smallest disc of light is obtained. This is the focal point, and its distance from the lens is the focal length. The quantity so found is termed the solar or *principal* focal length, and is the standard by which we compare the powers of lenses. The terms "focus" and "focal length" are used indiscriminately, and, when we speak of a lens having, say, 10in. focus, we mean that, if held towards the sun, it would form a solar image at 10in. distance behind it.

This is a practical way of finding the required quantity, but we can also determine the result by calculation, provided we know certain things concerning the lens we are using. These are: first, the *radii* of the spherical surfaces of which our lens is a part; and second, the *refractive* power of the glass of which the lens is made. For every species of glass, there is a refractive index, consisting of a whole number and a decimal fraction; cut away the whole number and the remaining decimal part is the *refractive power*. This is the measure of the action of the glass upon rays of light, and it must be known before any focal calculations can be made. For convenience, this number, whatever it may be, shall be denoted by n; let R be the front radius, r the back ditto, and F the principal focus; then the fundamental focal equation is $F = R \cdot r \,/\, (R + r)\, n$. Or, put in words: Divide the *product* of the radii by their *sum* multiplied by the *refractive power*. This applies to the double convex lens; but the rule for the double concave is exactly the same, only F must be called negative, because its focus will be unreal.

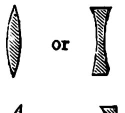
If one surface be flat, the equation becomes $F = R \,/\, n$; or divide the radius by the refractive power. Hence the focus will be real or unreal, according as the radius is convex or concave.

When one surface is convex and the other concave we must take their difference instead of their sum in our divisor; that is, the equation is $F = R \cdot r \,/\, (R \backsim r) n$. If the convex radius exceeds the concave, or R is greater than r, the lens will be a concavo-convex, and will give a negative focus; but if the convex is the lesser, it will be a meniscus, and will give a positive focus. It will perhaps be advisable to exhibit these results in a tabular form with a figure corresponding to each. The upper or + (positive) sign relates to the first form, and shows the focus will be real, while the lower or − (negative) sign relates to the second or concave lens, and denotes that the lens has only an imaginary focus.

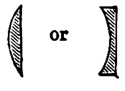
Table of Focal Values.

R, Front radius; r, back radius; F, principal focus; n, refractive power.

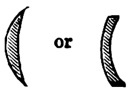
1. Double convex, or double concave .... $F = \pm \dfrac{R \cdot r}{(R + r)\, n}$



2. Plano-convex, or plano-concave .... $F = \pm \dfrac{R}{n}$



3. Meniscus, or concavo-convex .... $F = \pm \dfrac{R \cdot r}{(R \backsim r) n}$



Next, we will assume that it is required to produce a lens of given focus, by curves having a given relation to each other, and of glass whose refractive power has a known value (n). Let the ratio of the front curve to the back one be $R : r :: q : 1$, or $R / r = q$. Then, if F, q and n be given, $R = F (q + 1)\, n$, and $r = R / q$, for the double convex or concave form.

For the meniscus we shall have (since q is in this instance less than 1), R (positive or convex) $= F (1 - q)\, n$, and r (negative or concave) $= R / q$.

For the concavo-convex, q is greater than 1, because the front radius is the greater, and R (as before) $= F (q - 1)\, n$, and r (as before) $= R / q$.

Let us illustrate these rules by one or two examples.

Ex.—A double convex lens is made of glass, whose refractive power is ·52: its radii R and r are 4 and 12 respectively: what is its focus?

$F = (4 \times 12) \div (4 + 12) \cdot 52 = 5{\cdot}77.$

If the second radius r had been concave (thus making it a meniscus), what would have been its focus?

$F = (4 \times 12) \div (12 - 4) \cdot 52 = 11{\cdot}54.$

Ex.—It is required to find the radii in the proportion of 1 to 3 of a meniscus lens of 10in. focus, the material being flint glass, having a refractive power of 0 6? Here $R : r :: 1 : 3$, that is $q = \frac{1}{3}$.

R (positive) $= (1 - \frac{1}{3}) \cdot 6 \times 10 = 4$. r (negative) $= 4 \times 3 = 12$.

Supposing it had been required to form a concavo-convex lens of 10in. negative focus, with radii as 4 to 1 out of the same material, we should have: R (positive) $= (4 - 1) \cdot 6 \times 10 = 18$. r (negative) $= 18 / 4 = 4{\cdot}5$.

Where the two sides of a lens vary in character, I have assumed that the convex is the front surface; but if the lens be reversed, it will not alter its action, and the focal length in the two cases may be taken as equal. It is not accurately so, but in these approximate formulæ it is not necessary to take the thickness into account. In my next paper I will deal with conjugate foci. **O. V.**

TO "TEMPUS."

[19890.]—In reply to "Tempus" (letter 19853), I do not recommend amateurs to *open* brass holes, but make them to the pivot. My reasons are that when the verge is in the turns, it would (I think) be easier for the amateur to make a nice small pivot, finish and polish, without having continually to remove the carriage to offer it, to the bottom hole especially; he can make his hole, as explained in "How to put a Hole to Cock-plate" without losing his Position; the bottom hole he will find more difficult, but with a little practice he will, I think, succeed. If he drills the hole through, puts in a bush with the hole drilled in centre, I don't think he will lose his position at the bottom hole. You see, I want him to finish his verge without removing it from the turns; he can do it which way he thinks is easiest. The holes, too, are generally worn, and I find that new holes are an improvement in escaping. I forgot to mention that he must generally shorten the pallets of the verge; this may be safely done by making a narrow saw-cut in a piece of hard wood, letting the pallet rest on the outside of the cut. When he files it with a fine file, he will find the pallet will bite against the sides of the cut and hold firm; only he must be careful not to file it too much, and see that he does not leave any burr on the face of the pallet.

I am not a self-taught man: but I admit that some of my instructions are original, as I thought it would be easier for a beginner.

I do not recommend interfering with the balance. I think the amateur will get taken in if he tries some of the old balances, they are generally pretty hard.

What part of the cleaning did I neglect? I do not want to take up more room in this paper than is necessary.

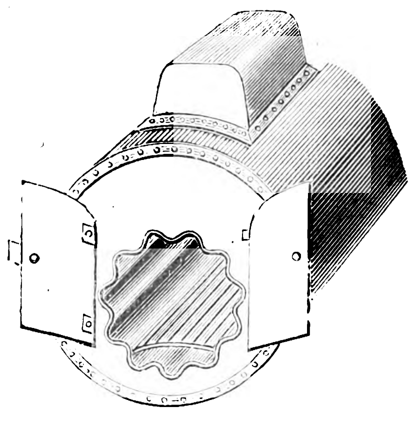
I suppose I began at the wrong end; but I thought I would begin at the escapement, and go right through the watch, to the best of my ability.

I shall be only too pleased for any workman to criticise what I write; and if he can offer any better or easier method, why not do so? It would help to make my articles more complete.

A Fellow Workman.

MODEL STEAM-BOAT BOILER.

[19891.]—"E. L. P." (19846) has given a very good idea for increasing the heating-surface of model boilers. May I also give one which I have tried and found to answer very well indeed? It consists of a corrugated furnace instead of using tubes, and though it might not answer in a large boiler, works well in a model. If sheet brass the thickness of a new farthing be used, the bending will be found an easier matter than fitting tubes. The following drawing will explain better than a long description. **F. G. B.**



PANORAMIC SLIDES FOR THE MAGIC-LANTERN.

[19892.]—Some twenty years ago, when I was an assistant engineer in India, I invented and patented a panoramic camera, but other matters engaged my attention at the time, and besides, strange to say, a patent was taken out in England by a Mr. Johnston, for a camera, made on the same principle as mine; some few years after this I improved on the invention, and when on leave in England, I had a camera made in London, which took two pictures simultaneously: these pictures were stereoscopic, and each took in a view of 180 degrees. This instrument was exhibited at one of the London Photographic Society's meetings, and was examined with some interest. It, however, was too expensive for general use, and a special stereoscope had to be made for it; besides, it was rather unwieldly, being about a yard wide. It was also somewhat complicated, owing to the fact that the collodion-plates had to be flat, whereas the pictures produced by the lenses were circular. I inclose, for the Editor's inspection, a picture taken by this instrument, a view of Falmouth Harbour; this view takes in an angle of 180 degrees, so that, looking at an object represented on the left of the picture and then at an object on the right, the spectator would have to turn "right about face."

In these days of gelatine films, and gelatine paper, a camera could be made of very simple design, as the films or paper would adapt themselves to any curve; besides, the gelatine being so much quicker than collodion, no clockwork (which was a feature of Mr. Johnston's camera) would be required, as one sweep of the lens would produce the picture.

The principle of the panoramic camera will be understood by the following illustration:—I f we hold a single lens between the first finger and thumb (holding by the rim), and using these as pivots, we can turn the lens round its diameter in any direction; now hold it near a wall opposite a window, so that a picture of the window is produced on the wall · it will be found that we can turn the lens through a considerable angle round its vertical diameter without moving the picture that it produces. In the same way it can be shown that there is some vertical line between the two lenses of the ordinary combination used for portraits, round which the combination may be turned through a small angle without the least interfering with the picture it produces.

In my camera, I used small combination lenses by Ross, focus about 3in. (to back lens), front lens about 1¼in. diameter, back about 1½in.

In order, then, to make a panoramic camera suitable for gelatine films, we should have to ascertain the "neutral axis," as we might term it, of our combination lenses.

This is easily ascertained by experiment. Now measure the distance from this neutral axis to the image of a distant object produced by the lens on a sheet of paper or ground glass. This distance will give the radius of the curve of the gelatine film, and the dark slide must be made to this curve. The camera would have to be made of a fan shape; that is to say, the top and bottom would be of this shape, the sides being vertical. The apex or handle of the fan would have to be cut off so as to allow of the lens being placed there. The lens must work between pivots above and below, these pivots being exactly in the neutral axis: and of course some arrangement will have to be made to allow the lens to turn freely without admitting the light. The circular part of the fan-shaped camera must be left open to receive the curved dark frame. Now suppose the lens to be placed in position between the pivots: we attach a tin tube to the back lens of the combination inside the camera, the tube being of such a length that the end farthest from the lens will be within a short distance—say, half an inch—from the sensitive film. Now imagine the tube to be squeezed together sideways, beginning gradually at the end attached to the lens and working towards the other end; we can squeeze it so that the free end will be a mere slit—say, a quarter of an inch wide, and about 3in. high, or about the width of the picture we wish to take.

All the light from the lens will have to pass through this slit, and as the lens is turned in any direction, the slit passes over the sensitive surface.

All that is necessary to take a picture is to place the sensitive film in the dark slide (the film will adapt itself to the curve), place the dark frame in the camera; then, with one motion of the hand, turn the lens through the whole angle that it can turn, and the picture is taken.

The picture I send as an example was taken on a collodion plate. The lenses above described were stopped down to about ½in., and the slit was about ½in. wide, and the whole was taken in about two seconds; with gelatine films, of course, more stopping down of the lenses could be done and a narrower slit used, so as to obtain a microscopic picture.

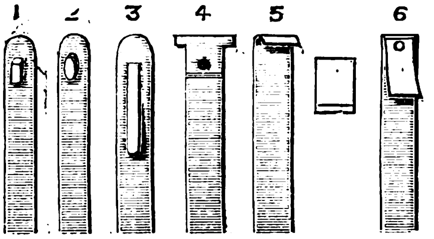
Transparencies printed from negatives so obtained could only be exhibited in the magic-lantern bit by bit; but this is much better than the peep-show views we are accustomed to. If it were not for difficulties about lighting, there is no reason why the principle of the moving lens should not be applied to the lantern, so that we could see the whole panorama at once. The above is a mere verbal sketch, but I could easily make drawings or give further details if the subject is considered of sufficient interest.

Garelochead, N.B. **M.I.C.E.**

WATCH MAINSPRINGING.

[19893.]—The subject of fitting mainsprings to watches is one, I think, which has received but scant attention in the columns of the English Mechanic. Occasionally queries and answers of a desultory kind have been published, but little of a comprehensive character, which dealt with the work of mainspringing in all its phases. The subject is one of paramount importance to all watch-repairers, and, in a remote way, to watch-wearers. I am induced to take this subject up for the reason previously mentioned, and that because information is so frequently sought as to the manner of fitting new springs to watches. Although I take it that the majority of these queries emanate from "outsiders," I still think that much information may be imparted to, and be welcomed by, those who are beginners in the trade, and have only just come within the "pale." In these days of half-and-half apprenticeship, when many young lads are in a measure left to their own resources to "pick up" what little knowledge may be gleaned by observation rather than actual teaching, a few words of practical instruction and advice may serve to help a few of the lame dogs over the stiles of difficulty they meet with at almost every turn in their daily work. When it is considered how large a part the mainspring plays in the economy of a watch, seeing that it is the life, so to speak, thereof, it will not, I think, be occupying space uselessly if a little close study of its action, mode of fitting, relation to the barrel, some causes of breakages, advantage and disadvantage of stopwork, and the benefit of sliding-clicks, be made.

It will be necessary to set before the reader figures of the various forms of hooking and attachment of the ends of the mainsprings to the barrels. I apprehend that the treatment of such questions as these may to many appear needless; so to those I would say, Pass it by. The following examples of spring-hooking will show the various forms now in general use. References will be made to them as I proceed. Until a comparatively recent period only about two forms of hooking were in vogue, and these are depicted in Figs. 1 and 2. Fig. 1, with the hook made of steel, riveted to the end of the spring, and fitting loosely in a correspondingly shaped aperture in the barrel ring or rim as it is sometimes called; the hook being sloped and undercut to the pull of the spring, and the face of the hole sloped in like manner, thereby insuring that the hook be not pulled out when the tension is on the spring. In Fig. 2, the hook, instead of being attached to the spring, is screwed or riveted in the barrel-ring, and its protruding point undercut a little to catch and hold the spring, which, it will be seen, has a hole made in its extremity. Each of these forms—as, in fact, do all the others—have their advocates, and, all things duly considered, not without reason, although it cannot be denied that a given make of hooking may be quite unsuited to a given make of barrel. There seems to be no rule as regards this—various makers selecting whichever form pleases them best. This, then, brings me to the desired point, i.c., which form of hooking is best for this barrel or that. In modern lever watches one more frequently finds the hook fixed in the barrel, and where the hook is made of good brass, of a consistent strength, and properly fitted and shaped, no form of hooking, to my mind, is safer. In practice it is frequently found that with the form of hooking in Fig. 1 the spring breaks close to the riveting. One reason being that the end is not properly softened; and the other, that enough room in the hole is not left to accommodate the swell of the rivet when hammered over. In consequence of which, the metal round the hole is unduly strained, and a fracture there, sooner or later, results. My practical readers will endorse what I say of this form of hooking, that even when the barrel has been adapted to the hook-on-spring style, the hook-on-barrel has been substituted for it, because it has, from one cause or another, failed to hold securely. This is evidence that the hook-on-barrel style is more reliable.



I hold that this form is best, but with this proviso, that the hook is properly fitted. Frequently, from want of careful fitting, the hook "draws," and a new one is needed. I will speak, further on, upon the subject of fitting these hooks, as it is to young hands a source of frequent trouble and vexation. In all the better and middle-class of Geneve watches the form of hooking is as in Fig. 2, where the hole is made in the spring, and the hook fixed in the barrel. In some of the cheaper grades of these watches, as also in some of the lower class Americans, the forms of hooking are as in Figs. 5 and 6, whilst Figs. 3 and 4 represent respectively the better-class American and the English Company's styles. Taking these examples in the order here described, we have in Fig. 5 a very rough and ready form, which, although possessed of strength and reliability, is certainly a very bungling way of attaining that end. In this case either a pin is fixed in the barrel ring, against which the short piece of spring is drawn by the hooked end of the mainspring, or a slot is cut in the barrel-ring which answers the same purpose. The same remarks will apply to Fig. 6, excepting that in this instance: the short piece is riveted to the spring instead of being merely caught up by it. The action of hooking up is the same.

In Fig. 3 we find the same principle carried out in a neater and improved form; but, to the ordinary English workman, more particularly in the provinces, this form of hooking is hardly practicable, inasmuch as very few indeed keep springs of that make in their stocks, and, as far as I know, no punching tool for the purpose of producing the tang from the substance of the spring has yet been brought out by trade tool-makers or vendors. If these springs get broken, comparatively few workmen take the trouble to procure a new spring of the same sort: they invariably take an ordinary lever or strong Geneve spring and rivet a small, narrow piece of spring to its end, or break off the portion of the original spring, as represented in Fig. 3, and rivet that to the new one. This practice is bad, because, either from the rivet-head projecting, or owing to the thickness of the additional piece of spring, valuable room is occupied to little purpose. However, one or two advantages accrue to this form of spring, which greatly outweigh objections on the score of replacing if broken. These are that the probability of "blocking" by undue friction, and the chance of the spring giving way at its hooking-up, are reduced to a minimum. In Fig. 4, we have the English Company's form of hooking or pivoting, as it may more correctly be called.

In conjunction with their patent sliding-click, this form of attachment has little or no fault to be found with it; all that is needed to insure safety being that the pivots be properly set in the barrel-bottom and the cover. Blocking of the spring in the barrel is impossible with these, as, after winding, the returning click allows release to the spring. If the spring gets broken, the small pivoted piece may readily be riveted on a new one. Thus far I have endeavoured to put before my readers the prevailing modes of hooking among watchmakers of the present day. I will not say more as to their merits or demerits, as each in its proper place serves, for good or bad, the purpose for which it was intended.

It is needless for me to enter into a long course of instructions as to the manner of making the various forms of hooking, as anyone having even a very slight knowledge of the use of a file could make and shape as required. In fitting the hook, as in Fig. 1, the rivet should be kept well forward to its face, to prevent the point or edge of the hook rising above the surface of the barrel ring, as the spring is wound up. Should this occur, and not be corrected, the chain may be forced outwards, and catch up in the potence "chain-hollow," thereby stopping the watch.

Apart from the subject of hooking, there are other matters having a bearing upon the subject of mainspringing, which are of great importance to correctness of fit and proper working, and the first of these which I will treat of is the before-mentioned "blocking." By "blocking," I mean that state into which the spring gets when too tightly drawn up.

The friction of the coils one against the other is so great that the tendency of the spring to uncoil itself is overcome, and there is produced either a total loss of power, or the power is exerted with difficulty, until a sufficient "release" has come about to enable the spring to uncoil at an equal rate of speed.

Again, if the number of coils of spring in the barrel is too great, a less number of turns is got than with a shorter spring. If a spring is too short, then the like fault results, so that the mean of these two extremes is the length to be sought for. There are various theoretical and mechanical modes for determining the length a spring ought to be, but most workmen trust to judgment and the eye alone, and when much practice has been had they seldom fail to get a correct length. One very good rule is to divide the space between the arbor and the ring of the barrel in two parts, and let the spring fill one of them. This invariably allows a correct space for the spring to work in. Where stopwork is fitted to the barrel, and is in perfect working order, the mainspring is always at a tension, *i.e.*, it is never fully down, nor ever fully wound up, consequently "blocking" of the spring never happens, excepting it be fouled with dirty, hard oil, which prevents the coils gliding over each other easily. All springs require free oil to them, so any dirty oil should be cleaned away, either by removing the spring from the barrel (which is best done by taking hold of the *second* or *third* coil and easing up gently, not by the *first*, which is generally soft and easily bent), or by working a thinly-pointed peg between the coils as far as possible. In cleaning a watch that has been running a long time, it is always wise to see to the cleanliness of the mainspring. This, being the source of power, should in every respect be free. It it no uncommon thing to find the stopwork wheels either partly or altogether removed from the barrel. Generally speaking, the stopworks are badly fitted, or in the course of time get badly strained, and are a source of evil to the watch unless corrected, replaced with new, or altogether removed; which last, I think, is more frequently done. When the stopwork is perfect in its action, the full force of the winding, at the last pull, is not felt at the barrel-hook because the stopwork takes it; but when it is absent, then the hook takes the whole strain, and it is in such barrels that strong and reliable hooks are most needed, and the weak and insecure ones fail. When the spring is fitted with a tang, stopwork is seldom or never used.

I will now direct the attention of my readers to some known causes of breakage, which may in a great measure be obviated by care in fitting. My experience has been that eight out of a dozen springs, more particularly in watches of a common class, get broken in either the second or third coil. I attribute this in some measure to inattention to the size and make of the arbor hook, and to want of correct tempering of the inner coils of the spring. In the earlier and the better class of Geneve and English watches, it was usual to cut away a portion of the arbor, thus having the hook contained within the circle of the "roller," as it is sometimes called. Consequently, the spring is wound round a true circle, and not anyhow, as is too frequently the case where the hook is sticking a considerable distance out of the roller. In this case, the spring is unevenly coiled, and from the pressure of the outer coils against the inner, and these against the hook, which presents only a point, be it remembered, and that right in the *centre* of the breadth of the spring, it cannot be at all wondered at if the spring does break. In no case should the hook be left longer than is necessary to catch and hold the spring, and the inner coil of the spring should fit close round the roller. The roller-hook should be a little undercut. When a new spring is fitted it should always be observed to have a sufficiently large hole in its inner coil to fit on the roller-hook, without its being pressed up or down in the barrel.

Always examine the new springs for any specks of rust. If marked with it, it is always wise to discard them, as the smallest particle of rust may prove fatal to the durability of the spring. Where springs are kept in quantities, it is a very good plan to cover them with thoroughly dry slaked lime. Springs may be kept for years, without a sign of rust appearing upon them, if treated in this way. Being only a dry powder, the lime may readily be removed by wiping. It is no uncommon thing, either, when a spring breaks, for the hook in the barrel-ring to be forced out, and so necessitate a new one. In doing this little repair, the hole should either be fresh tapped, or a new hole drilled and tapped, if the old one be too large. Never insert the old one and secure with solder, as is frequently done; it is a horrid patch, and never safe. In fitting a new hook, it should be observed to have the thread on it one size larger, according to the number of the hole in the tap-plate, than the tap was with which the hole was threaded. For example, if the hole was threaded with a No. 10 tap, the hook should be threaded in a No. 9—*i.e.*, one size larger. This insures a tight-fitting screw. The point of the hook should in all ways be finished before screwing in, so that only cutting off and filing down outside the barrel is necessary. Occasionally one sees a hook made by inserting a piece of wire in a drill-hole, turned round, and soldered. This, at its best, is a wretched and unworkmanlike way of doing what, even when done in a perfect manner, is only a simple job.

Always take care, in fitting a new hook, that the hole comes in the centre of the ring. If otherwise, the spring, unless it has a large, square, hooking-hole, will be pressed upwards or downwards in the barrel, and so be bound. Always keep a little clearance between the springs and the barrel-lid.

If the lid, when pressed home to its seat, rests also on the spring, it will undoubtedly be bound, and be robbed of much of its power, and so cause it to act in a jerky manner. Always clean out the barrel-holes and the arbor, and re-oil them. In pinning on the stop-finger of a Geneve barrel, care should be taken that in doing so it is not pressing on the barrel-lid. The least portion of clearance suffices. It may have seemed needless to allude to these little matters, but it is well-known that watches frequently stop through neglect of these seemingly trite faults. Remember that small leaks sink great ships, and that one or two apparently insignificant errors may cause the worker more trouble, if neglected, than might a glaring fault which he feels cannot be passed over without correction.

It is always false economy on the part of the repairer to put cheap springs in watches; the difference in the cost of good and bad is but small.

When fitting springs with hooks riveted to them, the workman should always shape the hook and polish its face before it is put in the barrel. If finished off after, as is far too frequently done, the gilding on the barrel will be sure to be injured in the process. The rivet of the hook should be kept well to the front, so as to prevent the face of the hook rising after the spring is wound in the barrel. Never, on any account, if possible, wind in a spring to a verge or lever barrel without the proper winder. If wound in the barrel by the fingers alone, it is sure to get telescoped, and, consequently, will not work free in it. Geneve springs may in some cases be wound in with the winder, and in others by hooking the inner end on the arbor roller, placing the thumb on the barrel-lid over the spring, and turning with a key. See, too, that the arbor has end-shake when the lid is put on. Should a barrel lid fit loosely, burnish the edges over with a tool until tightness is obtained.

When winding in a spring, never let the recoil be great, and the hook snatch into the hole, or the spring on the barrel hook. It may either be injured or torn away by doing so.

I would like, now, to say a few words to watch-wearers ere I conclude my rather lengthy letter. You get very much vexed, do you not, when you hear that ominous buzzing, whizzing, rush of the spring, when it has departed this life? Of course you do, and, mentally, you anathematise the workman who last had your watch in hand; but you think yourselves blameless. Not so fast, good friends! Take a piece of cotton thread, and attach to it a weight, say, a pound or so; lift it gently, and you will raise the weight in safety. Now set it down again, and with a sudden jerk try to raise it again. What is the result? Why, the thread breaks, of course. So it is with the spring of a watch. Either through a badly-fitting key, or a spasmodic rolling-up-a-well-bucket style of winding, the spring is unduly jerked and strained, and soon or late "is not among the things that are." Wind up smoothly and regularly, and ten chances to one a good quality spring will last many years. I have seen springs in good working order after fifty or sixty years' wear and constant usage. Something more than mere quality of metal must have contributed to such a long-drawn-out existence.

I had intended to have written a little about punching, and otherwise making the holes; but my letter has been spun out to such an abnormal length that I fear it will be excluded if I trespass any further. **Alfojoe.**

WATCH REPAIRING.

[19894.]—"A Fellow Workman" begins by saying that his article is intended for amateurs, a class of beings requiring in the general way full and clear instructions. And then he proceeds, at a tremendous rate, to cram the art of watch-cleaning and repairing into less than five columns of the "E.M.," the paragraph on putting in pinions being tite cream. He really must forgive me for saying that the drawings would puzzle a practised jobber, let alone an amateur. Far better would it have been had he taken up the same space with instructions for taking to pieces and cleaning, and left the rest for future articles. I appreciate the spirit in which the article was written, but the article itself must be condemned on account of its *extreme* briefness. I also noticed a short time back that "A Fellow Workman" advised a querist to scrape the end of a hair-spring to make the watch go slower, and he must again forgive me if I tell him that a more barbarous method does not exist, the action of the spring being entirely spoilt by such treatment. His method of putting in new holes means repitching the depths—no easy job for an amateur. I would suggest the use of a bouchon (100 for 1s.). I would also inform "F. W." and "Skip" (p. 65), that it is very bad practice to allow a dirty watch to run down. I used to do it myself once; but after having had the extreme pleasure of twice seeing the 'scape-wheel start out of its place minus a pivot, and the watch go down with a rush, I relinquished the practice. Always let down the mainspring *first thing* in a Geneva, and next to removing balance and dial in an English watch. **F. C. Putley.**

DYNAMO-MACHINES.

[19895.]—I waited with not a little interest for the description of the wonderful machine which "Conrad" foreshadowed some time ago. Now that it has been described, I am somewhat disappointed, and the most powerful objection I have to it is, that it will give no current. We are not concerned at present with the way in which the magnetic field is mapped out; but "Conrad" possibly knows of the existence of what are termed lines of force, and that the current generated in a closed coil moving in front of a magnet is proportional to the addition or subtraction of lines of force cutting the coil. Let W be the work done in moving the coil from a position where N, lines of force, cut it to another position, where N, lines of force, cut it. C = the current in the coil, E = the electromotive force, then $W = C (N - n)$. But the work done by the coil must equal the work done in the coil, and the work done by the coil is ECt $\therefore ECt = C (N - n)$ where t = the time in moving the coil. $Et = (N - n)$ and $E = (N - n) / t$, or the electro-motive force is proportional to the rate of adding lines of force. Now, in "Conrad's" machine, so far as I can see, lines of force are neither added nor diminished during the rotation of the armature to any appreciable extent. The lines of force will cross straight over from one pole to the other, and each coil will cut precisely the same number in every position. "Conrad" appears to think that sloping the poles will give him the desired effect, and it might do so to a very slight extent if there were no iron in the cores; but as he has drawn it I question if he will get a measurable current at all. It is not the fact of the iron cores being magnets that induces a current, but the fact of their magnetic condition being changed, and if there is no change in the condition of the core there is no current. So if the cores of "Conrad's" machine are not magnetised and demagnetised to a certain extent—that is to say, if there is no heating in the iron of the core—there is no current in the coil. To be sure, the ends of the cores on one side next the N. pole are all south, and remain S.; but if lines of force are added and subtracted (although how this can be in "Conrad's" machine is a mystery), these ends must be South, and more—South alternately, otherwise there can be no current; in other words, there must be magnetisation and partial demagnetisation of the cores; therefore, there must be heat in the iron. When "Conrad" hinted at his machine two or three weeks ago, I hope it will not pain him if I say that I never believed he could do what he professed; indeed, he does not properly understand the principles of dynamo-machines in their simplest application; and "Conrad" could do worse than take "Humble Bee's" advice. **E.**

[19896.]—I am sorry that "Conrad" (letter 19882) should have taken my advice to would-be constructors of dynamos in the personal sense he apparently has done. It was bona-fide advice to a class, calculated to help them to attain their desires.

Although the following remarks will be upon the substance of "Conrad's" letter, I trust he will take them in good part, and as meant for the general benefit and instruction. I fear that much useful discussion is lost to the English Mechanic on account of the tendency which many hon. members—I should say, correspondents—display to personalities and imputations of ignorance, &c.

"Conrad" admits that my statements with regard to the Brush machine, and his conception of its action are true. Now, that seems inconsistent, as he says that, during one quarter of a revolution *only*, the coils produce a current, while I say that during that particular time they are out of circuit altogether. Will "Conrad" tell us in which part of the revolution the bobbins are effective? He does not deny the cutting out of the coils.

"Conrad" is mistaken in his premise that currents are *only* induced in wires when the inducing power (intensity of magnetic field, I presume he means) either increases or decreases. That proposition involves another—viz., that a current cannot be produced in a wire moving in a uniform direction in a field of uniform intensity. But the reverse is the case. A current can be induced in a wire moving in one direction in the earth's field, which is sensibly constant for a large space.

The true law of electro-magnetic induction is, that the E.M.F. induced in a conductor is simply proportional to its velocity and the strength of the field in which it moves; in other words, to the number of lines of force cut by the conductor in unit time. Chapter IX. of Fleeming Jenkin's "Electricity and Magnetism," goes into the whole matter simply and thoroughly, and is worth careful study by all interested in these questions. Now, the Brush machine has its coils rotating in a nearly uniform field in one direction for about three-eighths of their rotation, and in a similar field of opposite direction for an equal time. Perhaps "Conrad" does not know that the opposing poles of the Brush machine are similar; if they were unlike, there would be no current.

The iron in the Brush armature takes a considerable part in making the direction of the lines of force perpendicular to the direction of motion of the coils.

The heating of the iron is certainly objectionable; both as a loss of power and as dangerous to the insulation. It is doubtful, however, that reversals of magnetism are the chief cause of this heating. Internal induced currents are more probably the cause.

"Conrad's" machine will undoubtedly produce a current; but the changes in the intensity of the field are so small compared with what takes place in other machines, that he will require a great weight of wire on the armature to give a good E.M.F., or a very high rate of speed. The latter method is limited, however, by the fact that the magnetic changes in iron take time; there is, therefore, a limit to useful increase of speed. Although "Conrad's" armature-iron is not reversed, yet its magnetism is continually altering in intensity—the difference is one of degree, not of kind. In the Siemens direct-current machines, the iron in the armature does not rotate; its magnetic condition is constant, and there should not be any heating in it. Like the Brush armature-iron, it directs the lines of force in a perpendicular to the wires. Probably the modern Siemens machine is the most efficient in use theoretically; practically it is not wound to give the highest efficiency in external work. The Edison is practically a Siemens machine, but with a rotating core—which is a doubtful improvement. Probably the best dynamo will be one without iron in its armature, or only a little, to direct the lines of force, and that little not in motion.

I hope a few others will take up this subject; it should be of great interest now.

Humble Bee.

RAMSDEN'S DIVIDING MACHINES.—PART I.: THE CIRCULAR DIVIDING ENGINE.

[19897.]—Through the kindness of "Ascalon," I am enabled to supply the drawings and description of Ramsden's apparatus. The description may be conveniently divided into three parts: of these, Parts I. and II. relate to the circular dividing engine, and Part III., to that for dividing straight lines. Ramsden was the first to construct a machine which would divide circles or circular arcs with anything like accuracy; and though his invention has, doubtless, been superseded by modern and more delicate mechanism, yet the account will be read with interest; especially his method of ratching or cutting the teeth of the main wheel.

I believe Hindley, of York, was the first to employ the tangent-screw as a means of obtaining slight angular motion in astronomical instruments, and mention is made of an equatorial mounting, having this appliance, made by him.

Troughton also invented a dividing-engine, and I trust some reader will send an account of the method he adopted, of dividing the great wheel into precisely equal parts. Ramsden's method being a tentative one, is long and laborious, and must soon have been supplanted by other and more direct means of obtaining the same result.

FIG. 1

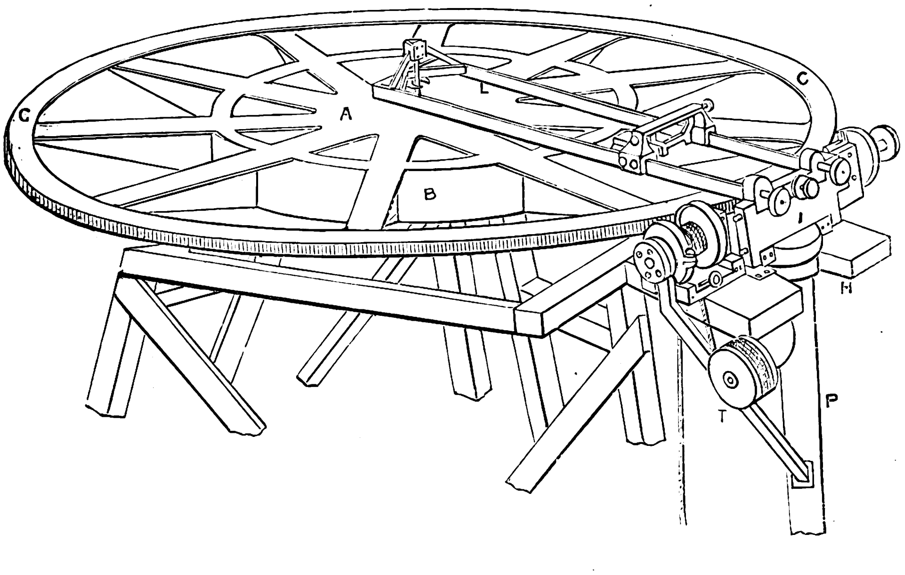


FIG. 3

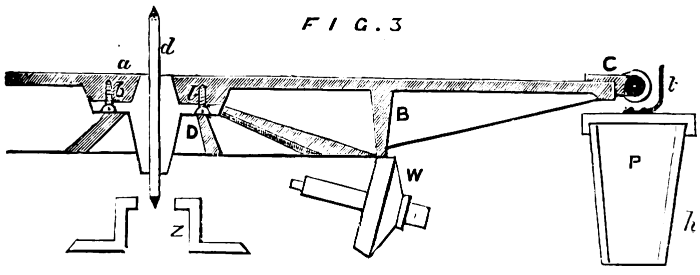
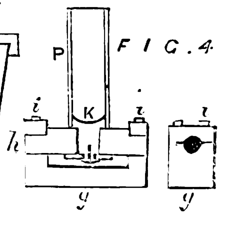


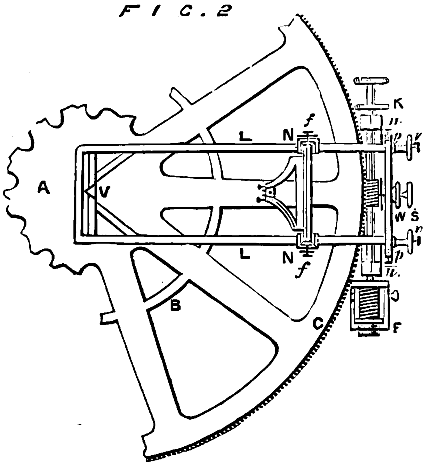
FIG. 4



The following description of Ramsden's circular dividing-engine is copied from Dr. Gregory's "Treatise on Mechanics." The original drawings, together with other information, will be found in Rees' "Cyclopædia."

On discovering the method of constructing this machine, its inventor, Mr. Jesse Ramsden, received £615 from the Commissioners of Longitude, engaging himself to instruct a certain number of persons, not exceeding ten, in the method of making and using this machine, from the 28th Oct., 1775, to 28th Oct., 1777, also binding himself to divide all octants and sextants by the same engine, at the rate of 3s. for each octant, and 6s. for each brass sextant, with Nonius's divisions to half-minutes, for as long time as the Commissioners should think proper to let the engine remain in his possession. Of this sum of £615 paid to Mr. Ramsden, £300 was given to him, as a reward for the improvement made by him in discovering the engine, and the remaining £315 for his giving up the property of it to the Commissioners. The following description of the engine is that given upon oath by Mr. Ramsden himself:—

FIG. 2



"This engine consists of a large wheel of bell-metal, supported on a mahogany stand by three legs, which are strongly connected together by braces, so as to make it perfectly steady. On each leg of the stand is placed a conical position pulley, whereon the dividing wheel rests; to prevent the wheel from sliding off the friction pulleys, the bell-metal centre under it turns in a socket on the top of the stand.

"The circumference of the wheel is ratched or cut (by a method which will be explained hereafter) into 2,160 teeth, in which an endless screw acts. Six revolutions of the screw will move the wheel a space equal to one degree. Now a circle of brass being fixed on the screw arbor, having its circumference divided into sixty parts, each division will consequently amount to a motion of the wheel of ten sec., six of these will be equal to a minute, &c.

"Several different arbors of tempered steel, are truly ground into the socket in the centre of the wheel. The upper parts of the arbors that stand upon the plane, are turned of various sizes to suit the centres of different pieces of work to be divided.

"When any instrument is to be divided, the centre of it is very exactly fitted on one of these arbors, and the instrument is fixed down to the plane of the dividing wheel, by means of screws which fit into holes, made in the radii of the wheel for that purpose.

"The instrument being thus fitted on the plane of the wheel, the frame which carries the dividing part is connected at one end by finger screws with the frame which carries the endless screw, while the other end embraces that part of the steel arbor, which stands above the instrument to be divided, by an angular notch in a piece of hardened steel; by this means both ends of the frame are kept perfectly steady and free from any shake.

"The frame carrying the dividing point or tracer, is made to slide on the frame which carries the endless screw, to any distance from the centre of the wheel, as the radius of the instrument to be divided may require; and may be there fastened, by tightening two clumps, and the dividing point or tracer being connected by the double-jointed frame, admits a free and easy motion towards or from the centre, for cutting the divisions without any lateral shake.

"From what has been said, it appears that an instrument thus fitted on the dividing wheel, may be moved to any angle, by the screw and dividing circle on its arbor; and that this angle may be marked on the limb of the instrument, with the greatest exactness, by the dividing point or tracer, which can only move in a direct line tending to the centre; and is altogether freed from the inconvenience that attends cutting by means of a straight edge. This method of drawing lines will also prevent any error that might arise, from an expansion or contraction of the metal during the time of dividing.

"The screw frame is fixed on the top of a conical pillar, which turns freely round its axis, and also moves freely towards or from the centre of the wheel; so that the screw-frame may be entirely guided by the frame, which connects it with the centre; by this means any eccentricity of the wheel and the arbor, would not produce any error in the dividing, and by a particular contrivance (which will be described hereafter), the screw, when pressed against the teeth of the wheel, always moves parallel to itself, so that a line joining the centre of the arbor, and the tracer continued, will always make equal angles with the screw. Fig. 1 represents a perspective view of the engine. Fig. 2 is a plan, of which Fig. 3 represents a section on the line (xy). x and y are points on a horizontal line passing through the centre of Fig. 2.

"The large wheel A is 45in. in diameter, and has ten radii, each being supported by edge bars, as represented in Fig. 3. These bars and radii are connected by a circular ring, B, 24in. diameter and 3in. deep; and for greater strength the whole is cast in one piece of bell-metal.

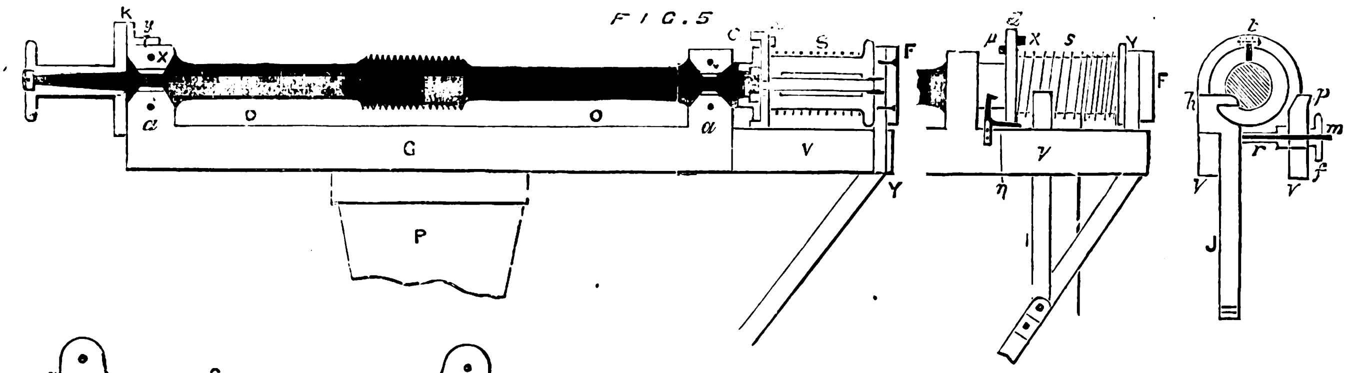
"As the whole weight of the wheel rests on its ring B, the edge bars are deepest where they join it, and from thence their depth diminishes both towards the centre and circumference, as represented in Fig. 3.

"The surface of the wheel A is turned very flat and true, and its circumference turned true. The ring C, of fine brass, was fitted very exactly on the circumference of the wheel, and was fastened thereon with screws, which, after being screwed as tight as possible, were well riveted. The face of a large chuck being turned very true and flat in a lathe, the flattened surface (a, Fig. 3) of the wheel is fastened against it with holdfasts, and the two surfaces and circumference of the ring C, a hole through the centre, and plane part round it (b), and the lower edge of the ring B, were turned at the same time. D is a piece of hard bell-metal, having a hole which receives the steel arbor (d), made very straight and true. This bell-metal was turned very true on an arbor, and the face which rests on the wheel at b was turned very flat, so that the steel arbor (d) might stand perpendicular to the plane of the wheel; this bell-metal was fastened to the wheel by six steel screws (Z).

"A brass socket, Z, is fastened in the centre of the mahogany stand, and receives the lower part of the bell-metal piece, D; being made to touch the bell-metal in a narrow part near the mouth, to prevent any obliquity of the wheel from bending the arbor: good fitting is by no means necessary here, since any shake in the socket will produce no bad effect, as will appear hereafter, when we describe the cutting-frame.

"The wheel was then put on its stand, the lower edge of the ring B, Fig. 1, 2, 3, resting on the circumference of these conical friction pulleys W, to facilitate its motion round its centre. The axis of one of these pulleys is in a line joining the centre of the wheel and the middle of the endless

FIG. 5



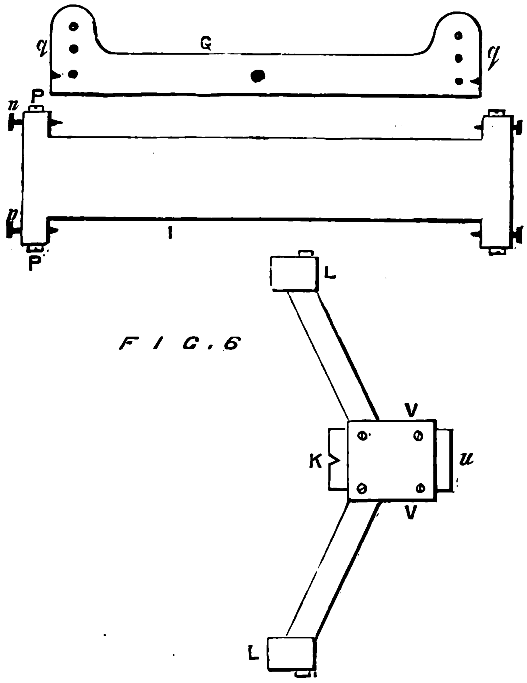


FIG. 6

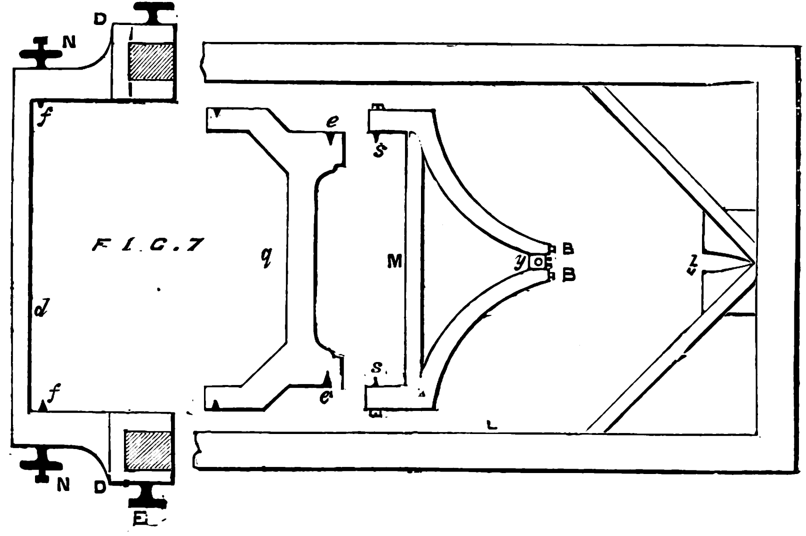


FIG. 7

screw, and the other two placed so as to be at equal distances from each other.

"Fig. 1, F, is a block of wood, strongly fastened to one of the legs of the stand; the piece *g* is secured to the upper side of the block, and has half-holes, in which the transverse axis *h* (Fig. 4), turns; the half-holes are kept together by the screws (1.)

"The lower extremity of the conical pillar P (Fig. 1 and 4) terminates in a cylindrical steel-point K (Fig. 4), which passes through and turns in the transverse axis *h* (Fig. 4), and is confined by a cheek and screw.

"To the upper end of the conical pillar is fastened the frame G (Figs. 2 and 4), in which the endless screw turns; the pivots of the screw are formed in the manner of two frustums of cones, joined by a cylinder, as represented at X (Fig. 5). These pivots are confined between half-holes, which press only on the conical parts, and do not touch the cylindrical parts; the half-holes are kept together by screws (*a*), which may be tightenend at any time, to prevent the screw from shaking in the frame.

"On the screw arbor is a small wheel of brass K (1, 2, 4 and 5), having its outside edge divided into 60 parts, and marked at every 6th division, 1, 2, and to 10. The motion of this wheel is shown by the index *y* (4 and 5) in the screw-frame G.

"H (Fig. 1) represents a part of the stand, having a parallel slit in the direction towards the centre of the wheel, large enough to receive the upper part of the conical, perpendicular pillar P, which carries the screw and its frame; and as the resistance, when the wheel is moved by the endless screw, to against the side of the slit H, which is turned to the left hand—this side of the slit is faced with brass, and the pillar is pressed against it by a steel spring on the opposite side. By this means the pillar is strengthened and supported laterally, and yet the screw may be easily pushed from or against the circumference of the wheel, and the pillar will turn freely on its axis, to take any direction given it by the frame L.

"At each corner of the piece I (Fig. 4), are screws *n*, of tempered steel, having polished conical points. Two of them turn in conical holes in the screw-frame, near O; and the points of the other two screws turn in the holes in the piece O. The screws *p* are of steel, which, by being tightened, prevent the conical-pointed screws from moving when the frame is moved.

"L (1, 2, and 6) is a triangular piece, which serves to connect the endless screw, its frame, &c., with the centre of the wheel. Each arm of this frame is terminated by a steel screw, that may be passed through any of the holes *q*, in a piece Q, as the thickness of the work to be divided or the wheel may require, and are fastened by the finger-nuts *r* (1 and 2.)

"At the other end of this frame is a flat piece of tempered steel, (*b*), in which is an angular notch. When the endless screw is pressed against the teeth of the circumference of the wheel, which may be done by turning the finger-screw, *s*, to press against the spring *t*, this notch embraces and presses against the steel arbor, *d*. This end of the frame may be raised or depressed by moving the prismatic slide *u* (Fig. 2), which may be fixed at any height by the four steel screws (*v*.)

"The bottom of this slide has a notch K (Figs. 1 and 6), whose plane is parallel to the endless screw, and by the part of the arbor, *d*, resting in this notch. This end of the frame is prevented from tilting. The screw, S, is prevented from turning by tightening the finger-screw, W.

"The teeth on the circumference of the wheel are cut by the following method:—

"Having considered what number of teeth on the circumference would be most convenient, which in this engine is 2,160, or 360 × 6, I made two screws of the same dimensions of tempered steel, in the manner hereafter described, the interval between the threads being such, as I knew by calculation, would come within the limits of what might be turned off the circumference of the wheel: one of these screws, which was intended for ratching, or cutting the teeth, was notched across the threads, so that the screw, when pressed against the edge of the wheel, and turned round, cut in the manner of a saw. Then, having a segment of a circle a little greater than 60 degrees, of about the same radius as that of the wheel, and the circumference made true, from a very fine centre, I described an arc near the edge, and set off the chord of 60 degrees on this arc. This segment was put in place of the wheel, the edge of it was ratched, and the number of revolutions and parts of the same counted between the interval of 60 degrees. The radius was corrected, in the proportion of 360 revolutions, which ought to have been made, in 60 degrees, to the number actually found; and the radius so corrected was taken in a pair of beam compasses, while the wheel was in the lathe; one foot of the compasses was put in the centre, and with the other a circle was described on the ring; then half the depth of the threads of the screw, being taken in the dividers, was set on this circle outwards, and another circle is described, cutting this part: a hollow was then turned on the edge of the wheel of the same curvature as that of the screw at the bottom of the threads; the bottom of this hollow was turned to the same radius or distance from the centre of the wheel as the outward of the two circles before mentioned."

Orderic Vital.

(*To be continued.*)

EVOLUTION—THEORY AND PRACTICE.

[19898.]—Some years ago I noticed in this journal questions were asked relating to this subject, and the answers given, as far as I remember, were limited to the square and cube roots, and that, in the rule-of-thumb sort of way, without much reference to the why and wherefore. In some arithmetics which have come under my notice a rule is given for the extraction of roots of all powers, which (dispensing with the necessity of a proper formula, as already adopted in the square and cube roots) results in a roundabout method and extra work. Let a person understanding common division, imagine the work which would be required, if at each time of annexing a new figure to the quotient, he should multiply the divisor by the whole of the quotient, and subtract from the proper part of the dividend. Such as this, by analogy, is the rule given.

Having lately given some attention to the study of this subject, I am now able to set forth a method founded on a uniform principle applicable to finding roots of all dimensions; and will endeavour to explain, also, several matters which are not referred to in the usual stereotyped rules; and this method is, I think, as simple as it is possible to find.

Instead of giving arbitrary rules, which, as a form of words, are soon forgotten, I shall appeal to the understanding by means of algebraic formulæ, showing how obtained in each case, and also their uniformity. And I think it will not be difficult to make this understood by those whose attainments extend no farther than common long division, seeing that, in the absence of negative signs, complexity is avoided. The formulæ will also be much more easily remembered than forms of words, or otherwise worked out in order to find necessary procedure, for few persons, I believe, can remember the rules usually given even for cube root.

As in common division we bring down one figure at a time, so in the square root we bring down two, and so on, according with the index of the root sought; but in order that we may commence at the right place, a system is used of putting a point over the unit's place of each period to be brought down. Thus, putting a point first over the unit's place, we, for the square root, mark over every second figure to the left, and also to the right, if there be any decimals, and so on, corresponding to the index of the root sought.

The formula showing the necessary procedure in each case may be found by taking $a + x$ as a factor, the number of times corresponding to the index of the root sought, which, worked out, gives for the square root, $a^2 + 2 ax + x^2$, cube root $a^3 \times 3 a^2x + 3 ax^2 + x^3$ biquadrate $r . a^4 + 4 a^3x + 6 a^2x^2 + 4 ax^3 + x^4$, and the fifth root $a^5 + 5 a^4x + 10 a^3x^2 + 10 a^2x^3 + 5 ax^4 + x^5$, which last is as far as I need go, as the principles are evident for higher powers. But this information would be of little use, even to an algebraist, without understanding how the terms (minus the first term) are to be placed in order to be added, so as to make a divisor, which is to be multiplied by the new root figure to produce the subtrahend. Now, if we take each term of any formula specified as above, beginning at the right, and place them in the order—units, tens, &c.—it is correct; but then, as each term often consists of several figures (when found) it would overlap the term to its left. In order to rectify this, the use of a formula of cyphers is adopted, and the terms added for a total divisor; thus:

Square.	Cube.	Biquadrate.	5th.
0	00	000	0000
	0	00	000
		0	00
			0

and the last term to the right, under the unit's place. In order, therefore, to proceed correctly, it is advisable to place in the divisor's place the formula of cyphers, which may be indicated, ready to annex to the left each term as worked in figures, not forgetting the last term to be under the last 0.

But algebraic formulæ (minus first term) here shown, if worked out into figures, would produce the subtrahend. But in order to somewhat contract the working, and to have a divisor (as in common division) with which to compare the remainder so as not to exceed, it is better to minimise the formula by dividing it by the x^1 the symbol of the new root figure; so then our divisors will stand thus. (It is better, however, to say here, that the 1st term is not again wanted after the first remainder is found, in fact done with).

$$\begin{array}{l} 2a + x \\ 3a^2 + 3\,ax + x^2 \\ 4a^3 + 6\,a^2x + 4\,ax^2 + x^3 \\ 5a^4 + 10\,a^3x + 10\,a^2x^2 + 5\,ax^3 + x^4 \end{array}$$

Which, when worked into figures in each respective case, is the sum of every divisor throughout, which × by the new root figure gives the subtrahend.

It is now time to explain what is meant by the a and the x. Now, as is usual, a means a known quantity, and x an unknown quantity, for a in the first place is the result of a table of powers, obtained either from memory or otherwise, and when subtracted from the 1st period, as said before, the first term is done with. In the 2nd place, a is to be always understood as the whole of the root or quotient found; and x is the new root figure annexed, or to be in the quotient. But before we find this we make use of a somewhat blind guide—namely (after annexing the next period to the remainder), the trial divisor, which is the commencing term of the respective formula to be used, as last shown. Having from this estimated a new quotient figure which we think to be satisfactory, we complete our divisor as per formula; we add up, and multiply by quotient figure for subtrahend, get our remainder, and proceed as before if more periods are there. In common division, there is the whole divisor to estimate from, but in evolution, only part of it—the known part. By a mental calculation of the next term, and thus by adding materially to the trial divisor (using the provisional new figure) more certainty would result.

There is, however, another blind guide—the remainder; but examples following will make this better understood.

		Trial divisors.	Into.	Appears to be.	Divisor complete.	Remainder.
$\surd$	360	20	260	83	28	36
$^3\surd$	6,858	300	5,858	19	604	1,026
$^4\surd$	130,320	4,000	120,320	30	11,872	25,344
$^5\surd$	2,476,098	50,000	2,376,398	47	223,696	586,530

Here, in each case, where we know that the quotient is 18, &c., yet instead of 8 we get 13, 19, 30, and 47 times, where we must not have more than 9; and again, the remainders are from about 1¼ to 2½ times as much as the divisor. Thus we are completely at sea as to the sufficient new root figure; but perhaps there may be a genius among our readers who could enlighten us with a method of getting over this difficulty.

I will now conclude with an example to the 5th root worked out; and in addition to the foregoing explanations it may be necessary to tell some of your readers that the numbers and letters in the formulæ separated from other groups by × mean that the numbers represented thereby are to be multiplied together, and that the small figures just above the a and x mean also the number of times they are to be factors therein. The usual method of the square root is *essentially* the same as the formula hereinbefore given. Ex. Find the 5th root of 14,348,907.

Formula. 1st subtrahend a^5; 1st divisor $5a^4 + 10a^3x + 10a^2x^2 + 5a^3x + x^4$.

$$a^5 = 2 \times 2 \times 2 \times 2 \times 2 = \begin{array}{l} 14\dot{3}4890\dot{7}\ (27 \\ 32 \\ \hline \end{array}$$

$$\begin{array}{rrr|l} 5a^4 = & 5 \times 2 \times 2 \times 2 \times 2 = & 80.0000 & 11148907 \\ 10a^3x = & 10 \times 2 \times 2 \times 2 \times 7 = & 560.000 & \\ 10a^3x^2 = & 10 \times 2 \times 2 \times 7 \times 7 = & 1960.00 & \\ 5ax^3 = & 5 \times 2 \times 7 \times 7 \times 7 = & 3430.0 & \\ a^4 = & 7 \times 7 \times 7 \times 7 = & 2401 & \\ \hline \end{array}$$

$$7 \times 1592701 = 11148907$$

Barry-road, S.E. **J. H. Huxley.**

MEDICAL REPLIES.

[19899.]—FLAT FEET, BOW LEGS, KNOCK KNEES, AND WEAK ANKLES (46382), is a comprehensive query, which I can only deal with in mere outline. As to flat feet, these are due either to congenital imperfection of the bony arch of the feet, or undue standing upon the feet, and permanent straining of the girder-like ligaments by which the base of the bony arch of the foot is kept together. In either case, flat feet is an incurable infirmity, and one that must be borne with. The policy of such a sufferer is not to aspire to become a postman, or to take up any other life which requires good feet. If he does he will always be getting lame and incurring suffering. Such a man should become a shoemaker, a tailor, or if he have the brains or education to take up a higher walk in life, he may become a wood-carver, an engraver, or other sedentary occupation, in which there is larger scope for an able man to rise.

KNOCK KNEES is due sometimes to congenital deformity of the bones which form the knee-joint, sometimes to mere weakness of the internal lateral ligaments of the knee-joint. The application of a splint, or jointed iron bar support, to the outer part of the knee, so as to keep the knees straight and take the strain off the internal lateral ligaments of the joint, is here the remedy. Sometimes we use a plaster and bandage casing for the knees, the plaster being put on wet, and the limbs held straight till the plaster has firmly set. The child then has either to be kept off its feet, or to walk with stiff knees for a time. Various expedients of this kind are indeed used to keep the knees from yielding inwards while the child is growing, but their selection and their practical application can only be advised upon seeing the case, and the applications need to be seen to be understood. Growing children, in such cases, should always be kept off their feet as much as possible, and especial care should be given to the construction of their boots. Low laced-up shoes, with square toes, broad treads, and very low, broad, vertical heels are essential. Weak ankles are due either to flat feet or to a relaxed condition of the internal lateral ligaments of the ankle-joint, and previous remarks apply.

BOW-LEGS are sometimes due to conditions of the knee-joints analogous to those causing knock-knees, but on the outer side instead of on the inner side. But in some of these cases the bones of the limbs are bent; sometimes the thigh-bones are curved too much, sometimes the leg-bones are curved, sometimes both. Here the treatment is preventive and remedial. Preventive treatment resolves itself into keeping the child off its feet, or giving mechanical support to the bones so as to prevent further yielding. Remedial treatment consists in giving the child such food as will supply earthy matters to stiffen the bones more rapidly. Here again we come back to feeding these children upon oatmeal porridge and milk. In these cases, unless there be some rare constitutional defect, the disease is generally due to the fact that during pregnancy and nursing the mother lived too largely upon meat and beer, and too little upon vegetable food, milk, and breadstuffs, such as brown bread and oatmeal, &c. The result is shown in the softening of the mother's teeth by absorption of the earthy constituents while the baby dependent upon her has its bony framework forming; also by the fact that the child's bony framework is not sufficiently consolidated by earthy matters, and therefore remains in the gristle stage so late that the leg bones bend under the action of the muscles and under the weight of the body. Under the tension of the respiratory muscles also the ribs bend, lose their curve, and the chest flattens, or the patient becomes permanently "pigeon-breasted." Of course other hygienic conditions must be attended to.

SKIN DISEASE—PSORIASIS (46429).—"Marine Engineer" will do well to live largely upon fresh vegetable diet and fruit, to avoid getting over-fat. Local applications are of little use, but a mere patch may sometimes be benefited by wearing over the skin a thin sheet of indiarubber or gutta-percha, or other waterproof material. This relieves the eruption for a time, certainly, but I am inclined to think that the amendment is not permanent. A little creasote ointment (vaseline, 15 parts; pure creasote, 1 part, and thoroughly incorporated), may also be applied, as cold cream would be used for an irritable face. Internal remedies there are which exert a large and more or less permanent control over the disease. But they are powerful and poisonous, and cannot safely be prescribed unless upon personal examination of the patient. "Marine Engineer" may safely try a vegetarian diet. What has been said about milk is not reliable.

MARRIAGE (43435).—The question of health before marriage is one of which the importance is very inadequately realised. "Widower" asks whether a woman aged 25, "who has suffered from pleurisy and sore throat," is eligible as a wife. The sore throat, if an ordinary one, and not of the nature of ulceration of the windpipe, may safely be ignored as not indicative of constitutional weakness. "Pleurisy" is another matter, but in its forecast depending altogether upon the accuracy of the diagnosis. Some people call a mere pain in the side, due to neuralgia, or temporary weakness, "a pleurisy." Rheumatism of the muscles of the side, again, is often called "pleurisy." Real pleurisy is inflammation of the lining membrane of the chest-wall and of the covering of the lung, and it is serious—generally it is indicative of lung-disease. If the woman is of good weight in proportion to her height, not short-breathed on going upstairs, and a good sturdy walker, not easily fatigued, she is not likely to have lung-disease or other constitutional delicacy. If over fat, that is not good. But here, again, the question turns upon the *diagnosis*, and this can only be safely arrived at by the skilled eye of a practical physician. People about to marry, and especially women, should always see that the spouse has passed the examination of a good life office and insured his life *at ordinary rates*. For the working classes the best office by far is the Government Assurance, effected through the Post-office. In this the funds are absolutely safe, they are not wasted in advertising, or in commissions to agents, and the forms were admirably drawn, under the advice of Dr. Farr.

DEAFNESS (46494).—A celebrated surgeon of the last generation, when lecturing to the students on surgery, on coming to the subject of ear-diseases used to say, "Gentlemen, there are two kinds of diseases of the ear—one that is curable by syringing and one that is not." He then went on to his next subject. I think that, speaking generally, what Lawrence used then to say is as true as ever; but patients suffering from deafness are not content to take the opinion of a good surgeon and act upon it, and which in most cases comes to this: "Let it alone." They will keep tinkering at the ear, and they will try every quack who offers assistance. "Auris" may or may not be one of those to whom I should say "Let it alone"; but I cannot say without seeing him and making my own diagnosis. I cannot help him by letter-writing.

COAL-TAR SOAPS (46533).—The only "effect" that these soaps produce is to put money into the pockets of the quacks who sell them. There is no soap better than the pure hard yellow soap. All soap and all ablutions are *cleansers*, but otherwise they are not *disinfectors*. For disinfection of the hands wash them in a weak solution of Condy's Fluid, just strong enough to be well coloured. For antiseptic purposes, use a solution (one in twenty) of carbolic acid after cleansing the hands well with soap and water, and rinsing the soap off thoroughly, as soap and carbolic acid naturally spoil each other. A cleanser is that which removes foul matter. A disinfector is that which kills or destroys its foulness, and, generally, by oxidation or other decomposition. An antiseptic is that which arrests decomposition, and so arrests foulness from arising, or from increasing.

COD-LIVER OIL (46534).—No cod-liver oil is better medicinally than that which can be bought by the pint at a really respectable fishmonger's, who knows what is what in cod-liver oil. The light-brown, dark-brown, and other advertised oils are all quackery, out of which large fortunes have been made by gulling the public, and which are, in no sense, worth the price which is put upon them.

INFANT'S FOOD (46540.)—The reason why

patented and proprietary foods for infants get so largely into vogue is generally because mothers and nurses do not know the simple cooking which is necessary to make nice foods. For babies under six months new milk, mixed with an equal bulk of boiling water and sweetened with loaf-sugar, is the best. It should be sucked out of a bottle. Absolute cleanliness at every step—from the milking of the cow to the sucking-in of the food—is essential; and when the baby is ill, it is nine cases out of ten because the mother does not know her business. The compound food mentioned by "Sigvald" would be very good after the child begins to get its teeth—say, after six months old. But I doubt whether much is gained by any special or very complex foods unless very carefully prepared and partially cooked with great accuracy on a large scale, as some of the proprietary foods are. Baked flour, well boiled to thin gruel and then mixed with an equal quantity of milk and sweetened, or fine oatmeal, or barley flour treated in the same way, are as good in a general way as anything that can be made. But if the stools are pasty, more flour is going down the child's throat than is digested; if curds of milk come away the proportion of milk must be lessened; if sourness, flatulency, and colic occur, the mother or nurse is generally a slut, and an emetic of ten grains of ipecacuanha powder in a little thin gruel should be given to empty out the foul contents of the stomach, and be followed by a little castor-oil to clear out the contents of the intestines. Meanwhile, feed the baby on barley-water, and inspect the bottles, teats, pots and pans, and other nursery arrangements, in order that a clean start may be made. Children are as often overfed as underfed. Many nurses lay a baby on its back and hold the bottle up so as to give the child no alternative but instant suffocation or over-gorging its stomach and all sorts of consequent aches and pains from surfeit.

James Edmunds, M.D., &c.

Grafton-street, Bond-street.

THE ETHOXO LIMELIGHT.

[19900.]—It gave me great pleasure to see in your issue of the 24th, Mr. Lewis Wright's valuable testimony of the merits of the ethoxo limelight. I believe I was the first to publish its use as a substitute for hydrogen gas, in a paper read before the Manchester Photographic Society, on my "Automatic Oxygen Apparatus," in which the principle used by Mr. Fisher is fully described. The only difference being that the oxygen gas for the regulation of the burner is taken from a T-piece a short distance away from the ether tank, to prevent the ether from rising into it. Mr. Wright seems to doubt the efficacy of the pulverised pumice in preventing explosions. If he had used it as often as I have the past three years, under varying conditions and circumstances, I believe he would come to the same conclusion—viz., that it is the best safeguard against explosions. I would not work without it. I have tried other materials, notably coarse emery and sand, but found they offered little or no obstruction to the passage of the flame. While on this subject, let me call attention to the safety mixed jets, so called from having a single layer of wire gauze in some part of the burner, which offers as much obstruction to the passage of flame as a sieve to the passage of water, or an open doorway to the inlet of air: such jets cannot be too strongly condemned. Valves are not much better, for if by any mishap—as, for instance, the filling of the hydrogen bag with oxygen before it has been emptied, and done for the sake of economy (such mistakes have occurred and will occur again). Now should the pressure be suddenly checked, the explosive mixture rushes down the pipes, and if a rubber or other membrane be interposed to prevent the return of gas, burns it and passes on unchecked to the bag, ending in its total demolition, if nothing worse occurs, the past season not having been, I am sorry to say, without its mishaps, Mr. Fisher himself being one of the sufferers, but trust he is recovering.

A good thing for experimental trials is an indiarubber balloon. This should be filled with the mixed gas as it issues from the nozzles, after it has been adjusted to give the best light, afterwards attaching it to one of the taps. So long as the pressure is kept up by the contraction of the indiarubber it burns all right; but when the balloon gets exhausted, the explosive velocity being greater than the pressure, the light is carried back, the balloon bursting with a sharp report. Another of Mr. Wright's objections is the storage of the ether. Until the advent of gelatine plates, ether in one form or other was found on the shelves of every photographer all over the world, and is still used without any great complaints about its storage or "carriage." I have oftener heard the jumping of the stopper of the ammonia-bottle than that of the ether. I have a very simple remedy for that—viz., an indiarubber finger-stall drawn over the stopper and neck like a cap. **W. Broughton.**

CHEAP MICROSCOPES.

[19901.]—May I be permitted to revert to the question of cheap microscopes, seeing that there has been, as yet, no response in the direction mentioned in a communication which appeared in the columns of "E. M." on the 27th January last, No. 19659, p. 495? I have yet to learn that it is beyond the range of possibility to produce "a perfectly efficient" microscope-stand at a less cost than £2 10s. If we consider what has been accomplished by the Americans in the manufacture of clocks and watches, will anyone be bold enough to assert that even a first class microscope-stand is as complicated a piece of mechanism, or requires a more perfect adaptation of parts, or more accurate workmanship, than a watch or clock? Yet these are produced by machinery in almost unlimited quantities.

Surely, it is not too much to hope that some English optician will be found with sufficient enterprise to undertake the manufacture of stands and accessories for microscopes by automatic machinery—otherwise, it is very probable that by a continued observance of the conservative and restrictive policy of high prices for what is, to many, unnecessary workmanship, the Americans and other foreigners will swamp the English market with cheap microscopes as they have already done with clocks and watches.

Take, for instance, the Peep-o'-day clock, manufactured by the "Ansonia Company" of New York, U.S. It is not so very many years since, that a timekeeper, of equal excellence, would have commanded nearly as many pounds as they now cost shillings. I am afraid that English artisans would never have taken the initiative in a reform tending towards cheapness of production. In the case above mentioned, however, the loss to the English watch-trade—and I may say, to the country—must have been incalculable when we think of the tens of thousands of watches alone which have been exchanged for English gold.

It is perfectly clear that a very excellent stand for a microscope need and ought to cost but little, since the price of materials is not worth taking into consideration, and we have also seen that by the employment of suitable machinery, in other instances, the cost of production is so marvellously cheapened.

I wish to be distinctly understood that it is not by any means intended to sacrifice efficiency for the sake of economy, nor do I see any necessity for such an undesirable result, since the chief cost must now, as ever, lie in the construction of the lenses.

G. Welborn, Ph.C.

Woolsthorpe, March 28th.

TOLMAN'S BATTERY.

[19902.]—With all due respect for Mr. Tolman's improved sal-ammoniac cell, permit me to state that that form of battery has been known to electricians for 15 or 16 years, and was the first form of the Leclanché, which depends for its E.M.F. upon the reduction of the salts of ammonia into their approximate elements by electrolysis.

The chlorine, uniting with the zinc, and the ammonia, being liberated, is absorbed by the water; now if this cell has any great demand upon its energy, particularly as it is pretty well sealed, the ammonia cannot escape, and it soon becomes polarised; but if that gas, at the moment of its liberation, met with an element able to decompose it, then the energy of the cell would be prolonged. This the peroxide of manganese supplies, giving up an equivalent of oxygen which unites with the hydrogen of the ammonia forming water; and if the cell is allowed sufficient time to rest between its action, the manganese abstracts oxygen from the air ready to give up when next called upon. The reason of the cell becoming at all polarised is that the sal-ammoniac is more readily decomposed than the manganese. When a substance is found to substitute the manganese, and give up its oxygen at the same rate as the decomposition of the sal-ammoniac, we shall have a splendid battery. I admire the ingenious construction of the cell, dispensing with the porous pot and allowing a good passage for the current; but must protest against the exclusion of so important a factor as the manganese.

W. Haines (Firm of Newton and Co.)

MR. BENNETT'S BATTERY—GRATIS ADVERTISEMENTS.

[19903.]—I thank "Os," Mr. Soward, and Mr. Horton for their replies to my query regarding soda. I quite understand that Mr. Bennett's paper did not say that "potassium hydroxide" and soda were the same thing; but I think to any beginner ignorant of chemistry it may imply as much. It would be much better if all chemicals, &c., likely to be used by beginners, where there would be no likelihood of a mistake, were called by their commercial names.

It may interest some readers to know that the porous cell can be dispensed with.

I have some cells made up in teacups, with a tin partition across the middle, cut so as to be a fair fit, so as not to allow small chips to pass and perforated with a few small holes. The partition may form the negative plate; but I prefer a negative plate, parallel with the partition and midway between it and the side of the cup, packed with turnings between the cup and it, and it and the partition. The positive plate is a bit of sheet-zinc hooked over the side of the cup and reaching to the bottom. (Of course it must be kept carefully from touching the partition.) The cup is half-filled with solution. One of these will ring my bell for one hour and a half continuously, and will regain its normal strength in about an hour. I have not found any difficulty from having the positive side open to the air, neither of my cells being closed.

I have noticed that cells made up on this plan will not start work as quickly as with a porous cell on Mr. Bennett's original plan.

I must say that "Os" has expressed the sentiments of all our readers whom I know, as to Mr. Chaster's letter on p. 61. He ought certainly to send a description of his battery, not merely an advertisement. **W. W. H. G.**

[19904.]—I have had a good deal of experience some time ago with battery cells, and appreciate their improvement very much. Now Mr. Bennett's discovery may be regarded as the distinct root of all future battery cells. I think they may be used almost for every purpose for which voltaic cells are used, depending on the number of elements and arrangement for the various purposes required.

I have tried one of these cells this week (ending 1st April), and I am highly gratified with it; and I have made a modification of it, which will almost make it cheaper. My plan is identical with the Bennett cell, except that I substitute carbon or coke (broken to the size of beans and peas) for the iron borings, with equal satisfaction. This modification is all open at present, but I intend to have an air-tight stopper on the porous pot. The liquid has subsided more than an inch in eighteen hours, which a stopper would prevent. I believe they are stronger when open; but of course they won't be so durable. One cell will produce a shock, with an ordinary size coil (shocking coil), lasting many hours; but the ultimate duration of these cells has yet to be ascertained, and Mr. Bennett's announcement of that will be universally welcomed by the readers of "ours."

South Shields. **J. H. Anderson.**

SCREWDRIVERS.

[19905.]—Sir Edmund Beckett's paper on screwdrivers puts me in mind of a circumstance which occurred with me nearly 30 years since. It was at the close of the General Exhibition in Cork in the year 1852.

The late Mr. John Kennan, the well-known engineer in Fishamble-street, Dublin, was packing up a very beautiful lathe which he had exhibited; he was on his knees screwing down the cover of the case with a *screwdriver set in a brace*. I was standing by him, when he turned up his good-humoured face and said, "That, Mr. Lecky, is the only machine I have ever known in which increase of power is accompanied by increase of speed"! You will easily perceive the drollery of his remark.

1st April. **Robt. J. Lecky.**

COMBINED ELLIPSE AND ECCENTRIC CHUCK.

[19906.]—A practical plan I have seen tried for this has been to make the piece that keeps the leading screw of the eccentric chuck from endway motion, instead of being, as usual, attached by screws, to turn on a pivot, so that by turning it back, the screw is free and can be withdrawn, leaving the slider free to traverse under the guidance of the ring and bars proper to the ellipse chuck. Another way is to make the nut of the slider to attach to it by a screw (or two), as the leading nuts of ornamental sliderests are. This screw, or screws, can be withdrawn by a thin turnscrew, inserted by a hole through the nose of the chuck.

Treadle.

LATHES AND LATHE-MAKING.

[19907.]—"J. K. P." wishes always to be courteous, and is sorry to see, by "Scorpio's" letter (12877), that he has failed in being courteous by "guessing at" something that he cannot understand. "J. K. P." is not aware that he did guess at anything; there was no guessing required. Now, speaking in the first person, I ("J. K. P.") say that I did not understand "Scorpio's" "notation," and I did not use the word "nomenclature" at all. And I have some reason to believe that "notation" means the form in which an equation or mathematical formula is expressed, and as "Scorpio" himself says the formula that he supplied was mutilated by the man who composed his letter, No. 19819, he need not have got his raiment so very much rent on that point. It appears that "Scorpio" has taken the two words "notation" and "vernacular," both of which appear in my letter on p. 55, and out of them has evolved "nomenclature," which he pretends to quote as mine.

As to Whitworth's plan of rounding-off the threads being "slovenly," or the "certain *lathe-screws* USED for ornamental turning," &c., &c., in "Scorpio's" letter, I beg to say that I have been cutting screws for 40 years, and that I never, in the whole course of my experience, saw a screw cut by any one else, or still less (except once) cut one myself that did not at least "profess" to be rounded off to a greater or less extent. That one unfortunate exception I remember to this day with remorse.

What on earth are "Scorpio's" "unavoidable inequalities"?

As to "analogy" between trigonometry and poetry, I don't see the need of supposing such to exist. I merely said I could not understand a poem any better than I could "Scorpio's" formula. Acknowledging humbly, as I do, my ignorance or want of appreciative power, I am said to lack "courtesy," forsooth! Must I go further still, and tell "Scorpio" that by "shop" I mean *work-shop?* And, further still, to tell him that almost all lathes, except those made by Holtzapffel & Co., or by such makers as copy H. and Co.'s tools, have *Whitworth's* threads on their mandrels, as *e.g.*: plain, ungeared, 5in. lathes, ⅞in. diameter, nine threads to an inch; geared 5in. lathe, 1in. diameter, eight to an inch: 5½in. geared, 1⅛in. diameter, seven to an inch; 6in. geared, 1¼in. diameter, seven to an inch, and so on. As a practical man, I should never dream of putting anything but a Whitworth thread on a new lathe-mandrel. Save and except that, I have often thought, and do now believe, that a very much coarser thread would be better still; say, for 1in. nose, six, or even so low as four, threads to the inch, and the nose itself not more than ¾in. long. But this is verging on the heretical and chimerical, so I forbear.

J. K. P.

UNIVERSAL CUTTER.

[19908.]—I NOW give a description of an instrument which sometimes is called a "fly-cutter," and sometimes a "universal cutter." It is very easily made, and is capable of doing very beautiful work. The one I am describing, and which I have made for my own use, I only work in two positions, vertical and horizontal, and though I have seen descriptions in books of instruments somewhat similar, but made to work at intermediate angles to mine, I never saw any advantage in it, and they are much more complicated. Fig. 1 is a general view; the head or frame A B C is of gunmetal cast in one piece. The part A, which carries the mandrel, is 1in. long by ⅞in. diameter, and is cylindrical; the mandrel is of steel, and has a round boss D at one end, having a square hole through it, into which fits the tool G, which is secured by the set-screw H, which has a squared head for a small spanner. This square hole or tool-holder must be made so that the centre of the tool is in a line with the centre of the square shank I, so that, no matter whether the instrument is set vertically or horizontally, the tool will still be in a line with the centre of lathe mandrel. The dotted lines show the shape of steel mandrel and how it is coned to compensate for wear, and of course, A is bored out to correspond, and the two are nicely ground together. Over the other end of mandrel a steel pulley, E, is slipped and made to revolve together by a feather, and at F are two lock-nuts, by which the wear can be taken up; there is an oil-hole in centre of A, as shown. At C the casting is bored to fit tightly on the rounded end of shank I, and both casting and shank are then drilled through and pinned as shown at C, and must be placed so that when I is in tool-holder of slide-rest, according to which side the shank is placed on, so the mandrel of instrument will either be truly horizontal or vertical. The shank I is ⅝in. square. When used horizontally, the gut-band from overhead passes directly round the grooved pulley E; but when used vertically, after passing round F, the band must go round the two guide-pulleys K K. A side view of these guide-pulleys, and their mode of attachment to frame, is given in Fig. 2. The pulleys are secured to an iron boss, L, by two screws, which also serve as axles; and the boss has a shank M, which screws into the frame B Fig. 1, so that the guide-pulleys, with their boss, can be readily unscrewed and removed at pleasure. Fig. 3 shows the shape of the tools used in instrument. The four in bracket are a front view, and the fifth a side view. The tool shown in tool-holder is generally made in three or four widths at cutting end. These tools are 1in. long, by ¼in. by ⅜in. shank. With this instrument, such work can be done as plain fluting of different widths; what is called the basket pattern, either straight or spiral; also straight line patterns on flat surfaces, such as the lid of a snuffbox; and this is also the best tool to use, set vertically, in beading or fluting irregular-shaped articles in combination with the curvilinear apparatus. Also the geometric staircase, which is very beautiful, can best be done with it; and as Mr. Evans explains how it may be done with the eccentric chuck, in the number for March 3rd, I shall give a short account of how I have executed the same pattern with this instrument. First turn the stem of your vase, or whatever the article is, cylindrically between centres of lathe; set your slide-rest with this instrument in tool-holder, parallel to work, with the mandrel of it horizontal, and a tool similar to the one shown at G of whatever width you wish the steps of your stairs to be. Throw off the band of your lathe, and put the overhead gut in its place around the pulley E. Place the counting index point in first hole of circle on dividing-plate of lathe, and beginning at one end of work, make the first cut straight into the centre of cylinder, which, if it is of any length, will require a back steady to support it. For the next cut, move main slide of rest as many degrees of its scale as are equal to the width of tool used, and move the index as many holes on dividing-plate of lathe as will give the spiral required, whether a quick or slow one, and take a second cut to the same depth as first; and so on, making the same movements between each cut until the stairs are complete. I often make it double or treble if the cylinder is of any thickness, and to do this you move back the slide of rest to where it commenced, then place index point at the half or third of circle, according as you want a double or treble spiral, and proceed as before. I think anyone will say there is less risk of injury to the work by accident in this mode than Mr. Evans's, and besides, the cutter revolving so much quicker, leaves a cleaner cut than with a fixed tool and the eccentric chuck. Another way in which I have sometimes varied this pattern is, previous to cutting the steps, to bore out the cylinder its entire length, and after the steps are cut, to insert a rod turned to fit the bore, of ebony, say, in an ivory staircase, or an ivory rod in an ebony staircase, and the contrast is very pleasing.

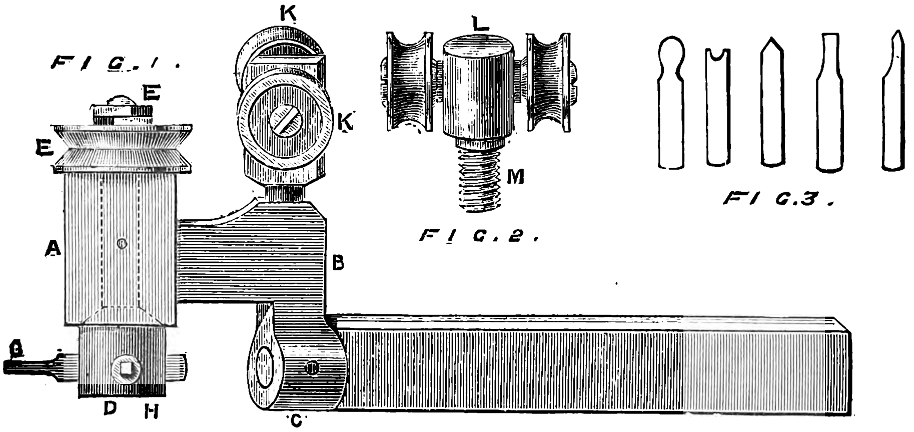


FIG. 1. FIG. 2. FIG. 3.

In using the universal cutter, you must feed it very gently, and keep the tool sharp, and drive it quickly; otherwise, in consequence of the necessarily small size of the pulley E, only 1in., the band will slip and the tool catch in the work, though it never does any damage, such as a fixed tool in the slide-rest would do if it were to "catch in."

F. W. G.

HUXLEY'S CALCULATING MACHINE.

[19909.]—THE machine for calculations illustrated on page 56, ENGLISH MECHANIC, is novel and ingenious, but the description fails to convey to your readers that its utility is likely to equal that of a well-arranged straight slide-rule. In such calculations as, say, the cost of 11cwt. 1qr. 17lb., 13cwt. 2qr. 19lb., 17cwt. 3qr. 13lb. at 17s. 7d. per ton, the latter instrument giving the respective values 120, 144, 188 pence, each within one halfpenny of correct, all at a single setting, and each operation and result being left undisturbed and open for revision (when necessary, at least); but by the proposed machine, for same examples, the cwts. or qrs. in a ton on arm G having been adjusted to the price 17s. 7d. on arm F, the arms B C require to be pressed together or opened for each calculation, so each operation on B C, but last, has to be disturbed, and consequently is beyond revision unless by re-setting. And, further, as by the straight rule, square and cube powers and roots are obtainable at sight, and such calculations as $\sqrt{5\cdot5^3/11 \times 53/37 \times 17}$ give 19·2, answer, very nearly, at one setting. A careful consideration of the two systems, viz., by proposed and straight instrument, is important.

March 28th. **Buttershaw.**

GRESHAM'S AUTOMATIC VACUUM BRAKE.

[19910.]—I HAVE noticed lately several queries in the ENGLISH MECHANIC relating to the automatic vacuum brake on the L. and S.W.R. I have prepared a short description of it with a rough diagram, which I trust you will insert, if you can afford the space, feeling sure it will be of interest.

Gresham's automatic vacuum brake is a modified form of Smith's automatic vacuum brake, and has been tried on the G.N. and L. and N.W. railways. It has also been fitted to the new L. and S.W.R. rolling stock. Its action is as follows:—

Before starting, the driver creates a vacuum with the large ejector on the engine in the train pipe, and also in the vacuum reservoirs (R), in connection therewith, which are under each carriage. Whilst running, the vacuum is maintained by the small ejector until the brakes are required for use, when air is admitted to the pipes, and the brakes are applied.

FIG. 1.

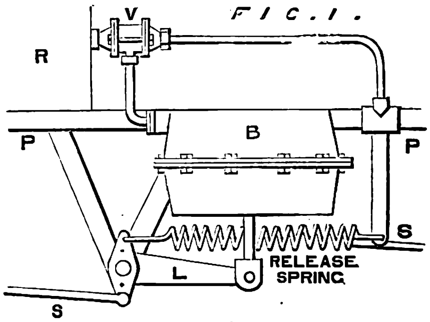
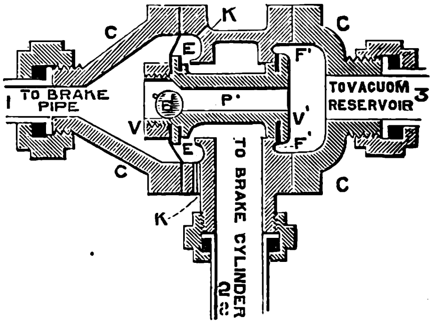


FIG. 2.



Under each carriage is fixed a patent valve V (Fig. 1), which is connected with the reservoir R, the Hardy brake cylinder B, and the train-pipe P, a passage being also provided to the atmosphere. Whilst the vacuum is maintained in the train pipe the main valve V (Fig. 2) is drawn into the position shown, and the rubber faces F′ are pressed against the seatings in valve-casing C. The pressure of the atmosphere entering at K and acting on the diaphragm D serves to keep the valve in this position. It will be seen that all communication between the brake cylinder B and vacuum reservoir R is effectually cut off, while the brake cylinder is in free communication with the atmosphere, and the blocks are kept clear of the wheels. At the same time the ball-valve B′ is unseated, leaving a free passage P′ through the main valve V′ between the main pipe and the reservoir, and the vacuum is maintained in the latter. When the vacuum is destroyed in the main pipe P, either by the driver, guards, or by accident, the pressure on D forces it and the valve V' over; the rubber faces F seat themselves, and those marked F' are unseated. Meanwhile, the valve or ball B' has been seated, preventing the destruction of the vacuum in the reservoir. In the position as above described, the main valve V' cuts off all communication between the atmosphere and the brake cylinder, and, owing to F' being unseated, the vacuum in reservoir R draws out the air from the brake cylinder. The leather diaphragm in brake cylinder is forced up, and the piston-rod draws up lever L, carrying with it the rocking shaft, and consequently the rods which pull the blocks on to the wheels. To release the brake a vacuum is created in the pipes, the valve V' returns to its first position, the vacuum is destroyed in the brake cylinder, and the brakes are released. Clayton's coupling is used with this brake.

Can Mr. Stretton kindly say if the automatic or self-closing couplings for the Westinghouse brake have been condemned, as I see that all the new carriages fitted with that brake have the old-fashioned cocks at the end of each vehicle. Will he kindly say why this change has been made? If it will be of any interest, I shall be happy to send a sectional sketch of the couplings.

Centaur.

THE CONTINUOUS BRAKES RETURN.

[19911.]—THE Eighth Continuous Brakes Return (No. C 3,149) has just been issued, and the following table gives the amount of rolling stock fitted with brakes which appear to fulfil the necessary "conditions."

As upon former occasions, I have placed vehicles which are provided with connecting-pipes only in a separate column.

Statement showing the amount of Rolling-stock fitted with Continuous Brakes which appear to comply with the Conditions of the Board of Trade, December 31st, 1881.

Name of Continuous Brake.	Name of Railway Company.	Amount of Stock fitted.		Fitted with Connecting-pipes only.	Miles run by fitted train in half-year.
		Engines.	Carriages, &c.		
Barker's Automatic	Great Eastern	2	12	..	51,809
Eames' Vacuum	Lancashire and Yorkshire ..	5	8	..	Not given
Fay, Newall, and Eames' ..	Lancashire and Yorkshire ..	..	10	..	Not given
Fay, Newall, and Sanders' ..	Lancashire and Yorkshire ..	..	6	..	Not given
Sanders and Bolitho Vacuum	Great Western	297*	996	71	1,033,053
,, ,, ,,	Lancashire and Yorkshire ..	2	2	..	Not given
,, ,, ,,	Midland	281*	1,703	714	2,550,317
,, ,, ,,	Somerset Joint Committee ..	..	..	2	..
Smith's Automatic Vacuum ..	Great Northern	2	33	..	33,422
,, ,, ,,	Lancashire and Yorkshire ..	5	33	..	Not given
,, ,, ,,	London and South Western ..	13	42	..	16,653
,, ,, ,,	Taff Vale	4	15	..	11,731
,, ,, ,,	Dublin, Wicklow, and Wexford..	2	14	10	2,040
Steel M'Innes	Caledonian	4	33	10	23,689
Westinghouse Automatic ..	Great Eastern	64	757	..	792,932
,, ,,	Great Northern	2	14	6	16,750
,, ,,	Lancashire and Yorkshire ..	19*	37	..	Not given
,, ,,	London and South Western ..	2	7	..	19,593
,, ,,	London, Brighton, & South Coast	238	1,672	313	2,428,266
,, ,,	London, Chatham, and Dover ..	12	71	9	131,351
,, ,,	Midland	57*	94	141	430,931
,, ,,	Midland, Scotch Joint Stock ..	..	40	..	
,, ,,	North Eastern	271*	1,590	123	2,734,307
,, ,,	Rhymney	8	13	13	38,868
,, ,,	West Lancashire	3	16	..	23,008
,, ,,	Caledonian	24	501	66	95,300
,, ,,	Glasgow and South Western ..	52	160	153	322,224
,, ,,	North British	96	656	245	1,122,656
,, connecting-pipes	East Coast, Joint Stock, and Cars.	..	..	121	..
	Total as above	1,465	8,535	1,997	
	Total June 30, 1881	1,132	6,881	1,224	
	Showing an increase of	333	1,654	773	

The total passenger rolling-stock consists of 5,287 engines, and 45,235 carriages and vehicles, and the table shows that only 1,465 of the engines and 8,535 of the carriages are fitted with efficient brakes.

The Great Western and Midland companies include 578 engines as fitted with the Sanders and Bolitho Vacuum brake, but the fact is they are provided with *steam brakes*, which do not fulfil the conditions, and are not self-acting in case of accident.

During the half-year twelve more Midland express engines have had the Westinghouse Driving-Wheel brake fitted to the coupled wheels. Sixty-six horse-boxes and other vehicles have, during the same period, been fitted with connecting-pipes for both the Westinghouse and Sanders brakes.

Barker's Hydraulic brake has been removed from three more Midland carriages and replaced by the Sanders and Bolitho.

The Lancashire and Yorkshire Railway Company has nineteen engines with the Westinghouse brake, but seven of these are working with trains not so fitted.

The North-Eastern have 35 goods engines provided with the Westinghouse brake to work excursion trains.

Kendall's steam brake has now become extinct, as the North-Eastern Company has removed it from the trial train of one engine and nine vehicles, and this rolling-stock will be refitted with the Westinghouse brake.

One new system appears for the first time in the present return—W. Parker Smith's automatic vacuum. It is fitted to four vehicles on the Liskeard and Caradon railway, but it can only be applied by the guard.

The following brakes are also in use, but they do not fulfil the conditions, and are, therefore, inefficient:—

Barker's Hydraulic (two systems).
Clark's chain.
Wilkin and Clark's chain.
Clark and Webb's chain.
Fay's.
Fay and Newall's.
Newall's.
Heberlein friction.
Smith's vacuum.
Parker Smith's vacuum.
Westinghouse pressure.

It is unsatisfactory to find that, during the past half-year some companies have fitted trains with inefficient brakes, which, at some future time, will have to be removed or modified, thus causing great unnecessary expense, trouble, and delay.

Clement E. Stretton.

Saxe-Coburg-street, Leicester, March 31st.

ERRATA.—P. 81, col. 2, line 70, for "mound on the foil, if iron, carefully" read "mound, on the foil, of iron carefully," P. 81, col. 3, line 34, for "base" read "box." P. 88, col. 3, line 14 from bottom, for "compound of ammonia" read "compound ammonia."

Alfred W. Soward.

AT a cost of £88,000 nearly 1,900 miles of railway have been interlocked on the London and North-Western Railway.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[34041.]—**G.N. Engines (U.Q.)**—There was a class of passenger engines introduced about the time referred to, built by Hawthorn. This class had single driving-wheels, 6ft. 6in. diameter, and leading and trailing wheels 4ft. diameter. The cylinders were 16in. diameter and 22in. stroke, boiler 10ft. by 4ft., 174 tubes, 2in. diameter; lap of valves 1⅛in., lead in full gear, 3-16in., ports 14in. long, steam ports 1¼in. broad, exhaust ports 2¾in. wide, no dome, cylinders inside. Or does querist refer to those of the Crampton type, inside cylinders and intermediate crank-shaft? They had 7ft. drivers and 16in. cylinders, stroke 20in. They were, I believe, built by E. B. Wilson, Leeds.—CARSTAIRS.

[34042.]—**G.E. Engines (U.Q.)**—The old 97—102 class, built by Stephenson, were, as "N. Z." remarks, very powerful engines considering the period when they existed. They had domes of the well-known Stephenson type, on firebox; I believe he is correct with regard to the dimensions he quotes. To these, however, I can only add the weight, which was 24½tons, of which 8tons 16cwt. rested on the leading-wheels; 10tons 15cwt. 2qrs. on the driving-wheels, and 4tons 19cwt. on the trailing-wheels.—CARSTAIRS.

[35398.]—**Jenny Lind Engines (U.Q.)**—If "R. N. H." has not yet got the required information, the following may be of service to him. These engines were used on the Midland, M.S.L., L.B. and S.C., and E.C. railways. They were built by E. B. Wilson. On the M.R. 26 and 27, on the Brighton 61 to 69, and E.C.R. Nos. 103 to 107 were of this type. They were single engines, with inside cylinders, double frames, inside bearings to driving-axles, and outside to leading and trailing; fluted dome on boiler, and safety-valve to match on firebox. The pumps were either worked by a small eccentric (outside), or by crank-pins in the bosses of the driving-wheels. They varied on different lines in minor details. All had cylinders, 15in. by 20in. stroke; driving-wheels, 6ft.; carrying-wheels, 4ft. M.R. 26 and 27 had 124 tubes, 2in. by 11ft.; heating-surface, 708 sq. ft.; firebox, 57 sq. ft.; and weight, 24 tons. The "Jenny Lind," on the M.S.L., had more firebox-surface, viz., 81 sq. ft., and grate-area, 12¼ sq. ft. Other engines of the same class had 142 tubes 2in.; heating-surface, 910 sq. ft.; firebox, 90 sq. ft.; total, 1,000 sq. ft.; boiler, 3ft. 10in. by 11ft. long. The E.C.R. "Jenny Linds" (103—107) weighed—

	tons	cwt.	qrs.
On leading-wheels	7	17	2
,, driving ,, ...	10	19	0
,, trailing ,, ...	4	0	2
Total	22	17	0

—CARSTAIRS.

[45569.]—**Velocity of Water in Sewers.**—"J. C. S. B." is in error in the result on page 571, Vol. XXXIV.; he shows a greater discharge for 18in. pipe ⅔ full than is due to 18in. pipe running full down 1 in 100. Velocity $= 55\sqrt{R \times 2H}$, $55\sqrt{\cdot436 \times 2 \times 52\cdot8} = 55 \times 6\cdot8 = 374$ft. velocity, $374 \times 1\cdot254 = 469$ cubic feet per minute.

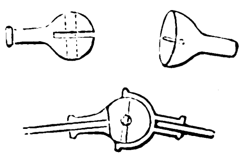
$$R = \frac{1\cdot254 = \text{area of water in pipe}}{2\cdot874 = \text{wetted circumference of pipe}} = \cdot436$$

R is the hydraulic mean depth, and in circular pipes running full is one fourth diameter, and would be $1\cdot7671 / 4\cdot712 = \cdot375$ in that case as against ·436 as above; the 18in. pipe full would have velocity 346·5ft. per minute, and discharge 610·2 cubic feet per minute.—JOHN S. B. BELL, C.E., Newcastle.

[45765.]—**Watch Jobbing (U.Q.)**—"Cranto" must enlarge his barrel holes, turn a stopping to fit, rivet in, and open to fit pivot: but this must be carefully done, or the barrel will be thrown out of flat. You omitted to mention the sort of barrel you wish to operate upon.—F. C. PUTLEY.

[45766.]—**Watch Fusee Chain (U.Q.)**—One end must form a double link, and the other a single one. To accomplish this hold the chain in the nippers in such a manner that only the part to be removed projects beyond them, the best place to hold it being across the next rivet, which is thus prevented from starting. Rest the projecting link on its edge on a piece of hard wood or bone held in the vice, and with the point of a penknife split the link open, and extract the rivet and the broken part of link. Should rivet remain behind, it may be extracted by placing it over a small hole, using the point of a needle as a punch, and a light tap with the hammer. Practise upon a large chain at first, and for rivets get a piece of chain wire from a watchmaker. Fit chain together so that both hooks point the same way.—F. C. PUTLEY.

[45864.]—**Universal Joints in Shafting.**—In the annexed sketch "Ignoramus" has sketch



asked for of the cup-and-ball joint for shaft. It is known as Keller's. The pin shown by dotted lines in left-hand half goes through the bar in the right-hand half, one of which pins merely bears against the interior wall of the shell. In another form the globular portion is kept in the hemispherical shell by means of a ring-cap bolted by its flange to a flange on the other portion. In that case friction is the only thing compelling one portion of the shaft to turn the other. I think it will be better for the querist to use four joints at angles of 15° than two at 40°.—J. T. M.

[45949.]—**Soldering.**—I am merely about to mention that for soldering anything that can be done with a lamp, there is nothing like muriate of ammonia dissolved in water; whatever has to be soldered, the solder melts just when the muriate evaporates. The wire or brass is merely wetted with it and touched with the solder, as it dries and evaporates. No cleaning is required, and no corrosion takes place, and it is seen at once when the solder will melt.—Edw. Thos. Scott.

[45990.]—**Organ Pipes (U.Q.)**—The scale of pipes in the above-named query are as follows:—CC 4in. by 3½in.; Ten. C 2in. by 1¾in., Mid. C 1¼in. by 1 1-16in.; G in Alto ½in. by ⅝in. I may here also state that the front boards of those pipes are cut across inside for height of mouth, which is one third the width of pipe.—D. W. C.

[46015.]—**Fowls.**—I see every now and then questions about their laying, and about this most people are sadly mistaken, and then complain of the fowls. You hear people say, "I get so few eggs and I give them the best barley, maize, and in extra quantity too, and the eggs don't pay the cost." Yes, and you may go on giving them barley and those kind of things, and they don't lay. People are quite mistaken. Fowls are really animal feeders; and if you want them to lay and to go on laying the greater part of the year, you must not give them too much barley, wheat, &c., but give them some animal food. Had I not done away with the account, I could have told a tale about my fowls. I always let them come into the garden when digging, or turn up some ground for them to get the worms. I collected all the snails I could get, and it is a good plan to get a sheep or bullock's liver and boil it hard, and give them a little every day. I cannot tell particulars; but we had five fowls, and from them we got above 1,500 eggs in the year, but gave them little grain food. They cannot lay properly if they don't have animal food.—Edw. Thos. Scott.

[46160.]—**Birmingham Wire Gauge.**—"Collodion" should procure from Spons, Charing Cross, the "Report of the Committee of the Society of Telegraph Engineers," price 1s., in which he will find a table of the B.W.G. according to different authorities. Mr. T. Hughes also issues, with same publishers, a pamphlet on the "English Wire Gauge," price 2s. 6d., which contains a table giving the French and German gauges. From the tables he will find that B.W.G. has no definite size to any No. of wire, but that wire of a certain No. may be some thousandths of an inch smaller or larger than the gauge by which it is measured. —Nun. Dor.

[46161.]—**Pumping to Pressure.**—If I put down a set of pumps for the high level, I should want an escape-valve in the well or in the reservoir. More information will oblige.—Water Motor.

[46180.]—**English and Norwegian Fish Guano.**—Somewhere in the Parliamentary papers there is a report from Consul Crowe on the trade and industries of Norway, but when it was issued I do not know. I am inclined to think that something similar to the following appeared in these pages some time ago, but here is an abstract of the matter. The Norwegian fish guano is made by grinding fish-offal, composed chiefly of heads and bones of the cod. The Norwegian manufacturers of Lofoden and Finma rkmake their guano almost exclusively from the heads and spines of the codfish, offal from herrings and soft parts of cod and other fish being seldom utilised for this purpose, as the expense of producing guano from the latter substance is greater and the product of an inferior quality. The manure which originally appeared for sale under the name of Norwegian fish guano was made exclusively of the first-named substances, and, according to chemical analysis, is composed of the following elements: Water, 13 per cent.; organic substances (of which 8 per cent. is nitrogen, and 7·6 per cent. ammonia), 49·3 per cent.; and inorganic substances (of which 14·9 per cent is phosphoric acid), 37·7 per cent. This larger proportion of fertilising agents has led to its being held in such high favour in the agricultural markets. It is manufactured as follows: The heads and bones of the fish are collected at the fishing-places and dried on the hills in the open air, before putrefaction sets in, the heads being tied in bundles of twenty each, and the bones carefully separated. After having been sufficiently dried, so as to be no longer exposed to the risk of putrefaction, they are carried into the manufactory, where they are cut into small pieces, thoroughly dried on plates in a kiln, and crushed; finally, the mass is ground between large millstones to the fineness of common flour. The heads and bones are crushed separately, but mixed together during the grinding process. As a rule, one sack, containing 204 pounds of bones, is mixed up with five sacks of heads; this turns out the best result. When guano is to be produced from damaged salt fish and herrings, the mode of manufacture is different, as the fish is not capable of being dried when containing salt, which must be previously removed. This is effected by means of a cylindric caldron of iron, furnished with the necessary cranes and openings for filling in and taking out the raw material; after that the cylinder is filled, steam is led into the bottom of the same from a boiler, and the mass exposed to a pressure of 30 pounds for about half an hour, sufficient to separate the salt, which runs off through a channel in the cylinder. The mass is then taken out, dried in the kiln, and crushed and ground in the manner above described. Fat is a similar hindrance to drying the raw material. When guano, therefore, is to be produced from herrings, or flesh of whales, Greenland sharks, &c., the mode of manufacture is the same as in the case of salt fish, the fat being extracted by means of steam-pressure, after which the mass is easily dried and ground. Guano of herring-heads is manufactured in the same way as cod-offal, the raw material being simply dried and ground; but this guano is of an inferior quality.—S. A. C.

[46189.]—**Muffle for Firing Painted Glass**—To "Jack of All Trades."—Many thanks. Would you add to your kindness by giving drawings and dimensions of cast-iron muffle to take 12 by 12 superficial, and with four shelves; also some idea of how to fix it in brickwork. I am not near pottery, and no fireclay to be had in locality. State distance from firebars to bottom of muffle. Also whether the flame must be in contact with bottom and all four sides?—Vitreus.

[46234.]—**Drum Timepiece.**—Some correspondents seem to be puzzled about pallets of drum timepieces, when cut, to put them in repair. This is easily done by lengthening either pivot of pallet-arbor, and putting a new bush to shift pallets either forward or backward, as required, for a new place for wheel to work on. A frequent cause of stoppage in these timepieces is the wearing of pivot above pendulum; when this is the case, it is best to make a new pivot here, and put a new bush in plate; this gives the desired result, both in pivot and escapement.—Skip.

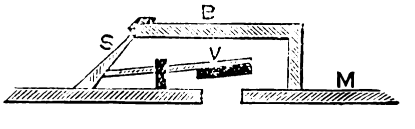
[46284.]—**L. and N.W.R. Brake Trial.**—The brake tried on the L. and N.W.R. on the 15th of February, was Gresham's modification of Smith's automatic vacuum brake. I have sent a description of it to the editor, which he will perhaps insert.—Centaur.

[46285.]—**Railway Brake Trials at Newark.**—I cannot say whether a report of these can be obtained; but "E.W. J." will find full details and much interesting information as to the engines which drew the trains, and also concerning the action of the brakes, in the *Engineer*, published immediately after (Vol. XXXIX.)—Centaur.

[46295.]—**Paralysis.**—I am very doubtful, if "C. R. B.'s" friend went to the trouble and expense of making a machine, if it would be of much use. I purchased a rotatory foot-power tricycle in May last year, thinking, at the time, I should partly regain locomotive powers. I could then walk, with the use of a stick, one or two hundred yards—not more, and I can do the same now. I can certainly drive the machine with more ease, and up a moderately stiff hill; but the only benefit I have derived from it is after doing eight or nine miles in this hilly part of Somerset, I am able to sleep better. Has "C. R. B.'s" friend ever tried Turkish baths? For my part, I think there is more benefit to be got from Turkish baths than many are aware of. Cannot Dr. Edmunds tell us how to rig up one for home use?—Hopeful.

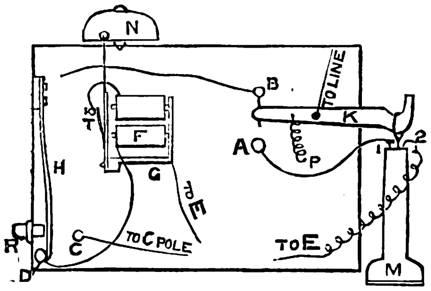
[46296.]—**Harmonium or Organ.**—Gentlemen, thanks. On suction I decide "Joiner's" rows at back, one over other with strips on underside. Soundboard appears simple and effective. Would strips affect tone? Sub-bass stands in way. Is it still possible to put complete rows at back, or must I be content with half-rows? Will "Joiner" kindly give promised hints for making the board, as it may be difficult to get two rows one over other. If doomed to half-rows, could channels be brought from sub-bass, same way, so dispensing with my present double-pallet action, which, with coupler, is stiff, and wastes wind. If practicable, how long should bass-pallets be?—Beta.

[46296.]—**Harmonium or Organ.**—The relative merits of the above instruments were discussed at great length some years ago in the Mechanic. If "Beta's" experience has not already proved to him which is the best, a revival of that discussion would hardly convince him. For my own part, I never heard from the harmonium the same rich, sonorous bass and clear ringing treble as is produced by American organ. Nor do I think it altogether due to voicing of the reeds or cavities in tubeboard, but these along with the exhaust system. Don't change to pressure bellows "Beta." If you want more power and variety, sell your organ and begin afresh with four-row tubeboard; or if the present instrument has voiced reeds and you add other two rows, let them be unvoiced. "Joiner's" sketch and mine are almost identical—viz., channels under mortice board. He shows it with a second tubeboard at back; reed apertures cut in mortice boards, with reeds screwed on over channels similar to harmonium plan, will answer. The reeds would then require covering by a sort of shallow box, the side over heel of reed hinged so as to open or close by stop. When closed, sufficient air might get in to make some reeds speak. Drain off this by inch diameter hole at each end. Over this hole must be a leather-covered valve so arranged as to be up only when stop is not drawn. See rough diag.:—M, mortice-board; B, box over reeds; V, valve inside box; S, stop-valve. Where I in "Beta's" place, I would channel underside of M, longest bass channel about 7½in. long by ⅝in. deep; 61st, 4½in. by 7-16in. Then put on a set of 8ft. unvoiced and treble half-set of 16ft. More than one reed on each channel is condemned, though for that matter I have had chords of three notes speaking on one channel at same time. There would be two on treble only. If you have room, mount the sub-bass oct. at extreme back, with separate pallets actuated by lever attachment shown on page 120, No. 577, Fig. 10. Get longer plungers, and if bellows power and space permit, put on super oct. coupler; then you will possess an organ that would please most people. I endorse the grateful sentiments expressed towards past writers in "ours," and think great credit due to its editor for the excellent manner in which the paper is conducted. England can only keep pace with the mechanical progress of other nations by the spread of such knowledge as fills "our" pages, and in which "ours" is not equalled by any periodical I ever saw. I sent information and cuttings from "ours" to a friend, by means of which he made two or three harmoniums. This set him off. He became a subscriber, and is now working in a large organ factory, in his element, and doing well.—D.



[46316.]—**Continuous Brakes on the L. and S.W.R.**—I am informed that the L. and S.W.R. have adopted Gresham's modified form of Smith's automatic vacuum brake. The other handle, which "Brake-Block" noticed near the regulator, was for the continuous brake, either for admitting air or for the ejector. The engine-wheels are fitted with a steam brake for the same reason that the M.R. and G.W.R. are.—Centaur.

[46336.]—**Telephone Circuits and Call.**—After G. Tolman's reply on p. 67, it is almost needless for me to write more; but as I have promised, and thinking if "Meme" has no microphone arrangement, the extra connections might confuse, I append the following figure. When the button R is pressed, the spring H makes contact with support C. A current then flows from battery to C through spring H by means of a wire to B, thence through K to the line. Through the line it enters the other end through K, B, H to D; from D through coil F to terminal T, through the keep and frame G to earth, ringing the bell N as it does so. On taking the telephones off the hooks R at both ends, the currents produced by speaking into them are sent through A to K, and then to line entering K at the other end through A to the telephone there, and from end 2 of bobbin to earth or return wire. These connections can be made out of any old pieces of brass, screws, &c., and fitted up in a box. So long as the contacts are clean and firm, it will work as well as if better made. *K*. Automatic switch arrangement, brass hook pivoted so that a spring fastened to it and point P would keep it down firm on A if telephone M were taken off. A connected with one end of telephone bobbin. B, brass post so placed that K presses firm against it when M is on the hook. H, brass spring normally pressing firm upon D, and capable of being pushed hard against C by means of ebony button R. It is connected by a wire to B. C, brass post connected with positive pole of battery. D, brass post connected to one end of coil of bell movement, F. 2. One end of telephone bobbin connected to earth Z or return wire.—F. C.



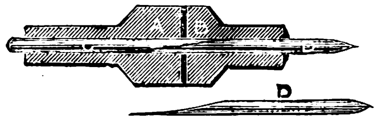
[46344.]—**Locomotive Matters.**—In reading the insertion of my reply to this query in the number for March the 31st, I find there has been made a mistake in the numbering of the engines. That with a dome ought to have been marked No. 2, 1877, as will appear from the context. I seize this opportunity to add that this latter engine is fitted with Thieffry's steam jets for the purpose of smoke-prevention. All engines on the P.L.M. line are fitted with this apparatus.—E. Gobert, B.Sc.

[46376.]—**Weight of "Abbotsford" Class, N.B.R.**—

	tons	cwt.
On leading bogie-wheels	7	4
„ second „ „	7	4
„ driving-wheels	15	16
„ trailing „	14	8
Total	44	12
Tender:—		
Leading	11	3
Middle	10	16
Trailing	10	5
Total	32	4

—Carstairs.

[46384.]—**Balance-Springs.**—"To Guyot."—Years ago, watch-jobbers used to buy hairspring on reels, like reels of cotton, and used to make their own hairsprings. I remember seeing a tool some time ago, in an old watchmaker's shop, by which these said hairsprings were wound. It was very simple, and, as near as I can remember, was like sketch inclosed. A and B are two round pieces of brass, with a hole in the centre; C and D are two pieces of steel wire, like two wedges; C is soldered into A, but B and D are loose. Directions: Put D partly into A; put one end of the hairspring between the wedges, close to the face of A; now push wedge D in tight; now put together as shown, put B into vice; now turn A, which will turn C, which will turn D, which, together, will wind up hairspring, which is being held out somewhat tight with a pair of pliers.—A Fellow Workman.



[46410.]—**Velocity of Discharge from Pipe.**—Divide the product of 57, and the height of the head of water in inches above the orifice by the length of the pipe, added to 57; extract the square root of the quotient, which root, multiplied by 23⅓ and the area of the orifice delivering the water in inches, will give the cubical inches discharged in one second. Then the fall 500in. × 57 = 28,500in. in one mile 63,360 + 57 = 63417 − ·449 √ = ·212 × 23⅓. = 4·946, area of 2in.-pipe, 3·1416 × 4·946 = 15·54in. discharged in one second, area of a 3in. pipe, 7in. × 4·946 = 34·622 in one second.—W. H. S.

[46426.]—**Blackleading Scorched Iron.**—Scour the old black off with emery-cloth, and give two or three coats Berlin black, well thinned with turpentine—say half and half.—Frank Smith.

[46436.]—**Chemical Balance.**—Becker's balances will answer his wants. They are admirable, and the price of one to carry 50grm., and turn with 1mgrm. is, I think, 35s.—F. C. S.

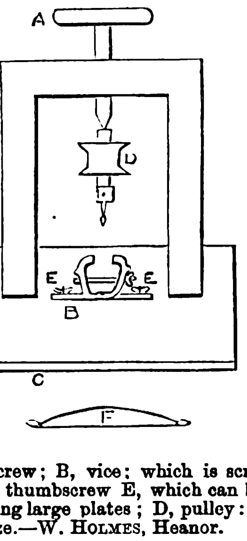
[46436.]—**Chemical Balance.**—In my reply to this, page 88, there is a printer's error, similar to one which, I thought, had occurred in the original query—viz., the alteration of the word "grammes" into "grains." In the seventh line, read "50 grammes" instead of "50 grains."—Arthur E. Morris.

[46441.]—**Vacuum Brakes.**—The brake used on the Bristol and Derby section of the Midland Railway is the Sanders and Clayton vacuum automatic brake. The vacuum is created by a large Gresham ejector on the right-hand side of smokebox; it is maintained by a small ejector under the foot-plate, and destroyed by a patent combined steam and air valve in right-hand corner of cab. A description of the Clayton brake will be found in Nos. 828 and 831 of this journal, and of the Midland steam brake for engines in No. 835. I have not heard of any work yet published on continuous brakes; but Crosby Lockwood and Co. have announced a book by Mr. Reynolds. A great deal of information may be found in the back numbers of this journal on the subject.—Centaur.

[46450.]—**Separating Fat from Mineral Oil.**—"Chandler" must take a fine mesh sieve, say a 40's, and pour the mixture through. This will leave the fat on the sieve. Then make a filtering bag of brown calico, the shape of a pillowcase; pass the oil through; it will then be clear of any particles of fat. To make the fat of any use I should want to know whether it was English melted tallow or rough fat. If "Chandler" will give me these particulars, I think I can help him.—Fellow-Workman.

[46456.]—**To Mr. J. Charles King, or any Wheelwright.**—In the first place, measure the old hub and get the exact size of it. And if there are 12 spokes in the old wheel, make a new hub 1½in. larger in circumference than the old one, and if 14 spokes, make it 1¾in. larger than the old one. (That is allowing ⅛in. to each spoke.) After you have got the new hub turned, set it out for your spokes, and number each mortice, also each spoke; after you have that done, measure No. 1 spoke at the tang, and mortise No. 1 hole in the hub, so as the tang of the spoke will fit tightly. When you have them all mortised, take your saw and saw the hub through the centre of each mortise; after your hub is to pieces, put them all together and fasten a strap round the centre of the hub and measure it; for the front and back hoops, make them out of ¼in. or 5-16in. iron, and 2¼in. wide; bevel the back edges down to ⅛in. thick, and make them to fit very tight. Then take each part of the hub and drive it down between the spokes, according to the numbers. (I have found it a good thing to give each spoke-tang a coat of red-lead before putting them together.) After you have got your hub in its proper place, make your hoops red-hot and put both on at the same time, if possible. As soon as you have got them in their place, cool as quickly as possible, and you will find the joints fit quite close. Dress off and give it a coat or two of paint, and you will find it last for years.—S. T. M. C. Cutler, King's Dragoon Guards, Cavalry Depot, Canterbury.

[46459.]—**Drilling-Machines.**—I think the drawing will be suitable for "Learner." A is the feeding-screw; B, vice; which is screwed on the bed C, by thumbscrew E, which can be taken off when drilling large plates; D, pulley: F, bow; ⅛th natural size.—W. Holmes, Heanor.



[46459.]—**Drilling Machines.**—To drill for pivots you must get a turn bench and screw ferrule, if any real good is to be done. To put a new pivot, see sketch. A, screw-centre, B, drill-centre—this has a handle on end for clocks only; C, pinion to be drilled; D, drill bow. There are several ways of finding centre. Perhaps it will be best for you to use a tool made of a piece of steel about the size of a slate-pencil, with a three-sided point, like Fig. 2. Hold pinion vertically in left hand, and with thumb, first and second fingers of right hand, rotate the tool on centre till a dot is made just large enough to receive point of drill. In fitting new pivot make it perfectly straight, and let it go nearly to bottom of hole in pinion before driving home. If it happens pivot and pinion are out of true, file the side of pivot at end, and so get pinion true afterwards; turn pivot true with graver. After all is true, a centre like Fig. 3 is now put in turns in place of the drill; on this the pivot rests in a shallow cut, the same as a pin rests in a cut on filing-block, and then has all marks took out left from graver with a fine file—a slightly worn file is best; after this a smooth old file, and, lastly, the burnisher. Watch-pivots are put in by the same method. The other part of this query is not in my business.—Skip.

FIG. 1.

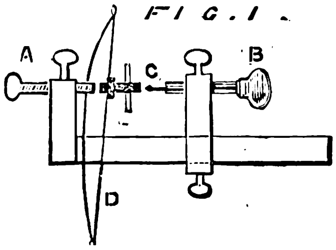


FIG. 3.

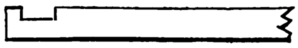
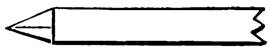


FIG. 2.



[46459.]—**Drilling-Machines.**—The article mentioned in this query can hardly be called a machine, being nothing more than a drill-stock in a holder. They are nothing new. I have one with some claim to antiquity, and having three speeds instead of a single ferrule; but so far from finding it useful, I never use it at all, the position of the hand being inconvenient and cramped. No drilling-machine is wanted for watch pivot-holes. You want to be able to "feel" your drill at its work; and even for holes in clock-plates nothing of the sort is required, because in the majority of cases only one hole of a size is wanted, and that not very deep. "A Learner" will find that three ordinary stocks and one archimedean for the larger holes, and about four drill-bows, will prove to be the best drilling apparatus that he can use for the purposes named in his query. Only wedding and similar rings can be made smaller without cutting them, and this is done with a tool in the form of a thick metal casting, circular in shape, and pierced with a number of taper holes. The ring being annealed, and forced into these holes by means of the stakes (which fit each hole), being placed on the ring and struck smartly with a hammer; but if the ring is to be made much smaller, it must be cut. The gold paint I now nothing about; it savours of tinkering.—F. C. Putley.

[46463.]—**White-Lead.**—White-lead is frequently adulterated with chalk. If, on the addition of a small quantity of sulphuric acid to some of the white-lead you perceive effervescence, you may be sure it contains something which ought to be absent.—Hugh Tunnadine.

[46463.]—**White-Lead.**—Any wholesale house would supply pure white-lead. But as you say it is for dwelling-houses, pure white-lead, if for outside work, is apt to scale off in hard flakes after a year's exposure; even for inside use also, unless the ground colour in which it is laid is properly prepared, the same as is done by carriage-painters. This subject will be treated fully at the conclusion of "Cart and Wheel-Making." But with all my experience of pigments and colour-mixing, for which I have received a certificate and prize from the Coachmakers' Company, London, I would, if I had house-painting to do, write to any good firm and say for what sort of work the white-lead was required; for inside, pure; for outside, as fencing and garden-lights, or for walls, with such suitable admixtures as would best serve the purpose required. You would pay only such a price for suitable paint as would prove an economy and satisfaction in the end.—J. Charles King.

[46465.]—**Midland Carriages.**—The longest bogie carriage measures 60ft. from end to end. Those mysterious letters, "M.S.J.S.," simply mean

"Midland Scottish Joint Stock."—W. H. Richmond, Jun.

[46473].—**Pressure of Water.**—In answer to "W. H. B., Bradford," the way to find the pressure is as follows;—

Let D = 8ft. = depth.
W = 12 = width.
A = 4ft. = average depth.
C = 62·5 = weight of a cubic foot of water.
X = pressure.
DWAC = $\frac{1}{3}$

38·4	12
62·5	8
——	—
1920	96 area.
768	4
2304	——
——	3·84
240·000	——

Answer...... 24000lbs.

Then, in the second place, you would take the 2ft. as the height, and 1ft. the average height, and proceed the same way.—T. Sherwood, jun., New Tunstall.

[46481.]—**Boiler-Pump.**—The quantity of water your pump will inject into your boilers is as follows:—You will have to find the area of your ram in inches, then multiply by the length of stroke in inches, which will give the capacity of the pump-barrel in cubic inches. If you wish to have the weight of water, multiply the number of cubic inches by ·03612lb., which will be the total weight it will inject into the boiler. To find the area of your ram you will have to square the diameter and multiply by ·7854 (which is a constant number for finding the area of diameters).—E. Hardcastle, Bradford.

[46481.]—**Boiler-Pump.**—To "Sunlight."—Find the length of stroke and diam. of ram, and multiply that by the number of revolutions the engine, and therefore the eccentric, makes per minute. This will be the volume in cubic inches that the pump can deliver per minute. You can then turn that into gallons by dividing the number of cubic inches of water by 277·274. Had you stated the size and stroke of ram, and the revolutions of engine per minute, either myself or others could have told you exactly what the theoretical delivery would be. But from the theoretical quantity there must be a deduction made, as, except the pump runs very slowly, the barrel does not entirely fill; that is to say, that on the ram making the outstroke, the water does not rush in quickly enough to quite fill it, so that the full capacity of the stroke is but rarely delivered.—Sunlight.

[46487.]—**Chemical.**—If the material which is suspected to contain salt, be steeped in a little distilled water, the salt held by the fibres becomes dissolved. By taking a small portion of this in a glass and adding thereto a little silver nitrate a white, curdy ppt. will ensue. On adding ammonia it will dissolve. This reaction will not take place in ordinary water.—W. H. Binns.

[46489.]—**Bicycle-Making.**—One would suppose, from "Sunlight's" reply to this query, that the pins add greatly to the strength of the joint. This is not the case, for, as ordinarily done, the pins do not contribute to the strength in the slightest degree. They are used simply to keep the parts in position during the process of brazing, for if the peg, or pegs (which need not exceed $\frac{1}{8}$in. diameter), were absent, the necks, hollow forks, &c., would be almost sure to shift while being brazed, and consequently, when finished, would not be in their true position. Any other information if required.—Wm. Granger.

[46489.]—**Bicycle-Making.**—To braze bicycle forks in: first take hollow forks and clean out inside of those intended to be brazed; then take the head and shoulder at about 2in. from the end; put some spelter or brass wire, 18 or 20 guage, and a little borax in; drive into place and bore a $\frac{1}{4}$ hole into fork and through shouldered end of head, then put in a tight pin or rivet over, so as not to show when filed off; then clean outside for $\frac{1}{2}$in. at each side of joint and wrap three or four times round fork, brass wire somewhere about given sizes, and slightly damp joint; then sprinkle a little more borax on outside, and get hot. Be careful not to get tube too hot before the head is hot enough, or else the job is spoiled. Then let it cool, and clean.—Rex.

[46489.]—**Bicycle-Making.**—You must make the wheels first, as they are your guide in forming the framework. If this is a first trial, I should advise making the small wheel first, as it is less difficult, and it would give you a little experience before commencing the large one. The braze alone would hold, but the rivets are necessary to keep the work in place in the fire; they can be made not to show with a little care: countersink the holes and rivet down heads. When in fire be careful not to burn the tube, as it will spoil in no time: I always put a little brass outside, and when that runs I know it is melted inside. I suppose you understand the usual method of brazing? The head should be first brazed to forks, being careful to get them in the same plane as head; then fit in fork ends, put in bearings, and try the wheel in position. If the rim is nearer one side than the other, the fork the near side is too long. This must be filed; but a little does it, as an error here is multiplied at rim. It is much easier to "set" the wheel here than at join to head, and this is why it should be first brazed to head. If there is too much room between rim and head (with tire on), both forks must be shortened; but I should allow nearly an inch, as if too close the dirt collects and falls into bearings, causing them to wear very fast. When the wheel hangs properly the ends may be brazed in. A 3-16in. hole must be drilled in upper part of fork on inside, to put borax and brass in at. Brazing neck and back fork to back bone, or more correctly beam, requires some judgment. The front wheel and forks should be put to gather the neck in its place in head. The beam, when in position, should cover the rim all the way down, as if more on one side than the other the small wheel will not follow the large one, but run in another line at side, and thereby increase the trouble of steering and make more pedal work. When the beam is correctly placed, make a scratch on it and neck to correspond; rivet and braze as before. The small wheel should now be hung in back forks; and if rim should be too near one side, this can be altered by slightly increasing the curve of the near fork or straightening the far side. When right, the forks, with wheel in, should be put in, and so arranged that the small wheel exactly follows the large one, and is quite upright with it. Make a scratch, rivet and braze up. If I can give you any other assistance I shall be happy to do so. Will our kind editor allow me to make a remark in passing? It is really surprising how many readers are interested in queries that, at first sight, appear to be only of limited concern. More than a dozen, and if I counted I dare say score, times I have been on the point of asking something, and the identical question has appeared, although I had been deterred, fearing it was only of personal interest.—Ixion.

[46496]—**Sewers.**—I have sent my copy of the number referred to to be bound, so cannot refer to the original query. The "hydraulic mean depth" of a sewer or other water channel is the sectional area of the stream of water in square feet, divided by the length of the contour or wetted perimeter of the conduit in feet. Thus, if the sewer is of rectangular section, and 12in. wide by 24in. deep, the water flowing through it filling it half-full, the wetted perimeter = 3ft., the area of stream = one square foot, and the hydraulic mean depth is $\frac{1}{3}$ft., or ·333. If the sewer is full, the wetted perimeter is 6ft., the area being two square feet, and the hydraulic mean depth becomes 2-6th, or ·333ft. as before.—Glatton.

[46497.]—**Fortified English Cities.**—I very strongly think that "Antiquary" is mistaken in supposing that the affix "gate" to sundry names of streets in Leicester has anything to do with gateways. Humberstone-gate, not "Humber-gate," and Belgrave-gate, are the gates or ways or roads leading to the somewhat distant villages of those names. Sanvey-gate is the Sancta Via of the Romans, leading to the big church; and Gallowtree-gate, pronounced as if spelt Gaultry, is the road leading up to the gallows-tree, which, I believe, used to stand near the corner of what is now the racecourse. Brig-gate, in Leeds, is the way leading to the bridge. The Appendix to Imperial Dictionary gives "Gate, a road; a way; a street." The German gasse is a street. I don't think there are any signs of walls at Leicester; but the name Leicester is, I believe, derived from its being the castra, or camp, on the Leir, now called Loar river; and camps, I fancy, were not usually walled places.—J. K. P.

[46497.]—**Fortified English Cities.**—As a general rule, I think "Antiquary" may take it that all the English cities were walled, and probably most boroughs protected with earthworks as occasion required. I doubt whether there is any list of walled English towns. From the nature of the work in the "Holy Bones" at Leicester, I think there can be little doubt but it was walled by the Romans, as was Lincoln. The remains of the walls at Chichester and York are interesting. No one need be reminded of the famous walls of Chester, perhaps the most perfect example remaining in Europe. Goodwin, in the "English Archæologists' Handbook," says — "Canterbury, Nottingham, and York are mentioned in Domesday-book as having been surrounded by a fosse; Oxford, Hereford, Leicester, Stafford, Chester, Lincoln, and Colchester as walled towns and burghs." Nottingham, was, however, then walled with a fortification built by Edward the Saxon, and portions remain. The word "gate," for street, is no indication of fortifications when used in Midland and Northern towns. It there means "way," as in the common saying, "Gang thy own gate"—*i.e.*, go your own way.—Iota Pi.

[46499.]—**Lathe.**—My fly-wheel is carefully fitted on end of crank-shaft, and a set-screw passes through boss at right angless to shaft, nipping the latter tightly, so as to prevent wheel slipping. Steel centres are generally used; but, if well made, gun-metal bearings would be better.—Glatton.

[46501.]—**Length of Exposure.**—(1) This is a very difficult question to answer satisfactorily. As duration of exposure depends on quality of light as well as class of subject and rapidity of sensitive plate, and as the former fluctuates with every change of wind and weather, nothing definite can be stated. The required knowledge can only be obtained from much experience. (2) The stops of lenses by the best makers are supposed to be calculated and marked so that those with a whole number shall need an exposure twice as long as the one immediately preceding, those with a +, half as much again as the next size larger aperture; but this arrangement is not always reliable—in fact, is seldom correct. (3) This having been up to the present in a most unsatisfactory state, has rendered it incapable of treatment in the instruction books; a committee of the Photo Society has, however, just been formed to endeavour to reduce the difficulty to a practical method.—Baboon.

[46501.]—**Length of Exposure.**—Supposing the full aperture of lens is 1in., and the ascertained exposure 1sec., then, all the conditions being the same, a $\frac{1}{2}$in. stop would require approximately 4secs., and a $\frac{1}{4}$in. stop 16secs.; other sizes, a proportionate increase or decrease. It cannot, however, be too strongly impressed upon beginners that the art of giving correct exposures, under all the varying conditions met with in practice, can only be acquired by practical experience, and although it would no doubt be rather expensive to make experiments with 8 by 5 plates, surely "Beginner" could afford to make a few trials with quarter-plates. By the way, I hope no "beginner" will be misled by the recommendation as to exposure on p. 77, for unless an exceptionally small stop be used, it must be a very slow gelatine-plate that would stand an exposure of 5secs. under the conditions named. From 1 to 2secs. ought to be ample, even with the lens stopped down to F. 20 or 30.—W. Robinson, jun.

[46501.]—**Length of Exposure.**—To determine the length of time that a plate should be exposed is a simple mathematical operation. We know that the light which reaches the plate through the stops is expressed by the following proportion:—

$$\text{As} \left(\frac{\text{the focal length of lens}}{\text{diameter aperture of stop (1)}}\right)^2 \text{ is to } \left(\frac{\text{the focal length of lens}}{\text{diameter aperture of stop (2)}}\right)^2 \text{ so is}$$

the amount of light which passes through stop (1) to the amount required, which passes through stop (2). To reduce to practice, take the focal length of your combination, which we will suppose is $7\frac{1}{2}$in., and divide this by the diameter of the aperture of the stops, which we will suppose are $\frac{3}{4}$in., $\frac{1}{2}$in., $\frac{3}{8}$in., and $\frac{1}{4}$in. respectively; this will give the focal length of lens, divided by the numbers 10, 15, 20, and 30, or, as it is generally written:

$$\frac{f}{10}, \quad \frac{f}{15}, \quad \frac{f}{20}, \quad \frac{f}{30}.$$

Square all these numbers, which will give 100, 225, 400, 900. Now suppose the stop $\frac{f}{10}$ requires one second's exposure, the next stop $\frac{f}{15}$ will require 100 : 225 : : 1 : x, or $2\frac{1}{4}$ seconds, and so on through all the stops.—Stanley T. Hawkins.

[46511.]—**Stains in Dry Plates.**—These can easily be removed by a wash of acidified water; HCl, say, 1dr., water 2oz., is as good as any. Tin dishes are quite safe; for quarter-plates I not unfrequently use an old sardine tin; it is just the thing.—W. Robinson, jun.

[46511.]—**Stains in Dry Plates.**—(1) By the addition of citric acid to the developer in the proportions of 1gr. to every 10 of pyro., or by dissolving a few grains of sulphite of soda in each ounce of the strong developing solution. (2) If you confine yourself to alkaline pyro. development, you may use tin dishes.—Baboon.

[46515.]—**Cast Malleable or Annealed Cast-Iron Castings.**—Put about 14lb. of malleable iron borings into 1cwt. of melted metal, put the borings into the ladle, and then catch your metal at the furnace; put in a little extra coke into the cupola, so that your metal will be hot. Hematite pig is tougher than common pig. Could you not cast a wire in each casting?—a piece of common cage-wire.—Cast Iron.

[46519.]—**Kirk's Double-Expansion Compound Engine.**—The expansion in two cylinders is not, in practice, always more economical than in one. The reasons leading to this form of engine are chiefly these:—(1) It is always desirable to maintain cylinder at one uniform temperature; and with high rates of expansion the temperature of steam varies so much between the beginning and end of expansion that it is impossible to obtain anything like even temperature throughout this expansion. It the expansion is spread over two strokes instead of one, the steam will be cooled to the same extent; but the extremes of temperature in each cylinder will obviously be reduced. (2) By setting cranks at right angles, and properly proportioning areas of pistons, the strains are more evenly distributed during one revolution of crankshaft than they can be with one cylinder.—GLATTON.

[46529.]—**Varnish for Violin.**—"War" asks a curious question, "Is there any dependence?" &c. Now, I would opine that, as in all other trades, there may be found even an honest fiddle factor; but I have not yet established to my own satisfaction that there be such a homo as an honest horse dealer. I am satisfied with French polish for violins.—J. J. A., Liverpool.

[46530.]—**Rotary Water Motor.**—You cannot, I should think, do better than use one of Bailey's, as advertised in these pages.—J. J. A., Liverpool.

[46536.]—**Shaft.**—Presumably you intend to use pulleys, so the belt will not work if they are placed where the shafts cross each other. Had you given the size of your pulleys, you might have had an exact answer. However, you may find their position by knowing that a plumb-line held against the centre of the rim of the upper one must just touch the centre of the rim of the lower. These are points of delivery of the belt.—W. J.

[46539.]—**Water Power and Electric Light.**—J. Hezmalhalch appeals to me with regard to the stream of 2½ gallons. I saw his query when it previously appeared, but could not give him a very hopeful answer, so left it for someone else. His stream having a fall of 42ft., and weight of water being 2½ gallons at 10lb. each = 25lb., gives a total energy of 1,050ft.-lb. per minute. A water-motor will not utilise more than 50 per cent., or, say, 500ft.-lb. per minute. (This is without any allowance for loss of heat by friction in 1½in. pipe.) As there are considered to be 33,000ft.-lb. per minute to one horse-power, this will be equal to 1-66 of a horse-power, and I do not know where J. H. is to get a dynamo that will work with so little power. I am now making as small a machine as I can, and I calculate a man will be just able to turn it (which is equal to about 1-10 horse-power, or 3,300ft.-lb.), and that it will work one incandescent lamp. Perhaps, by storing the water and running it away rapidly, more power might be obtained for a short time; but under the most favourable circumstances, it would not do more than light one incandescent lamp for two to three hours each day. Storage batteries are out of the question, because there is no electricity to store. A Swan lamp is said to take 1-10th horse-power, but I have generally found that seven or eight lamps per horse-power is nearer the mark.—R. P.

[46542.]—**Broken Steam-Gauge.**—I had one of "Bourdon's Patent," with the tube split. I had it soldered by a tinsmith; it then did its work as well as before.—CAST IRON.

[46543.]—**Executors and Legatees.**—This is a case of a vested legacy, the payment of which was deferred until the legatee came of age. She is now over age, so that condition is fulfilled. The only other question was whether the executor had money enough to pay the legacy with after providing for the debts. By the writing he gave, this difficulty is got over, because he has admitted having assets, and assented to the legacy. The legatee should, therefore, now bring an action against the executor for payment of the legacy, either in the High Court, or, if the estate be below £500, then in the proper County Court. If the legatee consults a solicitor she will find she is not at all helpless; but, presuming the facts are as stated, will soon get her money, which, if the uncle dies badly off, she may lose altogether.—FRED. WETHERFIELD, solicitor, 2, Gresham-buildings, Guildhall.

[46547.]—**Jewellery Repairing.**—To get out rivets from brooch-joints, it is as well to know that jewellers as a rule put them in always the same way; that is, looking at the back of the brooch with the joint held at the top, it is "pinned up" by pushing a tightly-fitting wire through (slightly tapered) from right to left. It is not riveted, except in the case of a very old and worn joint. You can make a pusher out of an old bradawl, or any similar tool, ground down to the size of the rivet, but in case the pin is riveted in, it must be punched out. For this purpose nothing is better than a thick needle, with the ends nipped off. Holes are enlarged with a "joint broach," to be obtained of any jeweller's tool dealer. To file down the pin, put it in a pin-vice, file a notch in the edge of your bench, or the piece of hard wood you use to file on, lay the pin in the notch and twirl the handle of vice round while you file the pin. With a little practice you will do that all right. Then put a piece of wire in the pin-vice and file that down to the required size, and pin up the joint-tongue from right to left, as above described. If the coin is to make a brooch for home use, you can soft solder on the joint and catch, but it would not be either strong or workmanlike. If you want to do several for sale, you must acquire the art of hard silver soldering, which will require a good deal of practice, but will well repay you if you want to make good work. Soft solder is useful for patching up articles that you don't want to re-gild or re-colour; but no good workman likes to use it, and if once used on an article makes it very difficult to properly repair it at a future time. If you care to go thoroughly into it, ask again, as this reply may be considered quite long enough already, and it would take another reply equally long to explain hard-soldering, and would then take heaps of practice before you were perfect, as the goods have to be made red-hot, and there is a risk to a novice of burning, and perhaps, melting the article.—J. E. A.

[46547.]—**Hard Soldering.**—If "Blue Gown" will refer to some letters of mine on the subject of soldering, the numbers of which were quoted in "Answers to Correspondents" in No. 887 of the "E. M.," he will, I think, glean something useful to him. Joints and catches may be fixed on brooches, of whatever kind they may be, either by soft or hard solder. In the case of coin-jewellery, hard-solder is best. This may be procured in small quantities of any obliging jeweller; sixpennyworth will do twenty jobs. If not so procurable, get a small piece of good silver and melt it up with about twice its weight of good brass wire; then hammer it out thin, and use as required. In melting the solder use borax as a flux. In giving you a little instruction anent your query, I must premise that you have provided yourself with the joint and catch, which should, preferably, be of silver, although if of German metal, it does not matter. Get a piece of pumice-stone, and rub one side flat, taking care that the surface is clean; then fix the joint and catch in their respective positions on the coin, having previously applied a little moist borax to the surfaces in contact, and bind them over with fine iron wire, taking care in so doing that the wire does not touch the parts where the solder is required to flow. Molten solder exhibits this peculiarity—that, in whatever part the greatest heat is applied, it flows to that point, so that if the heat is misapplied, the solder flows anywhere but in the desired place. Having bound the coin with wire on the flat side of the pumice-stone, to prevent it slipping off, apply the little pieces of solder to the joint and catch, and with the gas and blowpipe steadily raise the heat until the solder is seen to flow. Stop blowing at once then, and examine to see if the connection is perfectly made. If not, apply a little more borax and solder, and repeat the operation of heating. The flame, which should not be larger than (what shall I say?) the top of a small wine-glass, should be directed just a little behind the joint or catch, the solder being put the other side, and so be drawn under when it melts. When the parts are properly soldered on, remove all traces of wire, and immerse in the vitriol solution as described in my letter. Allow it to remain therein for an hour or two, when it must be taken out and swilled in clear water. It should come out a pure dead white. If it is desired that this white bloom be preserved, do not brush it in any way—simply wipe dry, or dry in hot sawdust. If you require it to be bright, brush it with rouge or any polishing material, and rub up with chamois-leather. To remove rivets from brooch-joints, the burr, or rivet-head should be filed off, and the pin pushed out either with a steel point or be removed with the nippers by putting the point of one jaw on the broken pin, and the other on the end of the rivet, and so force it a little way out, and then take hold of the protruding end with both jaws and pull out. Another way is to put an old watch-key in the vice, place the joint over it—i.e., resting upon it—and drive the rivet out with hammer and pin-push. The holes of brooch-joints and pins may readily be opened with suitable "broaches," which are long, slender tools with four or five cutting edges upon them, and to be bought for about threepence at any trade-tool shop. They are sometimes called "rimers." To produce a good and tapered point to a pin, you will need a pin-vice and filing-block, together with rough and fine files, and a burnisher. Take the pin-vice in the left hand, having previously fixed the pin firmly in the centre of the jaws, and with the file in the right, and a shallow rut cut in the filing-block, proceed to file and twirl the pin-vice with a rapid, steady motion, always observing to keep the pin going in the opposite way to the thrust of the file. Bear in mind what you desire to obtain, and work to that end, always bearing on the file more to the side of the point. When roughly shaped, finish off with a fine file, or Ayr stone, and burnish. In cutting the pin-joint to fit, be sure to make it square with the brooch-joint. Let the hole in the pin-joint be a shade larger than the others; then, if the rivet is properly filed up, it may be forced in sufficiently tight to hold secure with little or no riveting over. The pin-point should protrude about a ¼in. beyond the catch. If you require further information, seek and ye shall find.—ALFOJOE.

[46548.]—**Pulleys.**—Grooved pulleys are generally used for small powers, as giving greater grip than such belts as could conveniently be used. The practical objections to them for machinery is that they cannot be shifted from a fast to a loose rigger when it is desired to stop the machine without stopping the power. V-grooves are generally thought to give more hold than round ones; but "D. H. G.," in his valuable articles on overhead gear, laid great stress on round grooves with belts to fit them accurately as being less liable to slip. The usual V-groove has usually a vacant space at the bottom, so as to put the grip on the sides of the belt, which does not seem to deteriorate it, but rather to improve it by the compression. A round groove does not act well, unless the band fits it very exactly.—TREADLE.

[46550.]—**Instantaneous Photography.**—If the plates named were really as sensitive as they were said to be, there should have been no difficulty in obtaining good negatives in far less time than you could uncap and re-cap the lens, supposing, of course, that the conditions were favourable and you did not use too small a stop. Are you sure they were not very much over-exposed? Mr. Muybridge's horses were taken, if I remember rightly, against a white background, which would enable an outline of the horse (which was all that was required) to be taken with a very brief exposure indeed.—W. ROBINSON, jun.

[46550.]—**Instantaneous Photography.**—Mr. Muybridge's photographs are mere silhouettes. They were taken on wet plates in an incredibly short space of time, and while passing in front of a brilliantly-lighted white background, the short exposure being sufficient to impress the latter without giving any details in the animals. The reply to your second query resolves itself into a question of light. If this be of the powerfully actinic kind as that which proceeds from a sky flecked with clouds after a sou'-wester, in the months of April or May, the plates you mention would give a fully-exposed sea-view in the time stated, and perhaps a well-lighted landscape likewise. Plates may be prepared exquisitely sensitive, but still the main consideration is the quality of the light; and for this reason, successful rapid pictures can only be obtained on a very few days in the year. In developing, use as little restrainer and as much ammmonia as possible, consistent with the non-production of fog or flatness.—BABOON.

[46551.]—**Unseasoned Wood in Furniture.**—A sure test, if the furniture has been turned out of hand for some little time, is to rub the fingers over the joints, and, if any difference of level is perceptible, the wood has been worked up before being thoroughly seasoned.—J. J. A., Liverpool.

[46553.]—**Riveting Copper Boiler.**—The method I employ is to rivet in the front end, and then to have the shell, say, 1in. longer than requisite for steaming purposes. Place the end of the boiler, with the flange for riveting outside, and rivet up; cut an aperture for the chimney and rivet it on this inch length; then rivet in another end for smoke-box, only putting two rivets in this, as you may require to take it out some time or another, if you allow the boiler to run short of water, and so spring a leak. Then with a Bunsen burner heat, and sweat solder into all the joints, put a flue through the shell and apply the lamp, so that the flame begins at the end where the chimney is above, travel to fore-end, up into, and through the flue, and so into the smoke-box and up the chimney.—J. J. A., Liverpool.

[46554.]—**Plumbing.**—"Oilman" cannot do better than employ his friend the plumber to line him a 3ft. square cistern by 3ft. deep, say 5 or 6lb. lead, have a bricked-up hole at the required depth to receive cistern, take care that the brickwork is only just large enough to receive the cistern, unless you have 1½in. sides. Another way: build your brickwork, then all round bottom angles, and also up two of the upright angles, fix some slating springing for soldering against, and line it with lead as you would were it a lead cistern; of course, you must not attempt to do this yourself, because if a leakage should be at the joints, you would lose a lot of oil before you knew anything about it, therefore such a job requires to be done well. Put in a wood bottom under the bottom lead. In this last plan your cistern may be made to any shape, round preferred; the only thing to keep in view is to fix woodwork, say, ⅜in. to ½in. thick, for soldering against and a good wood bottom. I should fit the engine with ⅜in. lead pipe.—P. J. DAVIES.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

* Since our last "Carstairs" has replied to 34041, 34042, 35398; F. C. Putley, 45765, 45766; "D. W. C.," 45990.

45860. Viola, p. 505.
45861. Trigonometry, 505.
45869. To Mr. Dresser, 506.
45873. Cotton Spinning, 506.
45878. Mr. Goyen's Lathe, 506.
45887. Polaristrobometer, 506.
45889. Cheese, 506.
45892. Gases, 506.
45904. Coloured Glass, 506.
45906. Umbrella Making, 507.
45908. Electro-Deposition of Iridium, 507.

46150. Engine Query, p. 601.
46159. To Mr. Evans, 602,
46167. Block Signalling, 602.
46183. Opals, 602.
46191. Air Absorbed by Water, 602.
46192. Sugar Refining, 602.
46196. Siemens' New Armature, 602.
46198. Hydrometer Scales, 602.

QUERIES.

[46556.]—**Skin - Disease.**—To Dr. Edmunds.—I should feel very grateful for advice on the following case:—Some four years ago an eruption broke out on my face, and ever since it has been spreading and getting gradually worse. It has taken root in my whiskers, and looks like a little scab around each hair. When I pull a hair out, the root is either quite black or charged with matter, and tinged with blood. Some two years ago I met a person who had a slight attack of the same sort, and he got rid of it by plucking out the hairs by their roots. I tried that remedy, but with no success. My doctor does not seem to understand it, and has given me the following remedies in turn:—1, Sulphuret of potash; 2, iodoform; 3, crysophanic acid; 4, a solution of chlorate of potash in very dilute hydrochloric acid; and lastly, a lotion to be sparingly applied, and strongly charged with arsenic. I have been trying these remedies for over two years, and am not one jot the better. I may also state that I have tried a well-advertised blood-mixture with no success.—Sufferer.

[46557.]—**Spun Wire.**—Will any of our readers kindly explain the method adopted in covering the bass wires of a pianoforte with copper wire, and describe the machine employed for this purpose? Could not our esteemed friend, Mr. W. H. Davies, furnish the desired information?—G. Fryer.

[46558.]—**Oil for Canvas Belting.**—Can any reader of "ours" tell me the kind of oil or mixture with which the new canvas machinery belting is saturated? The belting is made of four pieces of canvas sewn together, and appears to be saturated with a kind of quick-drying oil, which holds the canvas together, and makes it flexible.—Com.

[46559.]—**Sharpening Carpenter's Saws.**—General directions for the above would be very acceptable. More especially as to using proper-sized file, and as to the angle the teeth should be reset.—Tiro Tironum.

[46560.]—**Tuning Piano.**—To Mr. Davies.—My piano is nearly two whole tones below concert pitch. It is quite new, but has been terribly neglected for the past winter—left in a damp room, &c. I got it tuned a few days since, but the tuner would not raise it; he said it would be down the following day. Can I get it up by degrees myself? No chance of a tuner for six months. I have tuned an old piano myself, but I don't like meddling with this without advice. Is there any contrivance made by which I could tune the centre octave (C to C), sharps and flats? The chief difficulty lies in that, as it is easy enough to get the octaves when that is correct. The action is "check," and squeaks from damp also. Is blacklead any use? If so, please say how to apply it.—R. H.

[46561.]—**Water Supply.**—A. and B. buy houses adjoining. The water supply is intermittent; the pipe from main comes through premises belonging to A., and supplies a cistern on same premises, from which B.'s pipes are run. Now this cistern is continually a nuisance to A.—either leaking or running over. Can A. compel B. to have separate supply from main? If so, how can he best go about it? By doing so, a smaller cistern would answer A.'s purpose, and prevent occasional unpleasantness between the two parties.—Frank Smith.

[46562.]—**Drying Gelatine Emulsion Plates.**—I have a room, 18ft. by 7ft., flagged with slate flags, lean-to roof, average height, 10ft., open to roof, which I propose to partition across the middle, using the outer room for preparing the plates in, and the other I wish to fit up as a drying-room. I should be obliged for any hints as to the best method of warming and ventilating, so that the temperature (60° or 70° F.) may not vary much during the time the plates are drying. Gas is not available.—J. G.

[46563.]—**Washing Photographs.**—I should be glad to know of an efficient method of washing batches of 70 or 80 photos.—sizes, 12in. by 10in. and 15in. by 12in. There is an unlimited supply of water at high pressure. Do self-acting siphon-troughs answer well?—J. G.

[46564.]—**Organ.**—I have a small three-stopped organ, 4½ octaves; two stops have pipes. The front set of pipes belonging to the other stop is missing. There are no names on the stops. What I want to know is, whether the front set of pipes ought to be wood or metal. If wood, I could make them myself if I had a scale; but if metal, I must buy them.—Hebe.

[46565.]—**Legal.**—To Mr. Wetherfield.—There are two trustees in an estate (A. and B.). One of them (A.) is a lawyer. If A. should invest trust-money without B.'s knowledge, is B. liable in case the money be lost? Or if A. turn bankrupt, and all or part of the trust-money is found to be squandered, is B. then liable to refund it? Is there any useful legal handbook on the duties and liabilities of trustees?—Qui Non Legem Intelligit.

[46566.]—**Deafness.**—Will Dr. Edmunds kindly say what remedies must be used in cases of partial deafness arising from a stoppage of the eustachian tube from colds or similar causes?—Q. V.

[46567.]—**Micrograph.**—I want to make some microscopic portrait transparencies for the microscope, and will thank some friend to tell me how best to manage. I have objectives by our best makers, ranging from 2in. to ⅛in. I want my pictures not larger than a—Pin's Head.

[46568.]—**Revolving Gas Burners.**—Will some correspondent oblige with description of these arrangements? I want to construct something with four or five lights, that will turn in about a circle of 8in. A small plan would be a great help.—Crutch.

[46569.]—**Boiler.**—I have a steam-engine 3in. internal dia. by 4½in. stroke. I want a boiler to supply it with low-pressure steam, never to exceed 10lb. per in. Will "Sunlight," or any other correspondent, inform me what sized boiler I require to drive at 300 revolutions per min., and what would be the probable cost? The engine will not bear a high pressure, but is constructed for high speed. I am aware that low pressure is not economical; but as I intend to use waste fuel, that is of less importance to me than a high first cost would be.—Elephant Bill.

[46570.]—**The Weight of Metal by Measuring It.**—Will "Cast Iron," or some other eminent correspondent, tell me the way to ascertain the weight of a ladle of metal by measuring it? I think a few hints on casting would gratify many subscribers.—Metallurgy.

[46571.]—**Air-pumps.**—Could any reader kindly give a description of the McLeod gauge used for measuring the degree of exhaustion produced by mercurial air-pumps, its dimensions, size of the divisions, method of calibrating and using, &c.?—Plodder.

[46572.]—**Sound in Pipe.**—Will any reader kindly answer the following?—I have had a 1in. pipe fixed to large water-tank, which is heated by steam, to supply bath-rooms with hot water. The pipe runs past several bed-rooms. Now when the steam is turned into the tank (which is always done at 4 a.m.) it makes such a noise in the pipe that it wakes the occupants of the bed-rooms, which is not pleasant at such an early hour. What can be done to stop it? Would a few feet of the iron pipe cut out, and rubber pipe put in, break the sound? If not, what is the remedy? The tank is about 50ft. from the bed-rooms. There is a tap against the tank, but whether open or shut it is just the same. The water is heated to 180° Fahr.—Anxious.

[46573.]—**To Mr. Wetherfield.**—A. dies in 1870, leaving B. (his widow) sole executrix. The property left consists of four cottages and a small piece of building land, value altogether about £600, on which there was, and still is, a mortgage of £200. B. has not proved or administered to the will, but simply received the rents and paid the interest on mortgage as it became due. She wishes the property to be divided equally amongst her three sons. Please say how to proceed—if there will be a fine for not proving will sooner; and if so, how much? The witnesses to A.'s will are living.—West Yorkshire.

[46574.]—**Photo. Bath.**—What is the cause of stains same shape as the marbling on book-leaf edges, only they are white? Books say dirty carriers is the cause; but that's not so in my case. I am particular to have all my apparatus scrupulously clean. Those stains show as soon as iron developer is applied. Will somebody explain cause and cure?—Ouvrier.

[46575.]—**Photo. Lenses.**—To Mr. Lancaster.—I possess a double-combination photo. lens 2¼in. dia., and 6½in. back focus. The former owner was fond of experimenting, and so spoiled the lens in the following manner:—The tube has been cut shorter, and the two back glasses brought nearer together, and the difficulty is, readjusting the combination to proper position. The diameter and focus are precisely as I have stated. Will Mr. Lancaster tell me how to find the proper arrangement without the use of any mathematical formula?—Ouvrier.

[46576.]—**Embossing.**—Will some reader inform me if I can take prints from engraved copper plates and transfer them to bright steel plates, and emboss with acids? Or if there is a better and quicker way than painting on with the brush.—Novice.

[46577.]—**Telegraphy.**—Can any reader kindly inform me how I can obtain an account of Duplex telegraphy as applied to submarine cables? And also of any other methods by which the carrying capacity of a cable is increased?—R. Y.

[46578.]—**Roof Ventilator.**—I am about to build a new house, the ridge of which (on top of slates) will be 30ft. long; and will one of our subscribers oblige by suggesting the best form of ventilator for the roof on the ridge, and whether two will be required for such a length? It is a plain straight roof "hipped off" at ends.—W. Q. R.

[46579.]—**Continuous Brakes.**—Can anyone inform me what brakes are in use on the G.N.R., Midland, and L. and N.W. Scotch expresses, and S.E.R. Continental express?—C. M. T.

[46580.]—**Governors of American Colonies.**—Where could I ascertain the names of the different consecutive governors of the American States while they were still British Colonies, from the first, Lord Delaware, to the last previous to the Declaration of Independence? Also if their portraits are in England and where they may be seen?—Shah Jehan.

[46581.]—**Oxalate Development.**—1. I prepared some time ago (for use in the wet process) a stock of saturated solution of ferrous sulphate to which was added a little cuprous sulphate. Will the presence of the copper salt act injuriously, or altogether prevent this solution being used in dry-plate oxalate development? 2. Can other neutral oxalates—for instance, the sodium and ammonium salts—be employed as well as the potassium oxalate?—W. H. S. W.

[46582.]—**Pressure on Wheels of Railway Carriages.**—Will some of our readers give me some rule to find the pressure on each wheel of our railway carriages? I believe on the Midland, with the automatic Sanders' brake, they get about 1½ ton on each wheel. I can get the lifting power of cylinder, but I cannot calculate the leverage. I can also get the length of the levers. It must be a simple rule.—H. Edwards.

[46583.]—**Small Quantity Battery.**—I am afraid our esteemed contributor, Mr. Lancaster, is ill, as I have not seen any question answered by him the last two weeks. I shall be very thankful if Mr. Tolman or some other kind correspondent will answer as follows:—Can I have a small battery (without liquid) that will fuse a fine wire? I have made a chloride of silver one, but that will not do it. I know a small bichromate would do this, but I want one without the necessity of withdrawing the zinc when not in use, and that would stand being turned upside down, and be permanent (say) for a few days.—Carbon.

[46584.]—**Legal.**—A garden in front of a terrace of houses, and through which lies the approach to said houses, has had no gate hung in the gateway for sixteen years. The owner of the adjoining ground and house says the public have thereby acquired a right of entry into said garden. He therefore claims the right for the occupants of his house, and declares he will not permit gates to be erected now. Is his law good?—Fiat Justitia.

[46585.]—**An Organ Smothered.**—A fine and large organ is placed in an ill-constructed chamber in a non-resonant church. Everybody is disappointed who hears the instrument, as very little of the tone gets beyond the chancel. No alteration in position of organ or in construction of chamber appears to be possible. I have heard that wires extended along a building will aid in the transmission of sound. Will any correspondent who may have had experience of their use advise me, or tell me where I can get information respecting them?—Unhappy Organist.

[46586.]—**A Ruinous Wife.**—How can I restrain a drunken wife from pawning her clothes, &c., or my property? I have been distinctly told in her presence by a police officer that a wife cannot "rob" her husband were she to take the very shirt off his back. How can I restrain her from borrowing money under false pretences?—An Unfortunate Husband.

[46587.]—**Dynamo Machine.**—Will any brother-reader help me to construct one of the above? My present one fails to give any current when the armature is revolved, and so I conclude the wire is not wound properly. What I want to do is to construct an entirely new machine—Siemens' system—to be driven by a half-horse engine. Will any reader give detailed particulars of the winding of the wire, and if it should be covered with guttapercha, as well as the size?—Engineer.

[46588.]—**Telescope Lenses.**—To "Aldebaran."—On p. 608 you say it is of the greatest importance to fit the lenses square to the axis of the tube. Now I have a very excellent three-draw marine glass, but the tubes seem to have got so loose through wear that when it is fully drawn out I can move the one holding the eyepiece quite ¼in. either way, and yet it does not seem to interfere with its definition at all—how do you account for that? I do not put this query to try and prove you are wrong in your statement; but as I intend trying to make a telescope, and as I doubt if I can fix the glasses quite true, I want to know whether the axis being moved out of the centre would spoil the definition more in an astronomical telescope than in any other, and if so, what is the reason of it?—J. L.

[46589.]—**Sack-Marking.**—I shall feel obliged to any of your readers who will be good enough to inform me how to make an indelible ink for marking corn and flour-sacks with, and whether the same should be applied with a stamp, and what kind of stamp, or with a brush and stencil-plate?—H. H.

[46590.]—**Legal.**—To Mr. Wetherfield.—Can a purchaser of ordinary and county court debts recover the same by legal processes in the name of the original creditor without an assignment? Or, having an assignment, can he proceed in the name of the original creditor, the assignment empowering him to do so? Can cases entered for judgment be assigned as well as those not so entered? Which is the most reliable work on County Court practice?—A Subscriber for Thirteen Years.

[46591.]—**Adjustable Plane.**—I want to construct an adjustable plane for concave and convex work, to be made of iron with a steel bottom to bend to the different curves. There is one in the market—an American patent. Should I be infringing if I made one for my own use?—Cyclops.

[46592.]—**Deed of Gift.**—To Mr. Wetherfield.—A father conveys to his sons his house property under deed of gift, he (the father) retaining by agreement a life interest only; after which, can the property be sold or mortgaged by the father, or is such an absolute disposal of all control or power over such property?—Legal.

[46593.]—**Automatic Musical Instruments.**—Would "A. S. L." (19837) kindly say where the "Organette," not "Orguinette," may be seen? I am acquainted with most instruments of the automatic principle, but this is new to me, and I should like to see or hear it. The Organina is on a similar principle, it appears, but it lacks power. I should like to obtain an instrument with more power than the Orguinette. I refer to the small instruments with attachments. Also, can anyone describe the way of the tools by which the sheets are punched or perforated?—More Light.

[46594.]—**Heating Water.**—Would Mr. P. J. Davies or someone kindly give some advice? I have a tank fixed for heating water—it holds 20 gallons. We have steam-pipes for heating purposes, so I fixed a ½in.

pipe in the tank with the end hooked a little, then joined it to the heating pipes. It boils the water very well, but if it is not watched the hot water boils back in the cold cistern and overflows cold cistern; ball cock, &c., soon get out of order. I have an exhaust-pipe the same size as feed-pipe, and there is a lot of steam wasted. Could I in any way carry it back in the main again without danger to the tank? We want to boil the water in half-an hour—our boiler is steamed at 10lb. or 12lb. Any advice to help me out of this trouble will oblige—Jeff.

[46595.]—**Patched Boiler.**—There is a patch bolted on the boiler packed with red and white-lead and canvas. It soon leaks steam. What kind of packing would you recommend? I want to make as good a job as I can with the same bolted plate. It is about 6in. in diameter. What kind of packing would you recommend for steam-pipes generally?—An Amateur.

[46596.]—**Sugar Boiling.**—I would feel obliged if any reader of the "E. M." could kindly inform me the plant necessary for sugar-boiling on a small scale?—J. C. A.

[46597.]—**Gelatine Emulsion.**—Many thanks for the answer to my queries on the above subject. May I trouble W. J. Bashford again as to the following?—After mixing my toning-bath some seven or eight times, a black deposit is formed. The bath is made as follows:—Chloride of gold, 1gr.; acetate of soda, 30; water, 8oz. It is kept in the dark room away from white light. Can Mr. J. Bashford tell me how to stop this deposit from forming? 2. I have made my emulsion and added the acid, and it is less sensitive when dry than when wet (or properly set). It was cooking at a temperature of 93° Fahr. heat for 18 hours, and is but very little more sensitive than some which had not been cooked at all. The emulsion was made from gum. If Mr. J. Bashford can give me a proper formula for making an emulsion free from fogging and frilling, and fairly sensitive twenty times, I shall be extremely obliged to him.—Dark Slide.

[46598.]—**Problem in Plumbing.**—I have a cistern made of tile and cement, with 2ft. 5in. of water, which for certain reasons must not be emptied nor harsh means used against it. The supply pipe to boiler of range is very old, and has been cobbled about much because of leaks, and to stop the supply from cistern. I have tried to plug it with several gentle contrivances, but all to no purpose. Perhaps some of "ours" may put me in the way of doing it in a very quick and easy manner. The pipe projects in cistern, and is about 1½in. from bottom.—G. B.

[46599.]—**Photographic Portrait Lens.**—I have a portrait lens, which I think is defective. When focussing on white paper there are blue and yellow coloured lines round the edges of the image. Would separating the two lenses correct this, and if so, what distance?—Dry Plate.

[46600.]—**Legal.**—Will Mr. Wetherfield kindly answer the following?—A. left C. and D. the interest during their lives of all money in the 3 per cent. to be equally divided. The survivor to receive the interest on the whole, and at her death the stock to be divided in equal parts between her nephews and nieces—share and share alike. Can E. (one of the nieces) leave her share, in case of her death, to her children?—Phares.

[46601.]—**Double Object-Glasses.**—Has the correspondent who asked this question tried the arrangement of lenses recommended, and with what results? As I am trying to make up a telescope cheaply, and cannot afford to buy an achromatic o.g., any information on the subject will be thankfully received. I wish to get the best results with a simple lens o.g., without using a concave eyepiece.—Poor Amateur.

[46602.]—**Pendulum Springs.**—Will "Nicholls" tell me how to determine the size and strength of a pendulum spring for a new watch? I have succeeded in doing the other job that I wrote you about. Thanks for information.—Pivoter.

[46603.]—**Induction Coil Failure.**—Will one of "ours" kindly say what is probably the matter with a coil I have just made? Tube, paper, à la Dyer; core, 9in.×1in., soft No. 17 wire; primary, two layers No. 16, cotton; soaked in paraffin, smoothed, and then wrapped round with a piece of guttapercha 1-16in. thick; over this two folds of letter-copying paper. Secondary, 1½lb. of No. 36, silk; each layer varnished twice with shellac, and then wrapped with two folds of above copying paper also varnished. Condenser, "Dyer." Battery, one quart bichromate. Result: contact-breaker hums like large bee; but secondary spark only just visible. Connecting galvanometer with secondary and battery only, no deflection on making or breaking contact. Connecting it with secondary, and battery with primary: strong deflections; but, as this occurs just the same when the galvanometer is lying disconnected a foot from the coil, I presume it is merely the excited primary does it. On connecting the two ends together a loud rattling accompanies the humming, which gradually subsides when these wires are separated. On turning to back vols., I find many instructions vary considerably. One says: "Use guttapercha tissue for insulating secondary coils." Another: "If you have made use of guttapercha, I see nothing for you but remaking," &c.; so that I am dubious as to where my fault is. I made a regular "Dyer" some time ago, with what a correspondent calls "his clumsy insulation," and got a good ¼in. spark from ½lb. of 39; I therefore want a good 1in. from my present coil.—B. H.

[46604.]—**Incandescent Lamps.**—Can any reader give any definite information as to the behaviour of Swan lamps with batteries? I have heard that three quart Bunsens are sufficient to give a "good light"; but, on the other hand, I am told that 20 are needed to give the bright incandescence, and more than that to produce the full result. The resistance of a lamp and its appendages is said to be 50 ohms when cold; but if so, could three quarts possibly heat it up?—Petro.

[46605.]—**Dynamo Machines Sparking.**—What is the cause of "sparking" in dynamo machines, and what are the "damages"? I have seen some of the large machines at the Palace, when the commutator and brushes were sheathed apparently in electric flames.—Petro.

[46606.]—**Back-Gear Headstock.**—Would some reader kindly furnish a rough sketch, with sizes, &c., of a simple way to make a back-gear headstock, with a mandrel running in gun-metal bushes? Lathe is 5in. centre, and width of bed 3½in.—Progression.

USEFUL AND SCIENTIFIC NOTES.

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Professor Tyndall on Sound, Light, and Heat.—Last week, Professor Tyndall, F.R.S., concluded his short course of three lectures at the Royal Institution on "The Resemblances of Sound, Light, and Heat." He recurred to the researches of Dr. Thomas Young, as themselves illustrative of the close connection between the phenomena of sound and light; the studies of that philosopher on the nature of sound having led up to his parallel studies on the nature of light. The beats in music afforded the most familiar illustration of the interference to which the sound-waves are subject. Such a wave consisted of pulsations of condensation alternating with pulsations of rarefaction. If two waves coincided in such a manner that condensation answered to condensation and rarefaction to rarefaction, the sound became stronger. But if the pulse of condensation in the one coincided with the pulse of rarefaction in the other the sound was neutralised so far, and silence was the result. Experimental proof was given of this periodic reinforcement and extinction of the sound-wave's motion. It was then also shown by experiment that the phenomenon known as Newton's rings establishes a like periodicity as regards light. Newton's main objection to the undulatory theory of light was that it made the shadows impossible. Newton appealed to the fact of the divergence of the waves in water after passing through an aperture, and Professor Tyndall thought a like divergence ought to occur in the case of light. It really did occur, as Professor Tyndall showed by experiment, but the diverging waves obliterated each other according to the demonstrated law of interference. It was further shown that even in water something of the kind took place. In 1808 an observation of Malus ushered in the darkest days of the undulatory theory. Young himself at first felt that it presented an insuperable difficulty, but he wrestled manfully with it, and waited for more light. As yet the notion was current everywhere that the vibrations of the ether were spread longitudinally, like those of sound. At length the idea of transverse vibrations occurred to Young, and he patiently worked it out, undeterred by its involving the paradox of attributing to the ether the properties of a solid. The same fruitful thought long afterwards struck Fresnel, who was then working with Arago. The latter shrank from endorsing so daring an opinion, and that portion of their joint *mémoire* was signed by Fresnel alone. It virtually solved the problem. The remainder of the lecture was taken up with showing experimentally that polarisation was a phenomenon common to light and heat.

Vulcan Cement.—Messrs. Roberts, Adlard, and Co. have drawn our attention to some samples of a new metallic "Vulcan" cement, manufactured by the new Vronheulog Slate Co., of Nantlle, North Wales. The metallic cement is broken into small pieces, and melted over a very slow fire, and then stirred till quite liquid, when it may be run into any desired forms. On cooling it hardens very quickly. One sample, which has been polished, has a finished surface almost equal to that of enamelled slate. The cement is a cheap substitute for bronze, lead, and zinc, at a saving in cost of from 50 to 75 per cent. It can be remelted and recast into any shape or form, and resists atmospheric action and the effects of most acids and alkalies. It may be used most advantageously among many other purposes for jointing gas and water pipes, for packing purposes, for fastening ironwork and glass in wood or stone, for making moulds for concrete, for covering and repairing roofs, for covering walls and protecting from damp, for filling-in defective castings, for making, covering, or lining cisterns, tanks, pipes, baths, &c., and for statues, busts, and all kinds of ornamental and other useful castings, mantelpieces, &c.

On the Alsace-Lorraine railways mineral oil has been substituted for colza in lubricating the rolling stock, with a saving in cost of 60 per cent. The Bavarian lines have followed suit, with the same excellent results.

The Belgian Government is engaged upon a scheme for promoting a complete system of tramways throughout the country, as feeders to the railways, the work to be done by the various communes interested, either singly or in combination, and assisted where necessary by subventions from the State.

There are now 2,195 miles of steel rails on the London and North-Western Railway.

ANSWERS TO CORRESPONDENTS.

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⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Tuesday evening, April 4, and unacknowledged elsewhere:—

E. B. Fenessy.—J. L. Wrigley.—H. A. H. Daniel.—Dr. Bond.—David Jones.—F. Chadwick, Jun.—J. Berkeley.—B. and Co.—Britannia Co.—J. Francis.—F. A. Moilliet.—A. J. S.—Chemistiana.—C. S. Stretton.—Carstairs.—Orderic Vital.—D. McKay.—J. C. Brown.—J. W. Fisher.—In Want of Help.—Agricola.—Hum.—W.—Alfojoe.—C. M. R.—Founder.—H.—Working Tom.—Snowball.—T. E. Espin.—An Amateur.—G. J. H.—A. Pumphrey.—W. H. S. W.—A. A. W.—E. E. R. Trotman.—G. E. S.—Fellow Workman.—A. W. Soward.—H. A. Wassell.

W. J. Pollitt. (Your string of questions would require a page for full reply, and you will find most of them answered in back volumes. 1. 30. 2. No. 3. Possibly the Pilsen. 4. Any suitable size, according to the shape required; 11 and 13 millimetres. 5. About 12 hours. Yes, not only unpleasant but injurious. 6. Would do, but not preferred. Commercial acids. 7. Need not be. 8. Depends on how much you make and how much you buy.)—P. J. Farrelly. (Will one of those illustrated on p. 89, last week, do, or do you want a gas-furnace?)—R. T. B. (It has been exhaustively treated in our columns, and that very recently. See Vols. XXXI.—XXXIII. Perhaps Nos. 783 and 784 will give you what you want.)—T. S. (It should be the purest iron—certainly not cast. Bismuth and antimony are the best metals, but German silver is to be preferred to copper. See p. 226, No. 790, and the indices for several forms.)—D. E. H. C. (Write to the Civil Service Commissioners, Cannon-row, S.W. You require a fair knowledge of the ordinary subjects taught at school, a good handwriting, and a special acquaintance with arithmetic.)—A Novice, Birkenhead. (All such alloys contain bismuth; and possibly the cheapest for your purpose is composed of bismuth 8, lead 4, tin 4. That is liquid at 213° Fahr. Ask for some Darcet or Rose's metal at the chemical dealers, and try an experiment. You can make by adding bismuth to plumber's solder.)—Frank Smith. (See p. 109, Vol. XVII., and p. 190, Vol. XV. Anything really good in the line is already on sale.)—Melus. (He can assume what name or style he likes; but should he fall into unforeseen difficulties he must stand his chance of being taken for a member of the "long firm.")—James Pedler. (Have you taken medical advice? Your symptoms, as you describe them, are those of acute rheumatism, and can only be treated properly after personal examination.)—Rex. (If the father's property is personal, the daughter will inherit all; but any real estate will go to the heir-at-law, which, in this case, will be the eldest brother, or his eldest son.)—H.J. Peerlhamp. (We have no recollection of the card. The Birmingham wire gauge is given in inches on p. 14, but there is really no definite gauge. That given on p. 14 tallies with Holtzapffel's list, and approximately with Whitworth's; but wire from different makers varies. If you convert the inches given on p. 14 into millimetres, you will have an approximate measurement.)—Churchman. (A little printer's ink thinned with copal varnish and rubbed in is the best. Clean off with a rag dipped in turpentine or benzoline; or grind up lampblack in copal. Make the marks deep with a blunt chisel. Watts's "Electro-Metallurgy," 2s. 6d., Lockwood and Co., Stationers' Hall-court, E.C.)—R. J. A. (Horse-power means that amount of work which is represented by the lifting of 33,000lb. one foot high in one minute. The terms can be interchanged, 1lb. 33,000ft. high, or 550lb. in one second. 2. We believe it is one shilling.)—An Amateur Electrician, Dublin. (About 20, but the battery fails quickly. 2. There are several, but if that is all you want to know, you can see a diagram on p. 462, No. 878. 3. We do not know, but would suggest an application to the Secretary, Trinity House, Tower-hill, London.)—W. B. H. (What practical utility is the "time" of stop. The distance run is the real test, and we suspect it should be 270 yards, not seconds; but no official record has been published.)—A Traveller. (How can anyone answer questions so vague? Probably your suggestion is correct.)—Tat. (They are bent round pins placed in a board just where the bends are required. The coil is done on a mandrel.)—Electro. (You will find the most complete details in back numbers. See the index, issued March 24, and p. 33, No. 808; p. 103, No. 811; p. 458, No. 747.)—J. R. (You must have a top joint, which any musical instrument dealer ought to be able to get.)—Tyro. (See p. 41, No. 808, and many replies in back numbers. We do not like to discourage you, but a locomotive boiler is really a difficult job, and as you have to ask what tools are necessary, we would suggest a trial first of something more simple.)—A Poor Deaf Lad. (Cannot possibly be answered without personal examination. From the fact that you can hear better at times, the probability is that there is some mechanical obstruction. You are sure it is not an accumulation of wax?)—W. G. S. (We do not know of any book which gives such examples. What is the utility of the rule in such questions, which crop up only now and then, and are worked out in a few minutes?)—Fish. (There is a book by F. Vizetelly which enters into the question, but we forget the publisher.)—Apprentice to a Fitter. (A pair of dumb-bells, and gentle but constant exercise at spare intervals, will answer your purpose.)—Mirror. (The glass must be thoroughly clean; then on a flat table covered with baize place a sheet of tinfoil. Pour the mercury on that, and quickly spread it over the surface. Then slide the glass plate on so that its front edge drives a little ripple of the surface mercury in front. Weight down, and leave for a day.)—Guy Fodge, Belfast. (We know nothing of the "School of Telegraphy" named.)—Tasmania. (The disorder is a comparatively rare one, and personal examination by a medical man absolutely necessary. Dr. Edmunds could not give you any advice, and would, we know, decline to do so if we inserted your query.)—H. Sheriff. (If you had repeated the queries we could have replied more definitely. If they have been sent before, they have not been inserted, either because their proper place is the "Sale Column" or the subjects have been dealt with in former volumes. Send again; but before doing so, run your eye down the last published index.)—J. R. Leigh. (Two cylinders, one each side; both drive on the one crankshaft. One can be made to work by a little manœuvring.)—R. B. W. (Evidently constitutional, and advice only possible after personal examination.)—Veritas. (Yes, the distance has varied within the last six months. It is greater in winter than in summer; but for all purposes you may say it is 92,000,000 miles.)—H. C. (The later form of the first named is still protected, and so is the second one.)—T. (It is universally distributed within a height of, say, half a mile from the surface. It is found on the Atlantic and on the tops of the Alps, and is there called cosmic dust; but in dwelling-rooms and factories it exists in much greater quantity. Its nature depends on the locality—mainly organic in the flax or flour mill, mineral in a coal-mine and on the Atlantic, mixed in dwelling-rooms.)—J. S. Rochard. (1. Yes. 2. Nothing. 3. Possible, but at the risk of an action, for a patentee must declare that he has "invented" or that he has received a communication from some one abroad. 4. The clock is only a detail. We do not know that it is claimed as part of the patent.)—W. H. (Bathing in hot water is the best remedy, and some add bran or hay. See the indices of back volumes.)—D. David. (Yes, any of the makers of woodworking machines can supply such a machine.)—Faker. (Yes, the water does not injure the rubber because the latter is vulcanised.)—Hopeful. (12s. 6d., post free. Yes, Kent and Co., Paternoster-row, 1s. monthly, we believe.)—White Swan. (Would do to charge a secondary, but has scarcely sufficient E.M.F. for lighting purposes.)—J. H. Anderson. (Paraffin wax is the best, we believe.)—F. G. (You mean a dye, we presume. All preparations of the kind are based on one of three things—viz., a silver salt, a salt of lead, or the juice of green walnut shucks. With the silver salts it is almost impossible to avoid staining the skin, unless it is carefully covered with pomatum. Lead is objectionable, as it kills the hair, and walnut juice is not always obtainable. Perhaps the simplest and best is to moisten the hair, previously protecting the skin, with a solution of nitrate of silver (1 to 8 parts of water), and then with a weak solution of sulphhydrate of ammonium. That is an instantaneous process, and is as good as any.)—Subscriber, Rotherham. (Just the thing to be struck. See that the sheet-iron pipes are connected to a good earth-plate by an iron rod not less than 1in. diameter. Read the article on the Lightning-rod Conference on p. 441, No. 877.)—Young Mechanic. (The City and Guilds of London Institute, and the Whitworth Scholarships in connection with the Science and Art Department. Where do you live that there are no classes in your town? Particulars as to the City Institute of the director, Gresham House, E.C. The Whitworth prospectus can be obtained from the Sec. of the Science and Art Department, South Kensington, S.W.)—Digit. (See pp. 15, 16, No. 885, and a table, p. 410, No. 797.)—Amateur Electrician. (A simple one given on p. 452, No. 825; but why not endeavour to see one?)—Zadig. (Mix with solution of alum instead of water. It takes longer to set. May be plainly coloured, but scarcely marbled.)—W. A. H., Manchester. (Any oil, almost—say cotton-seed. 2. No French chalk at all if you wax the mould; but the sellers give the proportion they recommend. You can dust the type with the chalk if you clear the faces. It sticks because not properly oiled. 3. A hot solution of soda and a brush will do all the cleaning necessary. 4. Depends entirely on the heat. A little practice will show you. If you leave it too long, the rubber becomes too hard. How do you bed the type in taking your cast?—perhaps you make that too deep.)—Regulas. Marine glue is best, but Berlin black, thinned with turpentine, is good, as is also paraffin wax.)—Erin-go-Bragh. (Mix the rubber with sulphur; but it is better to buy the stuff ready prepared.)—Dr. Royston Pigott. (Shall be pleased to receive the contributions mentioned.)

THE LATE "SECONDS' PRACTICAL WATCHMAKER."

Since remitting the amount subscribed up to last week to Mrs. Coates, we have received a few more subscriptions. We will add any further contributions that may reach us, and remit the amount as soon as it is worth sending.

	£	s.	d.
Amount previously ackowledged	£24	15	2
J. M., 2s. 8d.; W. G. S., 6d.; Churchman, 6d.; Three Two Pennyworths, 6d.; Hopeful, 1s.		5	2
	25	0	4

The decrease in the number of second-class passengers, and the receipts from them, continues on the London and North-Western Railway, but at present Mr. Moon does not think it advisable to do away with that class.

Every Workman connected with the Building Trades requiring a situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden London, W.C.

"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

Every Workman should insist on seeing "THE BUILDING NEWS" every week at his Club or Coffee House. He will find more "Lists of Tenders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Intercommunication" if he wants to know anything about his trade; to write to the Editor if he has any suggestions to make and to advertise in the paper when he wants work.

The charge for Advertisements for Situations is One Shilling for Twenty Words, and Sixpence for every Eight Words after.

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Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

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Sixteen Words	0	6
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*** It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions; and in cases where the amount sent exceeds One Shilling the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement and charged for.

Advertisements *must* reach the office by 3 p.m on Wednesday to insure insertion in the following Friday's number.

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PAYABLE IN ADVANCE.

5s. 6d. for Six Months and 11s. for Twelve Months, Post-free to any part of the United Kingdom. For the United States, 13s., or 3 dols. 25c. gold, to France or Belgium, 13s., or 16f. 50c.; to India (via Brindisi), 15s. 2d.; to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post-office order. Back numbers cannot be sent out of the United Kingdom by the ordinary newspaper post, but must be remitted for at the rate of 3d. each to cover extra postage.

Messrs. James W. Queen and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post-free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes they must be paid for at the rate of 4d. each copy, to cover extra postage.

Vols. XXIV., XXVI., XXVII., XXVIII., XXIX., XXX., XXXI., XXXII., and XXXIII., bound in cloth, 7s. each.

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All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in March and September, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d each, through any bookseller or newsagent, or 2½d. each, post-free from the office (except index numbers, which are 3d. each, or post-free, 3½d.)

Indexes for each half-yearly volume up to Vol. X. (except Vols. II., III., IV., V., and X.) inclusive. 2d. each. Post free 2½d. each. Indexes to subsequent vols., 3d. each or post-free, 3½d. Cases for binding, 1s. 6d. each.

*** Subscribers are requested to order Cases and Vols. through their booksellers, and not to send direct. The regulations of the post-office prevent their transmission through the Post.

Throat Irritation.—Soreness and dryness, tickling and irritation, inducing cough and affecting the voice. For these symptoms use Epps's Glycerine Jujubes. Glycerine, in these agreeable confections, being in proximity to the glands at the moment they are excited by the act of sucking, becomes actively healing. Sold only in boxes, 7½d. and 1s. 1½d., labelled "James Epps and Co., Homœopathic Chemists, London." A letter received:—"Gentlemen,—It may, perhaps, interest you to know that, after an extended trial, I have found your Glycerine Jujubes of considerable benefit (with or without medical treatment) in almost all forms of throat disease. They soften and clear the voice.—Yours faithfully, Gordon Holmes, L.R.C.P.E., Senior Physician to the Municipal Throat and Ear Infirmary."

Holloway's Ointment.—A Cure for all.—This unguent may be rubbed into the system, so as to reach any internal complaint. By this means it cures sores or ulcers in the throat, stomach, liver, spine, or other parts. It is an infallible remedy for bad legs, bad breasts, contracted or stiff joints, gout, rheumatism, and all skin diseases.

OUR EXCHANGE COLUMN.

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The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

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Lathe wanted, in exchange for a Mahogany Biunial Limelight Dissolving View Apparatus, in perfect order.—Nicholl, Castle-lane, Belfast.

Scientific Instruments wanted in exchange for Oleographs, Chromos, or Picture Frames.—Nicholl, 29, Castle-lane, Belfast.

Organ Bellows and Windchests, several in good condition (ready for wind and pipes); books, musical instruments, or offers to W. Johnson, 12, Moxley, Wednesbury.

Slide-rest, 3½in. centre, nearly new. Exchange for stocks and dies, Whitworth gauge.—W. Simkins, 48, College-street, W., Camden Town, N.W.

Wanted, Screw-Cutting **Lathe**; will give part cash and another lathe.—H., 4, Sugden-road, Lavender Hill, S.W.

Large Plate **Electrical Machine** (3ft. diameter), conductor and stool, in exchange for other physical or chemical apps., or tricycle.—Lecturer on Physics, Central Science Schools, High street, Marylebone-road.

Heliostat.—Very massive new brass Heliostat, for solar microscopy, with mirror, double-motion screws, &c., weight 12lb., cost £5; exchange for microscopic or other scientific apparatus.—J. L. M., 106, Princes-street, Edinburgh.

Large **Cylinder Machine,** broken, Leyden Jars, splendid black Cat Skin, 20 zinc rods, 1lb. each, 10 small Bunsen Cells, 20 Porous Pots, &c. Wanted, ½-plate Portrait Lens.—H. Fell, Market Rasen.

Hydraulic **Pressure-Gauge,** indicates 4 ton, good conditon. Exchange for small Gas Stocks and Dies, or other offers.—22, Coventry-road, Hinckley, Leicestershire.

Will exchange "**Book of the Pigeon.**" "Book of Canary and Cage Birds." 4 Sebright Bantams, and 6 Fantails; for Chemical Balance, Apparatus, or Tricycle. Worth £8.—Jno. Dunlop, Dornock Public School, Annan.

Fretwork Machine new, prize Holly; exchange for violin and bow.—W. T. Kent, 68, Westbury-street, Swansea.

48in. **Bicycle,** set of castings for 2in. engine, 5ft. gap lathe-bed planed, leading screw, full set of change wheels; exchange, what offers?—R. D. Smith, 12, Fazakerley-street, Chorley, Lancs.

Lathe wanted, 4 to 6in., rests, chucks, screw-cutting or otherwise, cheap, also drilling machine; exchange small canoe. Ashenden, Chartham, Canterbury.

THE SIXPENNY SALE COLUMN.

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Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

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For Sale.

"**The Night-light Clock.**" Illustrated and described on page 370, No. 848. Price, carriage free, 5s. 6d.—F Robertson, 13, Greek-street, Soho, W.

Band Primo.—A Tutor for all Band Instruments. "A Book which every Bandsman should have." Price 5s., P.O.O. T. Rawson, 114, Heaton-lane, Stockport.

Metallic "E" **Violin Strings.** Infinitely superior to Gut. Three, post, 1s.—Smith, 2, Bedford-street, Plymouth,

Incrustation Prevented. When other means fail, Morgan's Boiler Compound is highly recommended.—W. H. Morgan, Engineer, Gloucester.

The **Britannia Company's** new No. 13 Screw-cutting Lathe, 30in., strong and accurate, price £15 15s. See notices in English Mechanic. Apply for circular, 1 stamp.—Britannia Company, Engineers, Lathe Makers to the British Government, Colchester, England.

Launch Engines, new, different sizes, cheap.—State size required.—John Middleton, 16, Hope-street, Glasgow.

Lathe, 3½in. centre, 3 foot, screw-cutting. change wheels, compound slide rest, nearly new, £10. Makin, Cupola, Sheffield, great bargain, good tool, warranted perfect.

Elastic Stockings. No makers in London. Made in Liverpool only by Smith and Sons, Breck-road.

Parkinson's Amateur **Polisher's Cabinet.** The most inexperienced can polish with success. Circular free.—James Parkinson, Warrington.

Japanning done for the trade. Machines of every description.—Merson and Co., 44, Wynyatt-street, E.C.

Bicyclists, Athletes, and Engineers should wear the patent nickel-plated steel Albert, new and elegant pattern, always retains rich polish. Does not rust. Post free 12 stamps.—Gorse, 128, Moor-street, Birmingham.

"**Fiddler's**" double soundboard **Violin,** loud and clear, 10s.—"Fiddler," 19, Edward-street, Burdett-road, E.

Paints.—Instructions for Making Paints suited for the grinder and operative painter.—T. Armstrong, Woodville, Hounslow.

Bachelor's **Brass Buttons.** No coming off. No sewing. Last lifetime. Packet free, 14 stamps.—Hezmalhalch.

Excruciatingly **Comic Readings.** You will be obliged to laugh. Send 1½d. for one, and rejoice.—Hezmalhalch.

New "Eclipse" **Pipe.** No oil in mouth. No smoking wet tobacco, 2s. free.—J. Hezmalhalch, 1 Fellisclifle, Leeds.

Two 10in. silvered **Glass Mirrors** to be sold for a very reasonable price, one of finest quality by Calver, with tube, flat, finder, focussing eyepieces complete, but without stand. What offers?—Apply Rev. W. G. Matthews, Rectory, Wadebridge, Cornwall.

The **Dental Wonder,** a marvellous cure for toothache, post free, 1s. 2d.—Southwell, Pharmaceutical Chemist, Boston, Lincolnshire.

Southwell's Absolute **Remedy** for Tic Douloureux, post free 2s. 9d.—Southwell, Pharmaceutical Chemist (by examination), Boston, Lincolnshire.

Munroe American Organ **Tubeboards** with reeds voiced. Few only.—Ray, 86, Poplar Walk-road, S.E.

Microscopic Objects for mounting. Sample 20 preparations and price list, 1s. 2d.—R. Philip, Grove-street. Stepney, Hull.

Sufferers from Indigestion, &c., should read Dr. Brearey's "Popular Treatise" on that subject.—Address the Author, enclosing 7 stamps, 1, Belle Vue-square, Scarboro', for copy.

Fisher's Ethoxo-hydrogen **Limelight Apparatus** gives the most brilliant and whitest light. Perfectly safe.

Ethoxo-hydrogen **Generator,** made in copper, price 30s. Send stamp for particulars.—Fisher, Calverley-street. Tunbridge Wells.

Ingredients for preparing Hop Bitters, 6d. per packet, post-free, 8d.—Jones, Chemist, Westminster-road, Liverpool.

Elegant Ladies' Gold **Rings,** 5 stones, diamonds and sapphires, diamonds and rubies, or all diamonds, 15s. each. P.O.O. to A. Francois, care of E. Charles, Ryland-road, Birmingham.

Patent **Eye Pretectors,** 12 stamps; to A. Francois, care of E. Charles, Ryland-road, Birmingham.

Pianista, quite new, an instrument for playing the Piano or Harmonium automatically, cost £32 10s., can be seen after 6 p.m.—18, Bedford-street, Choumert-road, Rye-lane, Peckham.

The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, APRIL 14, 1882.

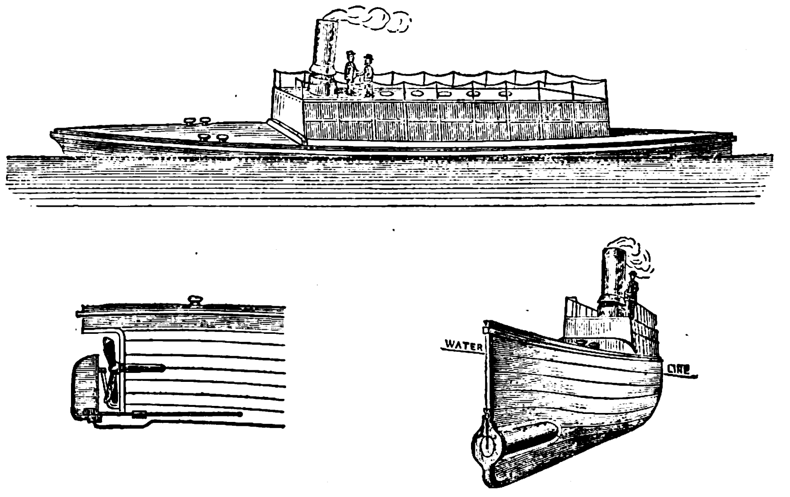
THE NAVAL AND SUBMARINE EXHIBITION.

THE Naval and Submarine Exhibition, opened last Monday at the Agricultural Hall, must be considered a decided success. Thanks to Mr. Samson Barnett, jun., Londoners and visitors from the provinces have now an opportunity of forming for themselves a tolerably clear idea of the value and variety of the means and methods employed in the mercantile marine, and of the various appliances for traversing the sea in comparative safety and comfort. Of actual shipbuilding itself, there is little to be seen beyond the models sent by Lloyd's Register, but everything else that can be supposed to appertain to the great carrying trade of the world is exhibited—from the furniture and fittings of the ships, to all those appliances and minor details which help to make a modern steam-vessel a little world in itself. As far as the general sightseeing public is concerned, probably the most interesting exhibit is that of Mr. Samson Barnett—a large diving-tank, 20ft. in diameter and about 12ft. deep, with a number of plate-glass windows, through which the operations carried on can be watched. That occupies the centre of the ground-floor, and around it are arranged the stalls of the various exhibitors of diving apparatus and other appliances used in submarine work. At regulated intervals during the day operations of various kinds will be carried on under water in this tank, including an exhibition of the skill and ability of a party of sponge-divers from the Levant, who have, by long practice, acquired a power of staying under water for a time which seems extraordinary. The utility of the Fleuss helmet, which we illustrated and described in No. 792, p. 272, will be practically demonstrated, as an improved diving appliance which relieves the diver of the incumbrance of pipes, and permits of the greatest freedom of motion under water. The helmet, it may be remembered, contains compressed oxygen, which is used to revivify the expired breath, the carbonic acid expelled from the lungs being absorbed as the expired air passes through a chamber packed with broken porcelain wetted with caustic soda. The helmet has already done good service, notably in the Severn Tunnel, where a diver was enabled to walk many yards up the submerged workings, and do some absolutely necessary work that would have been impossible if he had to drag the air pipes of the ordinary diving equipment with him. The Fleuss helmet is also of great utility in colliery explosions, and thus competes with the Denayrouze apparatus, which is also exhibited and shown in work as a submarine appliance. The apparatus of Messrs. Fleuss, Duff, & Co., Applegarth and Denayrouze, are fitly supplemented by Messrs. Barnett and Foster with a collection of improved diving appliances, and Foster and Fleuss's submarine and mining lamp, while Messrs. Siebe and Gorman, and some other firms, also show approved and tested apparatus. We may here say that it is impossible, in the space available, to give the names of all the firms exhibiting, which in the catalogue occupy, with a bare enumeration and brief description of their exhibits, nearly 200 pages. We can only mention names where they seem absolutely necessary for the purposes of identification. Passing the diving apparatus, the next most attractive exhibit will probably be the models of ships, and here we find a very complete collection. The Admiralty show the *Monarch*, the *Devastation*, and the *Polyphemus*, with a Russian Popoffka, or circular ship, while amongst celebrated mercantile steamers we have large-scale models of the three latest Transatlantic liners, the *Servia*, the *City of Rome*, and the *Alaska*, the last named of which has recently made the remarkable passage between New York and Queenstown of seven days, six hours, forty-three minutes—the best on record. Close at hand we have the *City of Berlin*, the *Britannic*, and the *Lydian Monarch*, the latter chiefly noticeable as a sister-vessel to that in which Jumbo was shipped to the United States; but we must not forget the *Stirling Castle*, a tea-clipper, which recently on her trial attained a speed of 18½ knots, and is amongst mere trading vessels the fastest steamer afloat. In the division of ships, there are many models and half-models of yachts which are sure to attract the attention they deserve, and amongst them may be noted a nicely finished model of the late Czar's "yacht" *Livadia*, noticeable as an experiment in naval architecture which is not likely to be repeated. Leaving the models, we will turn our attention to what may be termed the novelties of the exhibition, and these are found mainly in rotary engines, which have lately come to the fore in a rather unexpected manner. Practically condemned by engineers and by Reuleaux in his celebrated treatise, they have, during the last two or three years, pushed their way into notice, partly by reason of certain demands, partly because they are really useful motors. First and foremost, by reason of its size, we notice the large rotary of M. Brossard, which is said to be of 1,000 horse-power, but which unfortunately arrived too late to be shown in working order. This machine, which would require at least a page to adequately describe it, is of the type in which one cylinder is placed excentrically inside the other, and forms the revolver or roller of the engine. The "piston" is attached to the main shaft, and passes through a slot in the small or inner cylinder, which it obliges to rotate round an excentric axis. The steam enters the large cylinder at the bottom (that is, one of the sides, for the engine is of course horizontal), and the small cylinder through the shaft carrying the piston, an arrangement by which the area presented to the steam in the two cylinders is always the same whatever may be the position of the piston. The engine has an ingeniously worked out governor, which controls the speed either by regulating the degree of expansion or by throttling the steam; but we shall doubtless hear more of this engine when it has been fairly tested, and it must suffice to say that the inventor claims economy, simplicity, easy manipulation, and the minimum of wear and tear, with absolute regularity in working. Hodson's rotary is now well known from its performances at the Crystal Palace, where one is shown running at 1,000 revolutions a minute. The shaft carries a piston which is driven round the cylinder by the pressure of the steam until it reaches the exhaust, the steam being admitted by means of a flap. As the piston passes the exhaust, it closes the flap, which falls immediately afterwards, and admits steam to one side only, the admission being regulated by a cam on the shaft operating the throttle-valve. These engines, which are shown driving a De Bay fan, work excellently, and the only suspicion about them is their durability—*i.e.*, whether wear and tear will not be excessive. That, of course, remains to be proved. Another rotary engine at the exhibition is made by Mr. Dexter, of Bourne End, near Maidenhead, and is especially adapted for winches and slow work generally, though it can be utilised in launches. This engine consists of a cylinder with a roller and slides, the latter actuated by cams on the cylinder covers. The division between inlet and exhaust is passed by the slides rubbing against a steel spring, and as the details have been well considered, the wear has been reduced to a minimum. The engines reverse with a slight motion of a lever, and can be made to run at any desired speed. Amongst propellers we noticed exhibits claiming superiority over the ordinary forms, but in the absence of practical trial—the only safe guide in this matter—there is little to be said. The only real novelty is Welton's fan propeller, exhibited by Duncan Brothers, applied to a launch. In this device, instead of the shaft having a rotary motion, it reciprocates and works a couple of fan-blades which close in as the shaft is withdrawn and spread out as it is driven backwards, thus giving a direct pushing motion. In this case, as in all others connected with propellers, it is only practical trial which can determine the relative merits. In the tank-room Mr. J. Neal exhibits a boat in which the propellers are placed amidships, with tanks into which they can be drawn up when desired. The propellers, of the ordinary screw form, are thus placed in the solid water beneath the bottom of the vessel, and may consequently give an advantage which is not to be obtained in the usual position. Boat lowering and detaching gear is well represented; but we failed to find anything superior to the devices shown at the exhibition held at the London Tavern in April, 1873, an account of which we gave in No. 422, p. 131. As a matter of fact, many of the most successful boat lowering and detaching gears are merely modified or exact counterparts of those exhibited nine years ago; but that is not to be wondered at, for it takes a long while to establish the reputation of any new device of the kind—*e.g.*, the Berthon collapsible lifeboat, which is here shown in action. This boat, which packs up into a small space, and can be stowed along the bulwarks, so that an emigrant vessel might carry sufficient for all her living freight, was illustrated and fully described on p. 194, No. 424. Of detaching gears, we may say that they divide into two groups, in both of which slip or tumbling hooks are used, the difference consisting in the manner of letting them off. In this connection considerable divergence of expert opinion exists, some nautical men holding that the boat should not be released except by the movement of a lever in charge of some responsible officer, while others hold that it is preferable to make it self-releasing as soon as it is water-borne. The other differences between the various designs are mainly in matters of detail; in the first kind the usual arrangement is a rod running along the bottom of the boat connected to the hooking-tackle in such a manner that when moved by a lever both hooks must be simultaneously released; in the other kind the hooks are generally so contrived that on being relieved of the weight of the boat they automatically open and release the boat.

Amongst the machinery exhibited, the steam stearing-gear will have most attraction for nautical men, and probably also for shipowners, though some of the latter will no doubt examine with interest the refrigerating machines, comparatively new devices, which have already rendered possible the importation of meat from Australia, and which promise to create a large trade in the transport of perishable commodities of all kinds. Of the smaller sized marine engines nearly every good type is shown by a number of different makers; but for obvious reasons the engines of large ocean-going steamers are shown only in model form. Fox's corrugated boiler tubes are, however, exhibited in full size as applied to large marine boilers. Boilers, especially of the portable kind, are shown in great variety, and many of them are under steam, while boiler fittings are exhibited almost in profusion. Rudders are represented by well-known devices, and amongst them will be noted that of Capt. Heathorn, R.A., who uses two rudders, which can be opened one against the other, thus checking the way of the vessel. The inventor claims that the device, by using the deflected current of ejected water from the screw, doubles the power of steering, and enables the vessel to be steered when going astern. Two models are shown, one with a screw propeller working in a case, the other being a *facsimile* of the rudders as applied to a launch propelled by a jet of water through the sternpost. Amongst the models of lighthouses is a large-scale reproduction of the celebrated Galley Head lighthouse, which is under the control of the Commissioners of Irish Lights. Life-saving appliances in the form of rafts, buoys, dresses, mattresses, &c., are exhibited in great variety, and in connection with these and the lifeboats, two prizes will be awarded, after trial, by a committee consisting of Vice-Admirals H. Boys and A. W. A. Hood, C.B., assisted by Sir Digby Murray, Bart During the exhibition several lectures on subjects connected with naval and submarine engineering will be delivered, and these, together with selections from the papers read, and a number of special articles, will be published in a large edition of the catalogue, to be issued after the close of the exhibition.

THE BRITISH NAVY.*

THE first volume of Sir Thos. Brassey's interesting account of the British Navy has been rapidly succeeded by the second, which treats of miscellaneous subjects—armour, guns, unarmoured ships, harbour defence, torpedoes, &c. We gave a lengthy notice of the first volume, which dealt with the fighting ships, on p. 557, and we have now to review what Sir Thos. Brassey says as to the details of their construction and armament, so far as concerns armour and guns. The statistics given as to the relative strength of the British and foreign navies, represent the situation as it existed two years ago, when the work was mainly written; later details will appear in subsequent volumes. The chapter on armour and armour experiments is shorter than might have been expected, if we did not remember that the latest experiments usually rob their predecessors of much interest. Still, in something less than 30 pages the author has contrived to compress an account of the most important experiments, with illustrations, and to give views of the *Huascar*, after the engagement which led to her capture by the Chilians. The figures show the development of armour from the early *Warrior* to the trials at Spezzia on plates nearly 22in. thick. The second chapter deals with guns and gunnery, and incidentally with powder. The illustrations in this portion of the book give a good idea of modern heavy guns, as besides the 80-ton gun we have the new type of Woolwich breech-loader to compare with Krupp's enormous weapons and the system adopted by the French. The burst 100-ton gun of the *Duilio* and the experimental bursting of the *Thunderer's* gun also find appropriate places, as do the diagrams showing the penetrating power of the British muzzle-loading, and the French and German breech-loading guns. These are all taken from recognised authorities, and are duly acknowledged. Probably the most interesting chapter in the book is that on torpedoes and torpedo boats, which will, in the opinion of many competent judges, play a more important part in naval fights of the future than either armour plates or big guns. In his historical account Sir Thos. Brassey does justice to the claims of the Americans Bushnell and Fulton, who first invented "diving boats" for the purpose of affixing torpedoes to the bottoms of vessels. Submarine mines probably have their origin in Bushnell's idea; but little appears to have been done with them until in 1839 General Pasley blew up the wreck of the *Royal George* by means of powder fired by electricity. Nobell about 1841 sold an invention of the kind to the Russian Government, and in the same year Colonel Colt, who had been experimenting on Fulton's lines, completed a system the utility of which he publicly demonstrated in New York Harbour in 1842. The first instance of the use of the subaqueous mine as a means of protecting channels in time of war was in 1848-50, when Prof. Hinly laid a line of mines across the harbour of Kiel, to prevent the Danish war-ships entering. In his case the mines consisted of strong casks made water-tight and filled with gunpowder, which was to be fired by an electric current. One of these mines was picked up in 1873, and was found to be in a remarkably perfect condition. The mines were never actually brought into use, nor was the submarine boat, built at the time from the designs of a Bavarian named Bauer. During the Crimean war, two kinds of mines were used by the Russians—one exploded by contact with the ship, the other by an electric current sent from the shore. Although these mines did something to check the action of the Admirals, and rendered Captains very cautious, no effective service was rendered by them, for when they were not removed by the boats sent to fish for them, they either failed to explode, or did so in a manner that caused little damage. In 1859 the Austrians employed submarine mines of gun-cotton, to defend the entrance of the Malamocco at Venice, and devised a means of ascertaining when a vessel was within range of the mine, which, however, was useless on dark nights, or while smoke from guns hung about. It was not until the American War of Secession that torpedoes gave any practical illustration of their efficiency as weapons, both of offence and defence, and it is remarkable that although the heaviest artillery then known was used for the first time, not a vessel was lost, and a few only were materially injured by shot or shell. The losses, which included ironclads and wooden vessels, were all brought about by submerged torpedoes, some of which acted by contact, others being fired by electricity, while, for the first time the spar torpedo was brought into use. In nearly all cases the fuse devised by Prof. Jacobi for firing was employed in contact torpedoes. It consisted simply in a glass vessel containing sulphuric acid, which, escaping when the containing vessel was broken, found its way to some chlorate of potash, and thus ignited the powder. In the war between Brazil and Paraguay, in 1866, the defenders resorted to the use of submerged torpedoes to stop the advance of the fleet up the river Paraguay, and tried, without success, to blow up the vessels by means of floating torpedoes. An ironclad, which had been ordered to advance, however, struck a submerged mine, and was broken in two. In the Austro-Prussian War of 1866, an elaborate system of torpedo defence was devised for the protection of the boats on the Adriatic, but no opportunity of testing the efficiency of the mines occurred. An invention of Baron von Ebner combined the advantage of the electrical and the contact system, and left explosion optional on the part of the defender. In this arrangement nine percussion knobs, projecting above the cover, received the shock by means of bars on a horizontal wheel, the axis of which carried the electric fuse. The turning of the wheel put the fuse in circuit, and at the same time brought into action a current of a higher tension which was more suitable for inducing ignition. In the war between Germany and France in 1870, torpedoes were prepared by one of the combatants, but they were not actively employed. The results of the torpedo fighting in the Russo-Turkish war are too well known to need mention; but a record of them will be found in Sir Thos. Brassey's book, which is intended to be an historical epitome of the progress of the arts of naval war. So far as actual warfare is concerned, the various forms of torpedoes intended to be used offensively have almost a blank record, except the spar-torpedoes worked from boats, which must of necessity run some risk while approaching the enemy. The most remarkable invention of the kind is the "Fish" torpedo, which contains within itself the propelling and firing gear, and is apparently as perfect as such a machine can be, though there is no reason to suppose that its powers have been fully developed. Invented primarily by Commander Lubis, of the Austrian navy, it has been perfected by Mr. Whitehead, and the "secret" has been purchased by several Governments. The charge is from 33lb. to 55lb. of gun-cotton, and a mere graze is sufficient to cause an explosion. Hence,



ERICSSON'S TORPEDO BOAT, "THE DESTROYER."

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* The British Navy: its Strength, Resources, and Administration. By Sir Thomas Brassey, K.C.B., M.P. Vol. II. London: Longmans.

the trigger setting the screws in motion is only pulled as the torpedo leaves the firing tube, and it is not until some distance has been traversed that the machinery itself releases the last safety-pin preventing the accidental firing of the explosive. The fore part of the torpedo contains the explosive, the after-part the motive engines, while the centre is the "secret," the means whereby the missile is made to automatically regulate its depth according to the degree of immersion required. This is accomplished by horizontal rudders, but the method of actuating them is the secret. It is believed to be done by the pressure of the water acting on the ends of the chamber and on a spiral spring, which is set to suit the required depth, and the motion of which, by means of a rod, shifts the horizontal rudders. The amount of regulation can be arranged to the greatest nicety, for after the compressed air, which drives the screws, has expended itself, the torpedo may be made to rise to the surface or sink to the bottom, and further, if loaded, the safety apparatus can be arranged to prevent the explosion, and thus facilitate the recovery without risk. The engine is of the Brotherhood type, and is worked from a reservoir of air charged to a pressure of 1,000 or 1,200lb. The Lay torpedo, which appears to be more complicated than the Whitehead, is propelled by ammonia at a pressure of 40 atmospheres, and is complicated by trailing an electric wire at the stern, which, however, enables an electrician to direct its course, and to fire at the proper time. The Ericsson torpedo is worked by sending compressed air through a hollow cable; but owing to the weight of the latter, the "range" is at the outside only a few hundred yards. Two other so-called automatic torpedoes have been invented—one by Capt. MacEvoy, the other by Commander Howell, U.S.N. The former is carried at the end of a spar until near enough to be launched, the motive-power being carbonic acid released by the action of an acid on a carbonate; the latter derives its movement from the "inertia" of two heavy iron wheels which, just before starting the torpedo, are revolved at speeds of about 4,000 to 10,000 turns in a minute. Captain Ericsson has within the last three years devised an improved form of torpedo, which is fired from a special vessel called the *Destroyer*, having a fine wedge-shaped bow and stern, and an intermediate curved deck from stem to stern, which supports a heavy armour plate about 32ft. from the bow inclined at an angle of 45°. The vessel will be deeply immersed when in fighting trim, a deck-house being riveted water-tight to the upper part of the hull. There are some other peculiarities about the vessel which render her different to other ships which have been built specially for firing torpedoes. We are indebted to Messrs. Longmans for the engravings on the opposite page. Torpedo launches and torpedo boats are fully described, and many pages of the work are devoted to unarmoured cruisers and to "mercantile auxiliaries," illustrated by a couple of plates and several diagrams of the *Servia* and the *City of Rome*. This portion of the book is full of interesting details in connection with a subject which lately, thanks to Sir W. Armstrong, has attracted much attention, and received much elucidation at the recent meeting of the Institution of Naval Architects.

WATCH-CLEANING AND REPAIRING.

By "A Fellow-Workman."

(*Continued from page* 95.)

NOW you will naturally suppose that a mainspring, being a strong, sturdy fellow, is perfectly able to look out for himself; but if you do, you will soon get mistaken. I assure you that the mainspring requires as much attention as the balance. I do not say that it gets out of order as easily, but I mean that it requires as much care in repairing; the hole for the rivet or catch (as described last week) should be perfectly in the centre of spring, and when in the box you should see that the spring should not come high enough in the barrel to press against the lid or cover.

I have also seen some jobbers who have a way of pulling the mainspring out straight, and then letting them spring to again; also pulling it up like a spiral spring, and pulling it about like a piece of indiarubber. Now, I cannot see what possible good this can do the spring. I think it must weaken it, and in some instances of common springs, cripple it; so I would advise you not to pull it about more than is necessary. I have got some very funny ideas about the mainspring—I actually don't believe in oiling it; in fact, I have tried it in many instances of troublesome watches of different kinds, and have found that the watch will go longer between cleanings, and keep better time. I clean it first with paraffin oil, then with chalk, and don't leave off until I get it perfectly dry and clean; then I clean the barrel and arbor, put a little oil to the pivot of the arbor, and leave the spring dry.

Chain.—The amateur generally finds the chain very annoying—so did I when I first began; but as soon as my master told me how to do it, I found no difficulty whatever. I will tell you what he said:—I had jumbled up about five links, and the master, who was looking over my shoulder, said, "Let's look at your punch—that's too large." So he brought me four punches of different sizes, told me to take the smallest one, which he called the "starting punch." Now this was a very small one, made from a sewing-machine needle; the point had been removed on the oilstone, and was perfectly flat (this is done by holding the needle in the left hand, and rubbing a piece of oilstone, which is in your right hand, in a French-polisher's fashion over the point of the needle). "Now," said he, "put the point of your punch on the centre of the leaf about where you would suppose the rivet to be, and tap lightly with your small hammer. Now watch your rivet. Does it move?" "No," said I. "Tap a little harder," said he. "Does it move?" I could just see it breaking away, and I said so. "Now," said he, "just take a punch a little smaller than the rivet: you can see where to put it, and tap lightly." I did so, and the rivet came out clean, and since that I have never found any difficulty in removing a rivet. The chain should be laid on a piece of boxwood, with the oval side upwards, so that the rivet runs with the grain of the wood; use small piano wire, or wire sold on purpose, nip off close to the top, leave ⅛in. at bottom, then take hold of this ⅛in., close to the chain; with your nippers, nip half-way through, rivet top end while in the nippers; continue gently to squeeze the nippers while you lightly tap the top with a small hammer; continue to tap and squeeze until the chain drops from the face of the nippers. Now remove any part of the rivet that protrudes beyond the surface of the chain, polish and burnish, and it will be difficult to tell which rivet you put in. You must be careful to see that both the hooks turn the same way before you put the chain together.

The stop-work very seldom gets out of order of itself, but the spring sometimes gets ruptured in cleaning: you must always try it after you have cleaned it, to see that it works properly before you put it together.

Motion Wheels.—These wheels seldom require any repairing; the steel wheel is called the "cannon pinion,"—this carries the minute-hand; the next is called the "motion-wheel," the next is called the "hour-wheel,"—this wheel carries the hour-hand.

Dial or Face.—If you should have to fit a new dial (send the old one as pattern), put it in its place, take a needle, and mark for holes in stump to be drilled, and make a small hole with a pivot drill; see that the hour-wheel has got a little shake—if it has got too much, put on a "paper washer"; if not enough, turn back the shoulder by placing it on an arbor in the turns. Be careful and don't cut off the pipe.

Hands.—The hour-hand only wants putting on if you have the right size; if you are put to the push, you can sever the pipe; there are small square files made on purpose for fitting minute-hands. To hold the hands while filing, I make a notch in both jaws of a pair of old pliers. In these you will be able to hold the body of the hand while you are enlarging the square; the holes in second hands are made with a watch broach.

Glasses.—There is not much difficulty in fitting flints or double lunettes; but if you have a hunter, you will find a little difficulty; in any case the glass must not touch the centre-pinion.

This is the end of the "general repairs" for a verge watch. I will next deal with the "extra repairs," to the best of my ability.

(*To be continued.*)

THE INDUCTION COIL AS AN INSTRUMENT OF RESEARCH.—I.

1.—Introductory.

MUCH has been written, both in the pages of the English Mechanic and elsewhere, upon the subject of the construction of induction coils. Coils of all sizes, and of every imaginable pattern of build, have been described in all their minutest details. The relative merits of different methods of winding and of insulating, the claims of mercury and of platinum contact-breaks, the respective advantages and disadvantages of various forms of batteries, have all been so fully discussed that it seems almost impossible to find anything fresh in connection with coils about which to write. But notwithstanding all this talk concerning the making of coils, little has been written on the use of a coil when made. It seems usually to be considered by writers on the subject, that the object of a person who sets about to build a coil is to give himself a certain amount of amusement in the mechanical process of its construction, and when made, to provide himself with a little more amusement by lighting up a few pretty vacuum tubes, or by irritating the nervous systems of his too-confiding friends.

It is to supply this deficiency, to show that the induction coil is not a mere toy, to show that it is a powerful instrument of research in perhaps one of the most fascinating branches of science—that of molecular physics,—to tell the story of some of the discoveries that have been made by its aid, that these articles are written.

But what is an induction coil? What are the essential parts of it? What is its action? And why does it so act? These questions meet us at the outset, and unless we clearly understand the answers to them, it will be impossible for us ever to attain to a just appreciation of the use of the coil as an implement of research.

Let us, then, before we go further, glance at those electric phenomena which underlie, and are applied to, the instrument we are studying.

2.—Fundamental Truths of Current Induction.

A long wire A B (Fig. 1) is placed in connection with a battery C and mercury cups D and D′. Another wire, A′ B′, is stretched close to the first wire, and placed in connection with a delicate galvanometer, G. It is known, by previous experiment, that a deflection of the galvanometer needle to the right would be produced by the insertion in the circuit A′ B′ G′ of a battery, sending a current in the direction of the arrow marked 1, and a deflection of the needle to the left by a current flowing in the direction of the arrow marked 2.

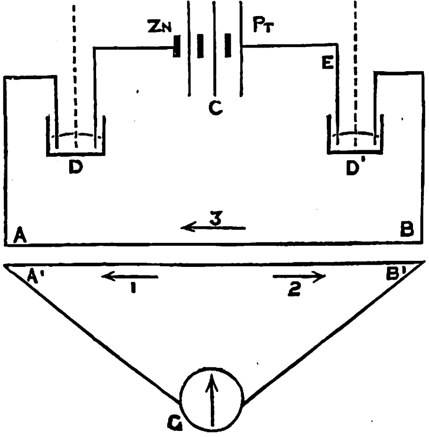
If the wire E is depressed until it touches the mercury, the circuit A B C (known as the primary circuit) is completed, and a current flows through it in the direction (by convention) of the arrow marked 3. At the instant of making contact with the mercury, the galvanometer needle swings to the left, showing that a current of electricity is flowing through the circuit A′ B′ G (known as the secondary circuit); and further, that that current is flowing in the direction of the arrow marked 2, and therefore in an opposite direction to the current in the primary. The galvanometer needle, however, does not continue in its position of deflection. It oscillates a few times and returns to zero. The secondary current, therefore, as the current flowing through the secondary circuit is called, is merely momentary.

If the wire E is removed from the mercury-cup the primary circuit is broken, the current ceases to flow, and at the same instant the needle swings to the right. A current, therefore, is flowing through the secondary circuit in the direction of the arrow marked 1, and consequently in the same direction as the current which has just ceased flowing in the primary. In this case also the galvanometer needle does not continue in its state of deflection, but falls quickly to zero. As before, the current is but momentary.

These currents flowing through the secondary wire are called induced currents, and the phenomenon induction.

If the primary circuit is again completed and, when the needle has come to rest, the wire A′ B′ is slowly moved away from the wire A B, the needle swings to the right, showing that a current is flowing through the secondary wire in the same direction as that in the primary. So long as the wire is being moved away the needle remains deflected. When the motion of the wire is stopped the needle falls to zero.

FIG. 1.



If the wire is moved back towards its original position the needle swings to the left, showing that a secondary current is flowing in an inverse direction to that of the primary. Here, again, so long as the motion of the wire continues, the needle remains deflected, but on the motion ceasing the needle falls to zero.

If the mercury cups D and D′ are joined by a wire, as shown by the dotted line F in the figure, the current flowing through the primary wire A B is decreased in strength. The needle swings to the right and then falls to zero, showing the passage of a momentary secondary current in the same direction as the primary.

If the wire is removed so as to restore the current to its original strength, the needle swings to the left and falls to zero. A momentary current in an inverse direction has flowed through the secondary circuit.

We may then enunciate the following laws:—

When a current begins to flow it induces in a conductor near it a current in a direction inverse to its own; when it ceases it induces a current in its own direction; and both these currents are but momentary.

When the distance between a conductor through which a current is passing and another conductor near it is decreased, a current flows through the latter in a direction opposite to that in the former; when the distance is increased, in the same direction as that in the former. These currents are not momentary, but continue so long as the distance is being varied.

When a current is increased in strength, a current flows through a neighbouring conductor in an inverse direction. When it is decreased in strength an induced current flows in the same direction as the inducing current. If the alteration in the strength of the inducing current is sudden, the induced current is momentary. If gradual, it continues so long as the strength of the inducing current continues to change.

To sum up: a current which begins, or which approaches, or which increases in strength, induces in a neighbouring conducting circuit a current in a direction opposite to its own; whilst a current which ceases, or which retires, or which decreases in strength, induces in a neighbouring conducting circuit a current in its own direction.

Alfred W. Soward.

PRACTICAL NOTES ON PLUMBING.—XXXI.*

By P. J. Davies, H.M.A.S.P., &c.

Seat-Action Closets (Fig. 173).

PERHAPS the best kind of water supply-valve for durability in a seat-action closet is that known as the double-*action* valve, *not double valve*, which means one that supplies a flush of water when first sitting down and a second one on rising. Such a closet and valve arrangement will be found illustrated in Figs. 173 and 174. The various parts are as follows:—A, 173, is the seat hinged to the back in such a manner that it will allow the front part A to drop about 1in. when anybody sits upon the seat; this slight depression communicates pressure to a plate under the seat and thence to the standard, B, which, in its turn, presses upon the end of the lever G, and so raises the weight F and the other end of the lever; this is connected by wire, rods, chain, pumpwork, or suchlike contrivances to the lever L, which allows the other end, N, to fall, and so pulls with it the chain O over the pulley Q, and actuates the sucker-valve U V, allowing the water to run for a given time, when the valve drops off and closes the aperture to the pipe W. Now, on rising from the seat the action is that the weight F again pushes up the seat, and as the weight falls, so will the lever G at I, and, by so doing, pull the wire J, bringing down the end of the lever L, and raising it at N, when it pulls up the loose chain S, and with it the sucker-valve, again allowing the water to flow to the w.c. for a given time. I should say that my friend, Mr. W. Ross, of Glasgow, designed this chain-action for after-flush valves; but I have adopted it for the purposes of a seat-action closet. K is a pull to be used for flushing the w.c. without rising from the seat.

FIG. 173.

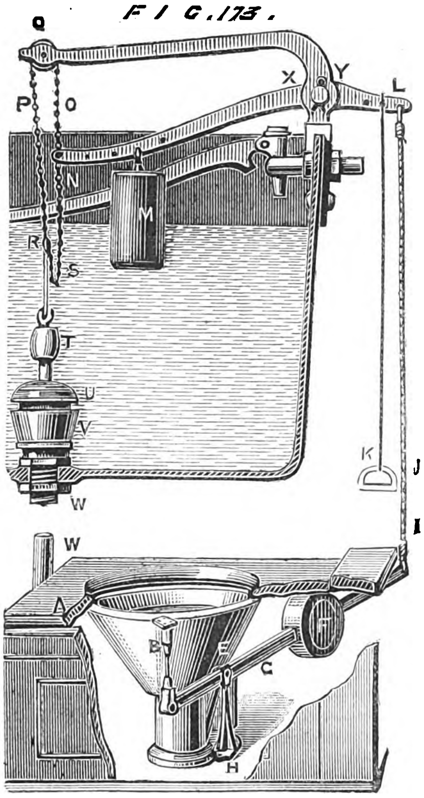
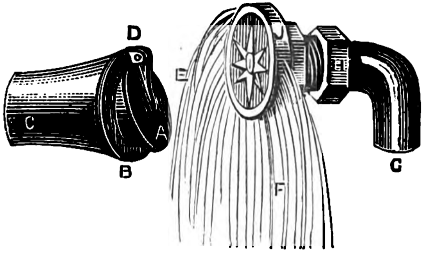
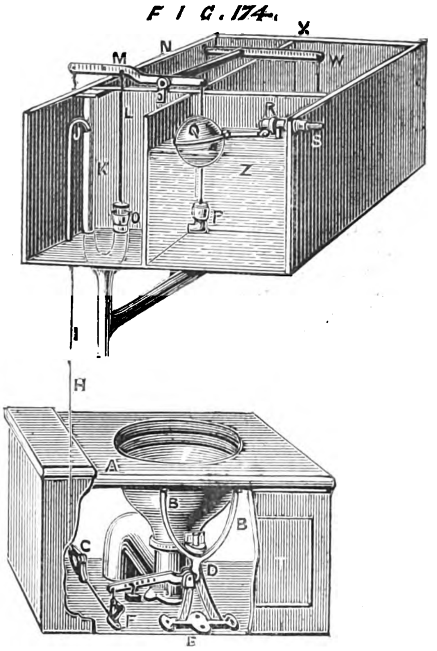


FIG. 173A.



The seat of the closet represented in Fig. 174 has two horns or standards, B B, which are connected to the lever J; this lever is weighted at F, and by wire connected to the cranks, which communicate with the cistern-lever at M. It will be seen that if any person sits upon the seat, the lever M is immediately set in motion, and so first closes the valve O, by reason of this end of the lever dropping; but as the other end of the lever rises, after a little distance through last motion, so it brings up the valve P, and allows the water to fill up the compartment K, and so be ready by the time the seat is allowed to rise, freeing the lever M to rise likewise, and so opens the valve O, which flushes the closet. My readers will say that this is only single action; but by having the lever M connected to another, as at W X, the end N will fall with the end M, and first close a valve covering a pipe leading from either the first compartment L, or from another into W, when the valve on the N end of the lever is closed, so as to prevent the water entering from Z to W. The valve in the bottom of the compartment W allows the water to flush the w.c., which must take place when the seat is sat upon, and the valve O opens on the rising of the person from the closet-seat. So that this, like that represented in Fig. 173, can be arranged for either single or double action. I may also remind my readers that any of my double-action closet valves before described may be adapted to seat-action closets. Perhaps the better title for these valves would be, double-flush action valves.

FIG. 174.

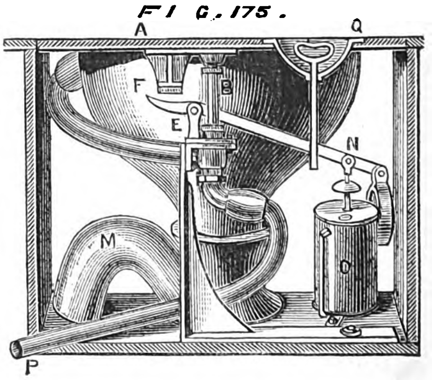


Under the Seat-Valve, Seat-Action Closets.

These closets are shown at Figs. 175, 176, 177, 178, and 179.

Fig. 175 is simply a stool-valve, having the end lengthened as at E, the seat being hinged at the back, as in Fig. 173. On sitting down

FIG. 175.



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upon the seat, the stud or spur F obtains an extra pressure upon the end of the lever, and brings up the other end N, and with it the valve B, and the stem of the regulator O, when the water runs continually unless it is fitted with a waste-preventing valve, as before described and illustrated at Figs. 149, 152, &c. Should this seat be fitted with a waste-preventing valve, it is often desirable to fit the dish and pull Q so that it may be used to flush during the time the closet is being used; but the handle must be of the slotted kind, to allow the lever to rise without the handle or pull. See M R, Fig. 177.

Fig. 176 is a seat-action valve somewhat similar to that described above, but is fixed upon the backboard V, or it may be fixed upon a strong riser (the board in front of a closet seat), or on a half-frame, as at Fig. 157 A. This valve is one that will continue running as long as the seat is occupied, but of course a waste-preventer may be used, in which case the dish and pull Q should be fixed, as in Fig. 175.

FIG. 176.

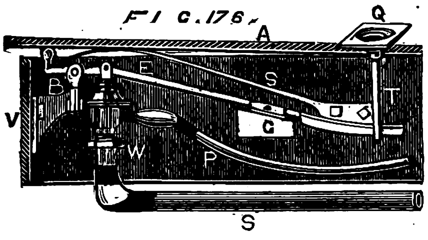
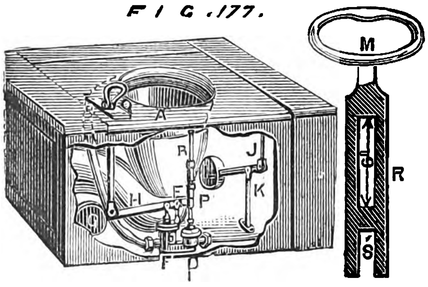


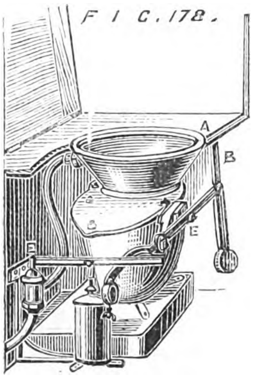
FIG. 177.



This is a seat-action valve, the seat of which, when pressed downwards, first shuts off the inlet-valve D, then opens F, but on rising from the seat, the valve D opens and the valve F slowly closes after a given time, so that to a certain extent this is a waste-preventer. The lever H should work through a slotted pull, as shown at R.M.S., so that the lever be allowed to rise, without the pushing up of the pull. This also refers to that shown at Figs. 175 and 176.

This is a seat-action pan closet; all that is required in this is the ordinary lever lengthened and the standard added, as at B; this is often fitted without thought. It is exceedingly bad, inasmuch as the copper pan remains open during the time that the closet is in use.

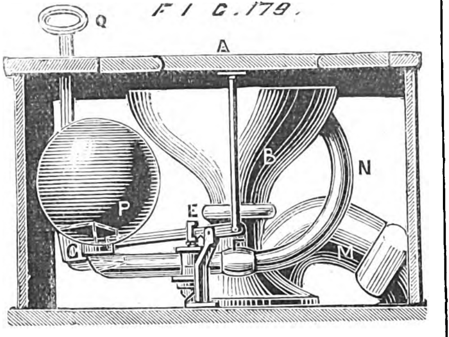
FIG. 178.



Comon's Valve Waste-Preventer.

Fig. 179 illustrates a waste-preventing seat-action closet. After what has been explained, the parts will be readily understood. On depressing the end of the lever F, it first closes the large valve leading from the air-chamber P to the basin (or the small valve from the supply-pipe); it next opens a small valve from the main supply, which allows the water under great pressure to enter the ball or air-chamber, when it compresses the air within, and, so to speak, becomes full. Now take the pressure off the end of the lever, and allow the small or inlet valve to close, and the large valve to open, the compressed air within the air-chamber will then force out all the water through the large valve and into the closet basin. This valve is very much used about the neighbourhood of Brighton.

FIG. 179.



(*To be continued.*)

THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURAI, AND LODGMENT.*

By John Watson Warman,

Associate of the College of Organists, London.

* Design Precise,

With reference to, and partly including, Key-Action.

(For Order and Posit see those Heads, at 91, *y*, and 92, *k*.)

c. We now come to a somewhat important portion of the Manual Design, and one about which there exists some diversity of opinion and practice,—viz., the exact arrangement and structure of the Manuals with reference to their Key Action; that is, speaking more minutely, the treatment of the Tails, Cranking, Sloping, and Crossing, of Keys and their Action, and the determination of some others points in connection with these. (For the *complete* Description of the Key and Coupling *Actions* the reader must of course wait till their own *Departments* are reached.)

d. In order to a better understanding of the subject, we will first consider, in the abstract, the several Points and difficulties which usually present themselves in the definite Lay-out of the Key-System. They are as follows:—

e. (1) *Removal of Key.*—It is obviously desirable that any Key of any Manual shall be easily removable at pleasure, while at the same time any increase in the number of the Key-Action *Centerings* is always to be as much as possible avoided. Thus; if the Key-Action (as is often the case with that of the Swell Section) do lead out straight horizontally from the Key Tail, it will as a rule be best to have the Nose of the Backfall or of the Square in actual contact with such Tail: by this means not only will the Removal of the Key be facilitated, and the Manual to Pedals Sticker perhaps shortened (see *rr*, next), but the cost of a set of Manual Stickers be saved. But, where the Key-Action leads perpendicularly down from the Key-tail, it becomes a question whether the additional cost, and friction, of a set of *Levers* shall be incurred, or whether the Tracker-End shall be attached *directly* to the Key-tail: the special circumstances and requirements of such particular case must then decide.

Note; that the said setting of the Square, &c., Noses in actual contact with their Keys will *not* facilitate the Removal of the latter, but will decidedly render such removal the more difficult, *unless* at the same time any *Stickers* of Action uniting such Keys to the *Pedals* be Wired *into* such Square or other Noses,—instead of into their Keys themselves. See here at *p*, next.

ee. One point to be always borne in mind is the *position* of the Manual. It is manifest, that for a Set of Keys which has a second such Set *beneath* it, there exists much greater necessity for the higher Keys' admitting of easy Removal,—for Access to the lower ones. See also (at *p* and *rr*, next) how this consideration is involved with that of the precise form of the *Coupler* Manuale to Pedals.

For an *Instance* see at 90, *m*.

f. (2) *Front Regulation.*—It is a matter of importance that the Key and Coupler Actions shall, so far as is possible, be adjustable at the Key *fronts*; that is to say, that a workman shall be able to regulate such Actions while he is placed at the Claviers themselves, and thus has the latter actually under his hand and vision. Otherwise the offices of a second person will become necessary for Regulating.

For *Instances* see at *d*, next; and again at 90, *m*. See also at 90, *h*, 9th parag. and on.

g. (3) *Key length Uniformity.*—It will be manifest that there must exist *some* particular dimension which is the best possible for the total length of a single Key (see 91, *n* and *nn*). This being so, it becomes theoretically desirable to have the Keys of *all* the Manuals made to such ascertained length; and such uniformity is as obviously more approached by making the *Tails* of every Manual to *overhang*—that is, to project beyond—the Tails of any Manual next beneath it. Among other Advantages of such a Treatment there is that of favouring the being able to easily secure more than one *Coupler* Manuale to Pedale with yet but one set of *Backfalls* for the same. Such a structure of these Couplers is sometimes very requisite,—see the *Tail-regulating* Variety of the *End-moving Sticker* Coupling-Action, in *Department* of latter. A *disadvantage* of such Tail Overhang will be indicated a little on (at *m*, next).

gg. See here in *Department* Coupling-Actions for a special *Instance* afforded in the *Leominster* Priory Church Organ.

h. (4) *Centering.*—There are three chief Considerations to be borne in mind in determining the point of posit for the Mid-Pin, forming the Centering of the Manual Key: these three are, (*a*) the requirements of the Action which runs from Key to Pallett, (*b*) the proper "balancing" of the Key itself, and (*c*) the suitability to the placing of a Coupler between two Manuals. Each must be looked at separately:—

i. As regards Consideration *a*, it is to be observed that there is or ought to be a fundamental Rule with all Organ Movements, that where "purchase" (leverage) has to be *gained* it should be gained as *soon* as possible, and where it has to be *lost* it should be lost as *late* as possible; the reason being the same in both cases, —viz., to avoid involving a larger amount of motion and of expenditure of material than is absolutely necessary. Thus, in the case of an ordinary Mechanical Stop Action it would be very unwise (though, by the way, our Builders do not seem to have yet properly realised this) to employ an *Equidistant* Centering for *all* its Squares, Levers, &c., *except* the one actually in *connection* with the *Slider*,—so making the Purchase to be obtained solely by such *Final* Square or Lever; for then, not only would the whole of the Stop-Action be made to move farther than there is any occasion for (and this might easily tend to a Fouling of the Square-Arms), but all the Arms except one would need to be longer, and the Final or other Lever would require to be wider, than would have been otherwise necessary,—the reason for this last being that the width of any Lever should manifestly be a ratio of the distance from its *Fulcrum* to its driving point farthest from latter, and not a ratio of the *total* Lever length. See on this matter fully in *Department* Stop-Action.

j. Now this Rule is of course, theoretically, just as binding with a Manual Key as with a Register Draw-Stop; but there are with the Key Action two further considerations which exercise, practically, a much modifying influence. The first of these is that as the Pallett ought to open as much as $\frac{3}{8}$ of an in. (see *Department* Wind-chest), and the Key-Touch is not pleasant if palpably over the same amount (see 93, *x*), there may not in fact exist any disproportioning *at all* in the Action from Manual to Pallett; the second is that, even if such disproportioning *should* be found necessary, the small amount total of the motion—certainly not over ½in., in all ordinary cases—very much reduces the chance of a Fouling, even without any attention to the said Rule. On the whole, therefore, it may be laid down that Consideration *a* should be, in the Key Action, held *subordinate* to the two points *b* and *c*.

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k. With reference to *b*, it will have been already apprehended—see 87, *k*—that (1) the Manual Key should be *slightly*, and *only* slightly, heavier forward than at its Tail, and that (2) it is *generally* advisable to endeavour to dispense with all Loadings (see 88, *e*). On the other hand, it is to be remembered that whenever a Key Action is really short, a little additional weight in the Key itself will be an aid in overcoming any "Pluck" existent in the Pallett (see again *Department* WINDCHEST). Excepting, therefore, when the Key-Action is tolerably long—say over 6ft. from Key-tail to Pallett-eye—, Consideration *b* may be regarded as not of great importance *unless* the Key-Tail is required to receive a Regulator for a Coupler (see *t*, ante), in which event care must be taken that the Loadings do not interfere with such Regulator. At this point see again at 88, *ee*.

l. Consideration *c* may be viewed as, on the whole, the most important of the three, because, as will be shortly seen (at *s*, next), the placing of a Coupler between two sets of Manual Keys is a Treatment often possessing very great advantages. Of course, the influence of any Coupler on the Posit of the Key Centering *ceases* at the instant that it is determined that such Coupler shall be *otherwise* located than in contact with such particular Manual (see *Depart.* COUPLING ACTIONS).

m. An *Instance* of the Center posit of a Manual interfering with a Coupler placed in contact with such Manual occurs in the Organ as Rebuilt some few years ago by *Hedgeland* (London) for the Parish Church of Hove, Brighton. In this case the Keys of both Manuals are not very long, and are Centered at points rather towards their Tails; the Tails of the Swell Manual extend so as to Overhang, by some little distance, the Tails of the Great Manual; and the [Swell] Coupler Contact-point is thus a like distance forward from the regular Action-point of the said Swell Key-tail: consequently, when the Great Manual Key is pressed down, it has a tendency, instead of raising merely the *Tail* of the Swell Key, to lift the *whole* of the latter; and the effect to the finger is very unpleasant. It will be obvious that a more *forward* posit of the *Centering* of the Swell Keys would have here lessened the disadvantage arising from the Upper Tails overhanging the Lower ones.

n. (5) *Key-Participation.*—It is of real importance (though the writer has not met with any instance of the recognition of this by any other Builder), when a Coupler which acts upon a Manual gives its impulse to a portion of the *Action* to Pallett instead of to the *Key* itself, that the latter be *engaged* with such portion of Action, and not be merely left free to *drop*: where this is neglected the Key has a tendency to *dance* during rapid or staccato playing on the Clavier *to* which such Key is united. The reason is simple: the attraction of gravitation takes a fraction of time to overcome the *vis inertiæ* of the Key, and this tardiness is increased by the fact of the Key's being only a *little* heavier forward (see *k*, ante); during very rapid passages the Key is both pressed and relinquished very swiftly, and so there is then a chance that any Key which is coupled to the Key pressed will be, during its descent, actually caught by the contact of its own Coupling Action. Besides this, in all cases where the Actuating Key is pressed swiftly down and then held, the Coupled Key, if unconfined by Participation, will tend to *rebound* up from the Bed-rail, and therefore to produce noise.

o. It has already (at *e*, ante) been seen that it is well to make the Nose of the Backfall or the Lever, or the Square to be in actual contact with the Key-tail; and wherever such Treatment is attained, and such Backfall, Lever, or Square is that upon which the Coupler acts, it will be very easy to secure the Participation of the Key, all necessary being to have the Tail of such Key suitably *Forked* (a Device of the present writer's), so as to receive the said Nose of such Backfall, Lever, or Square: and thus also the ready removal of the Coupled Key will not be interfered with. Another method of obtaining Key-Participation will be found given farther on (at *j*, next). Where a Sticker or a Tracker intervenes between the Key-tail of the Coupled Manual and the Backfall, Lever, or Square by means of which such Coupling is made, more difficulty will be experienced; and the case must be met by treating such Sticker or Tracker so that it fulfils the offices of both a Sticker *and* a Tracker. An *Exception* to the necessity for Coupling Key-Participation will be stated in proper place (at *q*, next; see also 90, *s*.)

It will now be obvious, that in deciding on the precise form of mechanism for any Coupling of a Manual, this matter of Participation should always be kept carefully in mind: see here what is said at *e*, ante; at *p* and *s*, next; and at 90, *r*. It is hereby necessary to add that the foregoing reasons calling for Participation can never exist in the Key *to* which the Coupling is made.

At this stage go over what is given at *m*, next.

oo. For the reason why it is not *always* desirable to secure the Participation by causing the Coupling impulse to be made upon the Key itself, see at *ee*, ante, and at *p* and *rr*, next.

p. (6) *Manuale to Pedals Coupler.*—It is to be borne in mind that a very *long* Manual Key, a very *short* Backfall (that under the Manual is here referred to), and an insufficient *Set-under* of Pedal-board (see 110, *i*) are all of them objectionable. One or other of the three is, however, often rendered *liable* by making the Sticker-head or other driving point of the Coupler Manual to Pedals to be in actual contact with the Key-tail so driven. The error can obviously be mitigated by the Treatment already enjoined for facilitating the Removal of the Key (see *e*, ante), and more definitely indicated in the preceding Head (at *o*, ante),—viz., that of making the driving point of the said Coupler to be against the Backfall, or Lever, or Square which is in connection with the Key-tail;—by which means the *Key* may be slightly shortened, or the *Backfall* under such Key a little lengthened, or the *Set-under* of the Pedals a little increased. All that is required is to so arrange the Coupling Backfall and Sticker that the latter enters and acts by means of a Piercing in the Nose of the Backfall, Lever, or Square that rests upon the Key-tail, instead of in and by means of a Piercing in latter itself. Do not forget that the necessity for Key Participation, just explained, holds theoretically good here just as strictly as in the Coupling of a Manual to a second Manual; and therefore the Nose of the Backfall, Lever, or Square should by rights act within a Tail-fork, as so described: but in practice an exception is—for a reason stated at *q*, next—sometimes allowed in respect of the Coupler *Great* Manual to Pedals; and such exception is the more to be tolerated because (1) the motion of the Manual Keys merely from their actuation by the Pedal Keys is not likely to be very rapid, and (2) because the Coupler Swell to Great will or may, in the case of such exception, be made to largely prevent the possibility of the Coupled Key's dancing (see *n*, ante; and 90, *s*).

(*To be continued*)

JUPITER.

By Prof. G. W. HOUGH, Director Dearborn Observatory.*

DURING the present opposition of Jupiter, the disc exhibits a variety of phenomena of interest to the practical astronomer.

Although this planet has received a good deal of attention during the past century, yet but few new *facts* have been added with regard to its physical aspect, since the time of Sir William Herschel.

It appears to be the generally-accepted idea that its surface is subject to sudden and extraordinary changes, sometimes accomplished in a few days or even a few hours. New belts are alleged to have been formed or to have disappeared in the course of an hour or two.

We believe conclusions of this kind have been too hastily drawn from the observations.

Owing to the rapid rotation of Jupiter, the various spots and markings follow each other so closely that one might readily imagine that what he saw was subject to change under his eye.

The great Red Spot, which has been an object of so much interest since 1879, becomes visible, in the Chicago telescope, at 2h. 25m. from the meridian of the planet, when its length is about one second of arc. As the rotation carries it further on the disc, it gradually increases in size, until, when on the meridian, it subtends an angle at opposition of 15 seconds. The smaller spots and markings, of course, become most conspicuous when near the meridian of the disc.

The visibility of objects depends very much, also, on the condition of the seeing. Sometimes the smaller spots are invisible for weeks, simply because the seeing is not good enough with limited optical power, and not because there has been any radical change on the surface of the planet. Its distance from the Earth is another important element in modifying the appearance of phenomena. After conjunction, the great Equatorial Belt and Red Spot are first seen and, as the Earth approaches nearer, other markings gradually appear, until the time of opposition, the greatest variety of phenomena is noticeable.

From September, 1879, when micrometer measurements were first begun, with the Chicago Refractor, on the markings of the disc, considerable change has taken place in its appearance at different times. But all changes, whether due to the distance of the planet from the earth, variable seeing, or other causes, have been slow and gradual.

The most noticeable change has taken place in belt No. 3 situated 6″ north of the equator. This belt, which was not conspicuous in 1879, gradually increased in width and distinctness in 1880, until at the present time its width is about 2·5″ of arc, and of the same colour as the equatorial belt—viz., reddish brown.

The equatorial region situated between the two outlines of the equatorial belt has been subject to considerable change, but the margins of the belt have not sensibly varied in width or latitude during the past three oppositions.

The great Red Spot, a conspicuous object even in a small telescope, is alleged to have materially changed in length during 1879, and again in 1880; but numerous micrometer measurements do not confirm this statement.

The following are the mean results, reduced to the mean distance.

	Length.	No. of Obs.	Breadth.	No. of Obs.	Latitude.	No. of Obs.
	″		″		″	
1879	12·25	9	3·46	8	– 6·95	8
1880	11·55	20	3·54	10	– 7·14	12
1881	11·50	8	3·40	3	– 7·41	7

These numbers indicate a small possible displacement of the centre in latitude, but it would be premature to assume such to be the case.

The colour of the spot is reddish-brown; however, when the seeing is unusually good, it appears almost a light pink.

The oval-shaped white spots, a number of which were observed in 1880, are quite numerous at the present time. They are about one second of arc in length, and are generally difficult objects to observe.

The following spots have been seen on belt No. 6. Latitude 9·5″ to 12·6″. They pass the meridian of Jupiter after the great Red Spot as follows:

h.	h.	h.	h.	h.	h.	h.	h.
+ 2.8	+ 3.0	+ 3.3	+ 4.0	+ 4.7	+ 5.2	+ 5.5	+ 5.8

There are also two white spots—more easily seen—near the great Red Spot, in latitude 9·63″ and longitude 0h. 36m. and + 0h. 24m.

The two White Spots situated in latitude 3·0″ south of the equator, which were observed in 1879 and 1880, were first seen this year on July 22nd. They appear to make a complete revolution around the planet in about forty-five days, corresponding to a rotation period of 9h. 50m. 9sec.

These spots, which are both occasionally seen at the same time, appear to be fixed relatively to each other.

The difference of longitude was measured with the micrometer as follows:—

1880.
July 24, + 23·5m.
Nov. 8, + 22·6m.
1881.
July 22, + 27·5m.
Nov. 26, + 27·5m.
Dec. 10, + 23·0m.

The fact that they have maintained for a year and a half the same relative position, and at the same time apparently drifted with a velocity of over 260 miles per hour, would seem to disprove the old theory that they are clouds floating in the atmosphere of the planet.

From observations made during the present opposition, it is probable that all the matter between the two margins of the equatorial belt, whether in the form of white spots or dark ones, moves with the same velocity—viz., a period of 9h. 50m. 9sec. And it is possible that the belt itself partakes of this motion.

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* From *Science*.

The rotation period of the planet, deduced from our observations on the Red Spot, made in 1879 and 1880, was 9h. 55m. 33·2sec. + 0·09sec. $\sqrt{t}$, in which t is the number of days after Sept. 25, 1879, the observations during 1880 showing that the spot was retrograding with an accelerated velocity.

This formulæ is found to be essentially correct for the present opposition.

The "mean" period for Dec. 14, 1881, comprising an interval of 811 days, being 9h. 55m. 35·80sec. from observation, and 9h. 55m. 35·76sec. from the formulæ.

Assuming the rotation period as above, the centre of the spot has retrograded more than fifty degrees since Sept. 1879, not uniformly, but with an accelerated velocity. It seems difficult to account for this fact on any known hypothesis.

THE THEORY OF THE GAS-ENGINE.

At the meeting of the Institution of Civil Engineers held last week, a paper, by Mr. Dugald Clerk, was read, "On the Theory of the Gas-Engine." The practical problem of the conversion of heat into mechanical work had been partially solved by the steam-engine; but its efficiency was so low that it could not be considered as complete or final. Hot air in the past had been looked upon as a possible advance. Owing, however, to many futile attempts, it had long been deemed useless to look in that direction for better results. The great progress made in recent years with the gas-engine, from the state of an interesting but troublesome toy to a practical powerful rival of the steam-engine, had shown that air might, after all, be the chief motive power of the future. Three distinct types of gas-engines had been proposed:—

1. An engine drawing into the cylinder gas and air at atmospheric pressure for a portion of its stroke, cutting off communication with the outer atmosphere, and immediately igniting the mixture, the piston being pushed forward by the pressure of the ignited gases during the remainder of its stroke. The instroke discharged the products of combustion.

2. An engine in which a mixture of gas and air was drawn into a pump, and was discharged by the return stroke into a reservoir in a state of compression. From the reservoir the mixture entered a cylinder, being ignited as it entered, and without rise in pressure, but simply increased in volume, and following the piston as it moved forward, the return stroke discharged the products of combustion.

3. An engine in which a mixture of gas and air was compressed or introduced under compression into a cylinder, or space at the end of a cylinder, and then ignited while the volume remained constant and the pressure rose. Under this pressure the piston moved forward and the return stroke discharged the exhaust.

Types 1 and 3 were explosion-engines, the volume of the mixture remaining constant while the pressure increased. Type 2 was a gradual combustion-engine, in which the pressure was constant but the volume increased. Calculating the power to be obtained from each of these methods, supposing no loss of heat to the cylinder, it was found that an engine of type 1 using 100 heat units, would convert 21 units into mechanical work; in type 2, 36 units; and in type 3, 45 units. The great advantage of compression was clearly seen by the simple operation of compressing before heating, the last engine giving for the same expenditure of heat 2·1 times as much work as the first. In any gas-engine, compressing before ignition, igniting at constant volume and expanding to the same volume as before ignition, the possible duty D was determined by the atmospheric absolute temperature T^1, and the absolute temperature after compression, T; and it was $D = T - T^1 / T$, whatever might be the maximum temperature after ignition. Increasing the temperature of ignition increased the power of the engine, but did not cause the conversion of a greater portion of heat into work. That was, the possible duty of the engine was determined solely by the amount of compression before ignition. Compression made it possible to obtain from heated air a great amount of work with but a small movement of piston, the smaller volume giving greater pressures and thus rendering the power developed more mechanically available. Seeing the great difference produced between types 1 and 3 by the simple difference in the cycle operation when there was no loss of heat through the sides of the cylinder, the question arose, Which engine in actual practice, with the engine kept cold by water, would come nearest this theory? In which of the engines would there be the smaller loss of heat? Comparing the two engines, with equal movements of piston, it was found that the compression-engine had the advantage of a lower average temperature and a greater amount of work done; also of less surface exposed to flame, and consequently it lost less heat to the cylinder. Taking all the circumstances into consideration, it was certainly not over-estimating the advantage of the compression-engine to say, that it would, under practical conditions, give for a certain amount of heat three times the work it was possible to get from an engine using no compression.

It was interesting to calculate the amounts of gas required by the three types under the supposed conditions. Taking the amount of heat evolved by one cubic foot of average coal gas as equivalent to 505,000 foot-pounds, and calculating the gas required if all the heat were converted into work, it was found to be 3·92 cubic feet per h.p. per hour. Therefore, the amounts of gas required by the three types of engines would be:—

Type 1. $\frac{3\cdot92}{0\cdot21} = 18\cdot3$ cubic feet per H.P. per hour.
„ 2. $\frac{3\cdot92}{0\cdot36} = 10\cdot9$ „ „ „
„ 3. $\frac{3\cdot92}{0\cdot45} = 8\cdot6$ „ „ „

Comparing these figures with results obtained in practice from the three types of engine losing heat through the sides of the cylinder, it was ascertained that the amount of gas consumed was as follows:—

Type 1.	Lenoir,	95	cubic feet per	I.H.P.	per hour.
	Hugon,	85	„	„	„
„ 2.	Brayton,	50	„	„	„
„ 3.	Otto,	20	„	„	„

It would be seen that the order of consumption was what was required by theory. The Otto engine converted about 18 per cent. of the heat used by it into work, while the Hugon engine only converted 3·9 per cent. Taking the loss of heat to the cylinder as given by the comparison of the adiabatic line of fall of temperature with the actual line of fall as shown on the indicator diagram, it appeared much less than really was the case, as shown by the gas consumed by the engine. The maximum pressure produced was much less than would be expected from the amount of gas present; this was due to the limiting effect of chemical dissociation. The gas-engine presented a more complicated problem than a hot-air engine using air heated to the same degree. Analysing the disposal of 100 heat-units by Clerk's gas-engine, it was found to convert 17·8 into work, to discharge 29·3 with the exhaust gases, and to lose to the sides of the cylinder and piston 52·9 units. About one half of the whole heat used passed through the cylinder and heating-water. St. Claire Deville had shown that water was decomposed into its constituents at a comparatively low temperature, considerable decomposition taking place at 1,200° Centigrade. The cause of so near an approach to the line of theoretical fall, as was shown by the actual indicator diagram, was simply the continuous combination of the dissociated gases. At a maximum temperature of about 1,600° Centigrade, complete combination of the gases with oxygen was impossible, and could only take place when the temperature fell low enough.

In calculating the efficiency of the gas-engine from its diagram, all previous observers had fallen into error, through neglecting the effects of dissociation, and, accordingly, their results were much too high. To account for this so-called sustained pressure, Mr. Otto had advanced the theory that inflammation was not complete when the maximum pressure was attained at the beginning of the stroke, but that by a peculiar arrangement of strata he had made it gradual, and continued the spread of the flame while the piston moved forward. Mr. Otto called it slow combustion. This designation seemed to the author to be erroneous; such an action should rather be called slow inflammation. It existed in the Otto engine, but only when it was working badly, and was attended with great loss of heat and power. This was proved by a diagram, and by certain considerations deduced from Bunsen and Mallard's experiments on the rates of propagation of flame through combustible mixtures. The conclusion arrived at was that slow inflammation was to be avoided in the gas-engine, and that every effort should be made to secure complete inflammation at the beginning of the stroke. The author had found it possible to ignite a whole mass in any given time, between the limits of one-tenth and one-hundredth part of a second, by arranging the plan of ignition so that some mechanical disturbance by the entering flame was permitted. A diagram taken from the Otto and Langen free-piston engine, as given in a paper by Mr. F. W. Crossley, and an analysis of his reasoning, showed that the results were misinterpreted, and false conclusions arrived at concerning the nature of an explosion. Mr. Crossley considered that an explosion of gas and air, pure and simple, must be accompanied by a rapid rise and an almost instantaneous fall of pressure. This, he thought, was proved by the diagram, but in this statement the author could not concur.

From the considerations advanced in this paper, it would be seen that the cause of the comparative efficiency of the modern gas-engines over the old Lenoir and Hugon type was to be summed up in the one word "compression." Without compression before ignition an engine could not be produced giving power economically and with small bulk. The mixture used might be diluted, air might be introduced in front of gas and air, or an elaborate system of stratification might be adopted, but without compression no good effect would be produced. The gas-engine was, as yet, in its infancy, and many long years of work were necessary before it could rank with the steam-engine in capacity for all manner of uses. The time would come when factories, railways, and ships would be driven by gas-engines as efficient as any steam-engines, and much safer and more economical of fuel. The steam-engine converted so small an amount of the heat used by it into work that, although it was the glory and the honour of the first half of this century, it should be a standing reproach to engineers and scientists of the present time, having constantly before them the researches of Mayer and Joule.

ADHESION OF FLAT DRIVING-BELTS.

There are certain discrepancies in the theories of published experiments relating to flat driving-belts which recently drew from Mr. Robert Grimshaw the following remarks which we take from the *Journal* of the Franklin Institute.

The elements governing the adhesion of flat driving-belts to pulleys are pulley diameter, material and condition, and amount of crown; arc of contact, and belt material and condition, width and thickness, and tension. Each of these exerts an influence upon the adhesion; these influences being modified and in some cases neutralised, or even reversed, by the others. Of only one of them (arc of contact) it may be said that there are no apparent contradictions in its action. In his experiments Mr. Grimshaw used ten changes of pulley, ten of belts, three of arc, and about ten of tension. He employed pulleys of turned cast iron, wrought iron, and wood, and also the same pulleys covered with leather and rubber lagging; these pulleys having diameters of 18, 24, 30, and 36 inches. The belts used in testing were rubber, single and double leather oak tanned, waterproof and fulled, and wire centres; and canvass covered with composition. The arcs of contact were 90°, 180°, and 270°; and the tensions from 10 to 100 pounds per inch of belt width. The machine used for testing, and which was shown in part at the meeting, consisted of a strong wooden frame bearing a shaft 2 7-16 inches diameter, 5ft. long, upon which were hung the pulleys to be tested—both shaft and pulleys being held from turning.

At the meeting there were turned cast iron pulleys of 18in. and 36in. diameter, and a 26in. "taper sleeve" wooden pulley. The belt to be tested was placed centrally upon the desired pulley, and one end weighted with a given amount per inch of width. Force is applied at the other end until the belt slowly slips. The difference between the weights on each end represents the amount of friction of the belt upon the pulley, or the grip under the circumstances. The tension is applied by dead weights in a cage (the weight of the clamps and the cage being allowed for). The force to cause slipping is preferably applied by dead weights; but as in some cases this is considerably more than a ton, for convenience in such cases the force is applied by a lever of the second class, having its fulcrum under the centre of the shaft and its point of application of force to the belt in a vertical line tangent to the pulley at the point in the horizontal plane of the shaft. In other words, for each pulley the short arm of the lever was the same length as the radius of the pulley. The dynamometer, one of Fairbanks' standard traction machines, is first tested by hanging dead weights upon it, at each division at which it is to be used; and in testing the belts the mean of four readings is taken; although in many cases no readings are counted until there are three consecutive ones alike. As the result of over 900 tests and readings made, Mr. Grimshaw announced that the influence of increased pulley diameter is always to increase the drive; especially with light tensions. The influence of pulley material is so largely modified by the other conditions that no general rule can be laid down concerning it. The same is true of belt material. Increasing the belt width does not always increase the driving power, especially with thick belts, small pulleys, and light tensions. Increasing the belt thickness does not always increase the driving power, especially with small pulleys, wide belts, and light tensions. Increasing the arc of contact may be said to increase the drive in every case yet known. Increasing the tension increases the drive up to a certain point, beyond which, in many cases, no further increase of tension will cause any augmentation in the grip.

Replying to questions, Mr. Grimshaw said paper belts were but little used, by reason of their great stiffness and lack of elasticity; a certain degree of elasticity being a prime requisite of a belt in order to permit a difference in tension between the two sides by alternate elongation and contraction. As to leather or rubber, he said that in some situations, as for instance, in dry places, leather was the most durable; while for damp places rubber only would answer. Rubber was rapidly deteriorated by mineral oils and could not be used for quarter twist and crossed belts.

Replying to a question whether the tests as made were of any value in determining the driving power of belts at high speeds, he said that the conditions of friction were substantially the same, and that conditions varied, so that he could not give any reply to any question as to the relative driving power of different kinds of belts at high speeds, without all the conditions being stated.

Mr. Grimshaw said he had made about 200 tests of canvas belts under varying conditions with some substance to increase the adhesion, and that its tractive powers under the conditions of his tests were exceptionally good, while it was the strongest belt that he had ever broken. As to the objection that the mode of testing was hardly the right one, the tendency being, by adding weights to both ends of the belt, to break it, Mr. Grimshaw said that the friction between the belt and the pulley was the same as that between the pulley and the belt; that the driving power of any belt was measured by the difference between the tight and the loose sides, and that the pulley got all the difference in the tension; it could go nowhere else. As regards the danger of breaking the belts—the tension possible to put upon any belt was determined by the strength of the lacing or other fastening, and that for lacings the maximum safe strain, as laid down by Briggs and Towne, was 66⅔ pounds per inch wide; whereas single oak tanned leather belting broke at 1,000 pounds per inch of width. Hence the method of testing not only registered correctly both the light and the heavy tension, but the difference or grip, and did not induce artificial conditions. It had two certain practical conditions over attaching the dynamometer to the pulley rim. Attaching the dynamometer to the pulley rim allows only as much slip as the motion of the spring permits (about ⅛in. in the present case); while allowing the belt to slip gives a foot or two.

ELEMENTARY LESSONS IN DRY-PLATE PHOTOGRAPHY.—VI.*

Lenses.

Of all the apparatus which the photographer uses, there is none of so great importance as the lens. With a bad camera shift can be made, and excellent work turned out, the only drawback being harder work and inconvenience for the operator; but with a bad or unsuitable lens nothing can be done. It will be necessary to define a few technical terms continually applied to lenses. By *depth of focus* is meant the power in a lens to represent sharply objects both near and far from the lens. The larger the aperture of the lens, the less the depth of focus. With every lens is supplied a set of *stops* or *diaphragms*. These are simply plates with holes of larger and smaller sizes in them, which are made to slip in front of or between the combinations of a lens. The more depth of focus is required, the smaller a stop must be used, and consequently the slower the lens will be.

By *width of angle* is meant the amount of picture which can be included. For example, with a camera placed in a certain position and pointed to a row of houses, one lens will include perhaps two houses, another four.

Distortion is a fault met with in photographic lenses. It causes straight lines near the sides of the object to be represented by curved lines in the image. *Flatness of field* is the quality in a lens of having the definition at the edge of the plate good, as well as that at the centre.

The *focus*—or, more strictly speaking, the *focal length*—of a lens is the distance between the lens and the ground-glass when the image is sharply focussed. In a single lens the measurement is taken from the centre of the lens. With compound lenses it is near enough to measure from the diaphragm to the ground glass.

The *aperture* in a lens is the diameter of the stop or diaphragm, or, where none is used, of the actual lenses. The rapidity does not require to be defined, but we propose to explain the factors which regulate it. Every lens is different in rapidity from others of another form, and each lens has a number of diaphragms varying its rapidity, so that at first sight it might appear a difficult task to put a value on the rapidity of a lens using any particular diaphragm. The law which governs the rapipity of lenses is, however, so very simple that its application is most easy, and we would try to impress on the beginner that he should thoroughly master it at the commencement of his practice. If he does so he will find the estimation of the necessary exposure a comparatively simple matter. In changing one stop for another, or one lens for another, he will have nothing to guess except the intensity of the light.

The method of comparing lenses is as follows:—State the ratios between the apertures of the lenses and the focal lengths of the lenses as fractions—the aperture as the numerator, the focal length as the denominator. Square the fractions thus obtained, and the resulting figures will give the ratios of the rapidity. It is usual to state the fractions thus: $\frac{f}{14}$ $\frac{f}{12}$ $\frac{f}{40}$ These fractions refer to lenses the first of which has an aperture one-fourth of the focal length, the second one-twelfth, and the third one-fortieth. We shall take a practical example. We are using a portrait-lens 10in. focus, and aperture 2½in.; that is, the focal length is four times the aperture, or we say the lens is working at $\frac{f}{4}$. The focal length, be it remembered, is the distance between the diaphragm and the ground glass. We now substitute a single lens of 12in. focus with a stop ¾in. in diameter. The aperture is now 1-14 of the focal length. The lens is working at $\frac{f}{14}$; square these two fractions, thus:—

$$(\tfrac{1}{4})^2 = \frac{1}{16} \quad \left(\frac{1}{16}\right)^2 = \frac{1}{256}.$$

The rapidity of the lenses is as 1-16 to 1-256. The exposure required will therefore be as 16 to 256, or as 1 to 16. Thus, if we had been giving two seconds with the portrait lens, we should have to give thirty-two seconds with the single lens. If the beginner will exercise himself in this rule for a little time, he will find that he soon gains wonderful facility in applying it, and he will find that it gives him a very great power in estimating the necessary length of exposure. With the same lens and different stops the rapidity varies as the square of the diameter of the stop, or as the area of the stop.

We shall now go rapidly over the different kinds of lenses most in use, giving the purposes for which each particular form is best adapted.

We have first the Single Lens (Fig. 1). It is the one with which we should recommend the beginner to provide himself, as it is the simplest form of lens, and is also the most generally useful. It is fairly rapid, has a fairly large angle, and gives wonderful definition and depth of focus. Its only drawback is that it gives slight distortion. If, for example, it be attempted to photograph a building of large size with it, the boundary lines will appear slightly curved, and the building will appear barrel-shaped.

FIG. 2

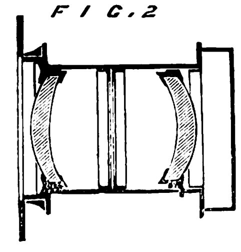


FIG. 1

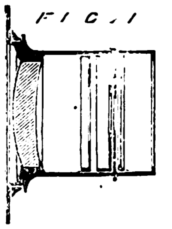


FIG. 3

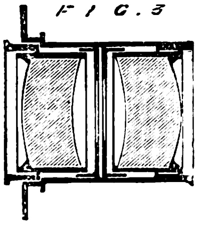
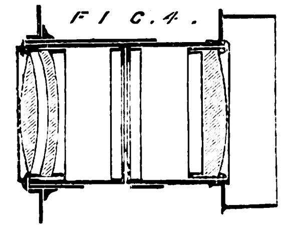


FIG. 4.



The Rapid Rectilinear or Rapid Symmetrical (Fig. 2) is one of the most useful lenses. It is very rapid, and one should be purchased when the photographer has so far advanced as to wish to attempt instantaneous effects. It gives no distortion, and about the same angle as the single lens.

The Symmetrical or Wide Angle Rectilinear (Fig. 3) is a slow lens, but takes in a wonderfully wide angle, so that it is useful for photograping objects when it is impossible to get the camera far enough away from them to use the rapid rectilinear. It is quite free from distortion.

The Portrait Lens (Fig. 4) is intended for portraiture pure and simple. The utmost ingenuity has been spent in the case of this lens to get the greatest possible rapidity, but many other good qualities have been sacrificed. Thus the field is round, the marginal definition bad, and there is very little depth of focus. For its own particular purpose it is, however, admirably adapted. With the very rapid plates which can now be had, it is quite possible to take portraits even in-doors with the rapid rectilinear or even the single lens, and we would not advise the beginner to purchase a portrait lens, at least, at first.

There are numerous photographic lenses sold under names different from any of the above, but all of them will be found to be very similar to one or other of the kinds described.

ODD WAYS OF MELTING IRON.*

There is probably as much reason for changes in the plan of melting iron as there is in moulding jobbing work. Melters will sometimes get nervous at being ordered to charge up their cupola in as many different ways as there are days in the week. A foreman that understands his business very seldom lays out a system, or a table of charges, for his melter to follow day after day in a regular jobbing-shop. The foreman may have various reasons for wanting his melter to make all these changes. To-day he may want the cupola to melt extra fast during the first of the heat, and slowly after some heavy casting is poured, in order to have melted iron to feed with. To-morrow, seeing that some moulder will not get ready in season, this order may be reversed. As he does not want to keep his men late when it can be avoided, he orders the cupola charged, so that the men having small work can be pouring off while the large casting is being got ready. This casting, that, perhaps, weighs five tons, may not be thick in any of its parts, so as to require much feeding, and the bottom can be dropped soon after it is poured. In this way the only moulders kept late are the ones that were going to keep the whole shop's crew behind, which, for a shop that pays overtime, would be expensive, and in any case, is not pleasant for the men.

On some days the shop-floor may be covered with a class of work that is better for being poured with dull iron, and the next day the work may be such as to require very hot iron. Again, there will be heavy and light castings, requiring entirely different grades of iron; and to complicate matters the foreman, if an observing man, will see that the brand of iron is not of the same grade as the last car-load. All of the above causes, to which could be added quality of fuel, sometimes make a thoughtful foreman think of a string tied full of knots.

I will try and show in this, two of the many plans that may be adopted to meet different conditions that may be new to some. One is for melting special grades of iron, and the other to retain the bed in a cupola after melting a heat for a break-down job, or for a piece of casting that is wanted in a hurry.

I worked once in a rolling mill company's foundry, and sometimes when everything was about poured off, there could in the distance be seen some one of the managers running towards the foundry, as if he meant business. Our ignorance of the cause of his haste would soon be enlightened by seeing a team, or some men bringing a pattern. This pattern would be given to some competent moulder, and two or three reliable moulders would be retained to help him. By this time all the moulds are poured off and the cupola man has received instruction not to drop the bottom, but to prepare it to melt iron again in the course of three or four hours. The way to do this is as follows: Leave the blast on until you are sure all the iron in the cupola is melted, and instead of dropping the bottom knock out the front breast, and with a bent hook pull out all the clinkering coke or coal and iron cinder that can be felt or seen. Then fill up the breast-hole with loose sand, and every 5 or 10 minutes take away the sand and pull out again whatever clinkers or iron cinders will have formed, repeating the operation for the first half-hour or so, until you are sure that all the droppings of iron and clinkers are pulled out. After this, every half-hour or so will be sufficiently often to clean the bottom out. The stopping up of the breast every time the clinkers are cleared out is done to prevent the fuel from burning away, and also to keep the clinkers and droppings of iron from being chilled with the air.

After the cupola is well cleaned out, there should be some fuel shovelled in, so as to freshen up and keep the fire in good burning condition. When the moulders have their mould or moulds about ready, then make up the breast as usual, and shovel in the fuel for a bed, the same height as for a regular heat. After it gets to burning, charge up the iron wanted, put on the blast, and you will soon have your cupola melting iron again. The first two or three hundred of iron is generally dull, and sometimes will have to be poured into a pig-bed. After this the iron will come hot enough for ordinary casting.

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* Condensed from the *Photographic News.*

* By Thos. D. West, in the *American Machinist.*

The question of how large a heat a cupola run in this way would melt could not be better answered than by the following: One morning early, two or three men were called upon to mould up a piece of machinery for a repair job. The melters and helpers were called to the shop to get the cupola ready as soon as possible. The casting, the weight of which was about 2,500 pounds, was poured about eleven o'clock in the morning. The iron was all blown down, the breast knocked out, and the cupola treated as above described, until the time for the regular afternoon heats, which were never less than 12 tons. The blast was again put on, and after the first few hundred pounds, the iron was as good and as hot as usual. The time that the cupola was held from one heat to another was about four hours. The size of this cupola was a five-foot shell.

To prevent the mixing of different grades of iron, when melted at one heat, has been the cause of a deal of thought and many experiments with foundrymen. I know of a foundry owner who makes a practice of melting only one grade of iron at a time. If he has a roll to cast, he will only charge up the iron weighed off for it. The blast will then be put on and all the iron in the cupola melted and tapped out. The blast is then stopped and the bed renewed with coke. Another grade of iron is then charged up and all melted down. I remember one day his making three distinct blow-outs during the same heat. The first was about 7,000 pounds for a roll; the second, about 2,000 for soft work, and the third was common iron to finish off a heat of about eight tons. The size of the cupola that this was done in was about a 4ft. 6in. shell. This same gentleman has a reputation for turning out castings of the grade of iron wanted, and it is owing to no more nor less than the way he charges up his cupola, and in being particular in the mixing and selection of his iron. The objection to this style of melting is that there is a little more coke used, and it takes from half an hour to one hour longer to run a heat off.

It seems almost an impossibility to run a straight heat, when there are two or three different grades of iron to melt, without having them mix more or less, and the less the weights of the different grades to be melted the more will they be liable to mix. For example: Charge an ordinary cupola with a regular charge of a special grade of iron, with the usual charge of fuel on top, and so on, charging with distinct grades of iron. As the grades of iron melt, pour some castings, the weight of which should not be less than 50 pounds. On the following day melt the special grades of iron by themselves, and pour some castings, and then compare the runners and gates, and you will see that there is a difference.

It is generally known that hard iron will melt sooner than soft iron, and most foundrymen, when making a casting of hard iron, have the hard iron charged first, to make sure of having the casting of good, sound iron and of the grade wanted. If they have soft iron to run, it is generally charged on the top of the hard iron. This is a plan that I do not always approve of, as there are always more or less particles of any grades or charges of iron left remaining among the fuel and on the bottom and sides of a cupola, and which will affect two or three other charges.

A plan that I find to work well, when there are two charges of soft iron wanted, is to melt the hard iron first; then, instead of putting the soft iron directly on the top of the hard iron, I charge about two charges of common iron—either soft or hard. On top of these charges the soft iron will be charged. After, as I think, all the hard iron is down, then the common is tapped out until, by the number of ladles carried off, I think it is all melted. At this point the soft castings are poured according to the degree of softness wanted. The softest casting wanted, if there have been three charges of soft iron charged, should be taken from what is thought to be the middle or second charge.

In some cases where I have only a small amount of very soft iron wanted, I charge up the soft iron on the top of the bed, which should be burning well, and should not have in as much fuel by from 4in. to 6in. as for ordinary heats. This iron will be put in from one half-hour to one hour before any of the other charges of iron are put in, and when all is ready to have the rest of the charges put in, make the first charge of fuel (that which is placed between the first and second charges of iron) a large one; as much larger than usual as the bed was left low. By this means the large charge of fuel takes a longer time to get hot enough to melt the upper charge of iron, and when the first charge of iron is melted, the second, or large charge of fuel, will come down and raise the bed up to the proper height to run the balance of the heat off. I have by this plan charged hard iron on the top of soft iron.

When not taking out the soft iron too closely to the amount charged up, the castings have been as soft as if the hard iron had never been charged up. It is in having only small quantities of different grades of iron to melt, that there is serious trouble with their mixing together. With large quantities there is more chance of having castings the grade wanted, but even then the melter must use judgment in seeing that the iron is charged as it should be, and the foremman should be watchful, so as to know that the iron is taken away from the cupola as the grades melt or come down. There is nothing about a foundry that requires such changes in its management as a jobbing foundry cupola.

SCIENTIFIC NEWS.

COMET *a* 1882 (Wells) was seen on the 6th by Mr. J. Rand Capron, in a position between Lyra and Draco. Mr. Coulcher, of Downham, Norfolk, writes that he has observed it on several nights since the 3rd with a 10in. mirror, and also with a 4in. achromatic. Writing on the 11th, he says it is now about 16° from Vega in a line towards the Pole-star. The *Science Observer* for March 24th gives the elements and ephemerides already telegraphed to Lord Crawford, and says, "it is an exceedingly pretty comet, and can be seen with a telescope of 4in. aperture." Prof. Lewis Boss says that the comet is remarkable for its small perihelion distance and its intense brightness. Some of the observations, we learn, were made under considerable difficulty, in consequence of fogs and clouds. Only ten comets have been known to approach the sun as closely as the present visitor to our heavens; but according to the American observers, the inhabitants of the southern hemisphere will have the best view, as, after passing through Cepheus, it will appear to make an abrupt turn in May towards the sun.

Mr. Christie, the Astronomer Royal, has been admitted a member of the Clockmakers' Company, in accordance with custom. At one time, the Government gave premiums for the best chronometers, but these are now made so accurate that a sufficient number are obtained without the incentive of a prize. The Clockmakers' Company, however, still give prizes, and the award is made by the Astronomer Royal in his official capacity.

The flint disc for the great Lick telescope is now on its way to Alvan Clark and Son's works to be fashioned into a lens. It weighs 374lb., is 38¼in. in diameter, and over 21½in. thick. The melting and pouring occupied four days, and thirty days were allowed for cooling. The disc of crown-glass is also cast, and is now nearly cooled. Each disc cost about £2,000, M. Feil having a practical monopoly of this branch of glass-making.

The Gresham Lectures on Astronomy will be delivered by the Rev. E. Ledger at Gresham College on April 18, 19, 20, and 21; those on Physic by Dr. Symes Thompson on April 25, 26, 27, and 28; those on Geometry by Dean Cowie on May 2, 3, 4, and 5; those on Divinity by Dean Burgon on May 9, 10, 11, and 12; those on Rhetoric (Mr. J. E. Nixon) on May 15, 16, 17, and 19; those on Law by Dr. Abdy on May 23, 24, 25, and 26; and those on Music by Dr. H. Wylde on May 30, 31, June 1 and 2.

Mr. J. Baillie Hamilton's new harmonium was used in Westminster Abbey last week, when Dr. Bridge's oratorio of "Mount Moriah" was performed. Opinions seem to differ as to its merits.

The Shipwrights' International Competitive Exhibition will be opened in Fishmongers' Hall on May 2, the prizes being open to all nations. Mr. ex-Sheriff Burt offers a prize of £50 for the best system proposed for the improved ventilation of passenger vessels.

Swan's lamps of five candle-power, with a portable battery of five bichromate cells, are recommended to photographers for work in the dark room, and also when using ether.

Mr. Clement E. Stretton sends us a copy of his pamphlet on railway accidents, the second edition, price 1s., published by Spencer Bros. and Russell, Leicester. We need scarcely say that it is a clear and unbiased account of the brake question as it concerns railway accidents, and in a few days it will be issued with an appendix containing the letter published on p. 109 of our last number, and five sheets of diagrams, two of the Westinghouse brake, two of Sykes's signalling and interlocking arrangements, and the brake efficiency diagram.

We have received the first number of the *Journal* of the Postal Microscopical Society (1, Cambridge-place, Bath), a quarterly published at 1s. It makes a good start with several interesting papers, and five pages of lithographed plates, some coloured.

The report of the sun's behaviour during the last quarter of 1881, by M. Tacchini, shows a continuous falling off in the mean daily number of protuberances, from a maximum in September. The increase of solar activity, however, is shown by the number of protuberances being nearly double that of the fourth quarter in 1880; their height and extent have increased very little. They figure in all the zones (as in the second and third quarters), and the greatest number are outside the zones of the spots. The spots and faculæ present, as in preceding quarters, two maxima between ± 10° and ± 30°, and the faculæ extend to higher latitudes than the spots. The frequency of spots is always greater in the northern hemisphere.

The disappearance of the sardine on the French coast during the last two years (a real disaster for the population of La Vendée) has been attributed by M. Blavier to a supposed displacement of the Gulf Stream, due to an exceptional ice-block in Davis Straits obstructing the polar current, whose encounter with the Gulf Stream is the cause of its bending towards the French coasts. In this connection, M. Broch has called attention to the variations observed, from time to time, in the herring fishery on the Norwegian coast (chiefly carried on between Capes Lindesnaes and Stadt), a record of which has been carefully made at Bergen for some centuries. Since 1870, the herring has failed on the south-west coast; and since 1874, even in the northern region; but during the last two winters, a few bands have visited the island of Karmö. It appears to be made out that it is the greater or less distance from the coast of the region where the herring finds its food in summer and autumn (consisting of myriads of small molluscs, crustaceans, &c. forming banks and tingeing the water), that determines whether the fish will come to this coast to milt. In his three years' exploration of the North Atlantic, Prof. Sars observed those banks of animalcules were being displaced eastward, and the recent reappearance at Karmö seems connected with this. The displacement of those banks of herring-food, now east, now west, is doubtless due to variations in winds and ocean currents, and the investigation of these latter is important both economically and zoologically.

Invention has been active of late years in the matter of fire-damp indicators, and a new apparatus by a Belgian, M. Body, is now to be added to the list. It is very simple, not requiring long and minute manipulation, like the Forbes apparatus, nor electric bells like M. Monniers. It consists of a Carcel lamp, the flame of which is protected, as in the Davy lamp, by wire gauze; the wick, chemically prepared in a way not yet made known, breaks whenever the proportions of fire-damp in the air exceeds 1-23. The rupture of this wick, which is distinct from the illuminating wick, releases the detent of an alarm-clock, which then acts. The apparatus, placed at either end of a gallery, thus indicates near danger, and its source and direction.

An interesting memoir on German railway carriages was lately read by Herr Wichart at a meeting of railway engineers in Berlin. There there are four principal types in use. The first have in each compartment six seats, with separate arms and back; the second, four sofas for eight persons; the third, two wooden seats for ten passengers; while the fourth have no seats. It appears that the average of seats (or places) occupied is 11·7 per cent. in the first, 23·2 in the second, 22·3 in the third, and 30 in the fourth. Herr Wichert would do away with the second class, and make the 3rd more comfortable. At the end of 1879 there were some 2,655 carriages in Germany lit with gas on the Pintsch system. At the end of 1880, in Prussia alone, there were 3,732 gas-lit carriages, while 1,487 were having the system applied. Herr Wichert affirms that the cost is not greater than with ordinary oil, and the illumination is twice as good. In the first years of railways on the Continent, the Prussian carriages were not lit at all, and in 1844 the king called the attention of the companies to this defect, which was only supplied two years later. To-day, Germany may boast (the author says) of having the best-lit carriages in the world.

It is a familiar fact that the glass discs of Holtz machines become rapidly inactive; and, for remedy, the disc is coated with an insulating varnish, or inclosed in a glass cover and surrounded with petroleum vapour, and so on. Prof. Marangoni has lately hit upon a device, which he thinks superior to others. In his Treatise on Electricity, Jenkin says that a glass-rod, which, because of surface-conductivity, is not a good insulator, will acquire this quality if immersed 24 hours in distilled water, and allowed to dry for the same time without being rubbed with anything. Prof. Marangoni treated the turning discs of his Holtz machines thus, and found that they immediately recovered their maximum activity. True, the activity decreases, but the same thing happens with varnished discs. Hence, it is easier and less expensive to have recourse to the distilled water.

The absolute tenacity and conducting power of phosphor-bronze wire have of late been thoroughly investigated by the German Telegraph authorities, who have, from the outset, favoured the use of this wire for their extensive aërial telephone lines. The results of the inquiry (given in the *Electrotechn. Zeitsch.*) are adverse to the wire, and the authorities have resolved meanwhile not to make larger use of it.

The French Government has viewed favourably a proposal made by M. Nicole, to erect, over the ruins of the Palace of St. Cloud, a Crystal Palace similar to that at Sydenham.

The Böttcher telephone (described in the German *Journal of Applied Electricity*) is chiefly distinguished by the fact that the magnet is not, as in other systems, fixedly connected with the case, but by means of screws and steel wires is freely suspended in it. Thus the magnet can, within certain limits, oscillate with the membrane, but in opposite direction. When the membrane is attracted there is mutual approach; in the other case mutual separation. Thus the difference of approach and separation is considerably greater than in ordinary telephones, and there is a stronger inductive action. A bent speaking-tube is fixed over the orifice of the instrument. The receiving telephone has also some distinctive features.

It has been recently noticed by M. de Chardonnet, that a very sensitive galvanometer in a telephone circuit is not affected by the sound of a tuning-fork, pipe, or the voice, so long as the sound continues of the same intensity; but variations of the intensity cause deflection, and in opposite directions, according as it is an increase or a decrease. The effect is most marked when the transmitter is affected by a short sound, as a detonation or a body lightly striking the plate. M. de Chardonnet gives (*Comptes Rendus*) a simple explanation of hese effects.

The cables of suspension-bridges are generally formed, it is known, of parallel metallic wires, bound at intervals by wire ligatures, and equally strained in manufacture. Whatever the care taken, however, it is always found that there is about 18 to 20 per cent. of the wires whose work is nil. M. Arnodin has conceived the idea of twisting the cables like ordinary cords. There is a two-fold advantage in this. First, the resistance of a twisted cable is superior to that of an untwisted one of the same composition, by 10 or 11 per cent. This is proved by recent experiment at Lyons. Secondly, the interior vacua are reduced to a minimum, and if the cable be plunged in a semi-liquid mixture which returns to the solid, or, at least, pasty state, at ordinary temperature, its form will keep this matter in the vacua, when the temperature of summer would tend to make it flow out, and the introduction of water is prevented. Further, while oxidation may occur, this, being chiefly on the under surface, will injure the twisted cable less (the wires being alternately above and below) than where the injury is localised to a certain number of wires always the same.

It is estimated that the average cost of furnishing motors, magneto-machines, regulators of lenticular apparatus, and the cost of installation in connection with M. Allard's scheme for transforming 42 lighthouses on the French Coast, will be about 25,000 francs per lighthouse, or 5,250,000 francs in all. A sum of 1,750,000 francs will further be necessary for amelioration of certain lighthouses, and special difficulties of depositing apparatus in lighthouses on isolated rocks. Lastly, the establishment of 80 wind-signals, at 50,000 francs a lighthouse, will cost about 1,000,000 francs. The grand total is about eight million francs. For annual maintenance, about 7,000 francs more will be required for each lighthouse than on the oil system (total 300,000 francs).

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

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COMET WELLS.

[19912.]—THIS object was found here in the 6in. Cooke equatorial, with comet eyepiece, on Thursday night (the 6th), just before the moon rose. The position was between Lyra and Draco, and nearly that given in Earl Crawford's circular, No. 50 (R. A. 18h. 28m. 53s., D.N. 44° 43′, Berlin midnight). Tail straight, short, and *n p.*; small condensed nucleus, about equal to 7th mag. star; object rather faint, as the sky was light.

J. Rand Capron.

Guildown Observatory, April 8th.

[19913.]—A SUPPLEMENTARY number of the "A. N.," published this morning, contains an ephemeris of Wells's comet, furnished by two independent observers. The paths, as given by them, agree so closely, that either of them will probably serve for picking up the stranger before it becomes visible to the naked eye; yet the elements which those gentlemen adopt differ very considerably. For instance, one calculator adopts

T = 1882, June 8·43114, and log. q 8·639526,

the other,

T = 1882, June 16·6130, and log. q 9 07186.

A third computer, in the same supplement, who, however, gives no ephemeris, adopts

T = 1882, June 28·3886, and log. q 9·10111.

The distances, too, of this comet, both from the Earth and the Sun, differ very materially as given in the two ephemerides spoken of; perhaps, therefore, it is not out of the way to hope the columns of the ENGLISH MECHANIC may shortly contain an article by the trustworthy pen of "F.R.A.S.," setting forth the future behaviour of the comet in question, which, *ut aliqui volunt,* promises, towards the end of May, to become a specially grand object, attaining, indeed, on the 8th of June, a brightness 5,824 greater than it had on its discovery on the 19th of March, thus enabling it, at the end of May and the first days of June, to be observed advantageously during the daytime.

Chelsea, 10th April. **M. W. Laing.**

STAR MAGNITUDES—VARIABLE STAR η URSÆ MAJORIS.

[19914.]—I HAVE very much pleasure in informing "Opera-glass" (letter 19861, p. 80) how I attempted determining the magnitudes of the stars in Ursa Minor and Draco. I assumed α Ursæ Minoris as 2·4, and from it γ of the same constellation was rated as 3·5. β Ursæ Minoris was excluded as variable. The stars 5 Ursæ Minoris, and 4 Ursæ Minoris were rated at 4·5 and 5 0. We thus have:—

α Ursæ Min.	2·4
γ ,,	3·5
5 ,,	4·5
4 ,,	5 0

The usual limit of magnitude for my opera-glass is 7·5; 24 Ursæ Minoris was rated 6·0.

Of course the accuracy of all subsequent determinations depends on the standards. For determining standards, the judgment can alone be used, and if backed by some little experience, the results will never differ half a magnitude from the truth, I believe. I cannot give the stars Mr. Read chooses for standards; one, I know, was γ Ursæ Minoris, over which we differed half a magnitude, and neither of us could convince ourselves which was wrong. Singularly enough, the stars rated from γ Ursæ Minoris by both of us, agreed quite well together. Mr. Read, I believe, next determined the magnitudes of a second lot of stars, and used this second series, together with his first standards, for determining the magnitudes of a third set of stars. For my own part, I preferred referring each new star back to my original standards, and usually did so, but occasionally checked the result by comparison with stars, not standards, whose magnitudes I had already determined. In a word, my method is (1) to assume certain magnitudes for certain stars, and call these standard stars; (2) to determine from the standard stars a series of intermediatory magnitudes; (3) to compare each new star with the standards, and to check the result, sometimes with the intermediatory stars.

I think your correspondent will see that great accuracy may be thus obtained. If the standards are carefully chosen, I cannot imagine a greater error than 0·2 between any determinations on different evenings. The star A is of the 4th mag., and star B of the 4½ magnitude. It is quite easy to assign to star C, which is less than A, but brighter than B, a magnitude which cannot be 0·2 from the truth. Mr. Read's method should insure greater accuracy, as he would use some star D as intermediatory star, and assign a magnitude from A and D if the star was brighter than D, or B and D if the star was fainter than D. Your correspondent will understand that I am speaking all this time about observations made with an opera-glass. In using the opera-glass the stars must be put out of focus, and we then have discs of light to compare instead of points; at the same time the effect of colour on the eye is in a great measure eliminated. It is quite easy, with a little practice, to move from your standard stars on to the one you are observing without altering the focus. This should be done so many times as to leave no doubt in the observer's mind as to the relative brightness of the star compared with his standards. The comparisons can be made with great rapidity after a little practice. The determination of magnitudes of small stars in the opera-glass, like small stars in the telescope, is hopeless, and for all accurate purposes the range of an opera-glass, I think, should end at a magnitude at least above the *minimum visible.* For my own part, I like to confine my observation to the region round my standards. As I only do star sequencing at intervals, I have several sets of standards, which I am hoping now to compare *inter se.* I believe, however, that the differences will affect the sequences throughout, and thus allow a correction. I give here the stars which accidentally occur in two of my sequences. The first was in February, 1879; the second about the same date in 1881, or two years later. The occurrence of the same stars in both sequences was quite accidental, and the standards of comparison were different:—

	Seq. VI. A.	Seq. XXII. B.	Diff. A – B.
30 Geminorum..	4 9	4·6	– 0·3
15 Monocerotis..	5 2	4·7	– 0 5
13 ,, ..	5 1	4·9	– 0 2
8 ,, ..	4·9	4·5	– 0·4
δ^1 Canis Minoris	5·9	5·7	– 0·2
ρ ,, ..	5·8	5·5	– 0 3
14 ,, ..	6·0	5 9	– 0·1

The sign is the same throughout, and hence it is quite fair to apply a correction, making use of a correction to B of + 0·2. We shall then be able to compare the real differences between the determinations of magnitude. We shall thus have:—

	Seq. A.	Seq. B.	Diff. A – B.
30 Geminorum..	4 9	4·8	– 0·1
15 Monocerotis..	5·2	4·9	– 0 3
13 ,, ..	5·1	5·1	– 0·0
8 ,, ..	4·9	4 7	– 0·2
δ^1 Canis Minoris	5·9	5·9	– 0·0
ρ ,, ..	5 8	5·7	– 0·1
14 ,, ..	6·0	6·1	+ 0·1

Excluding 15 Monocerotis, which is variable, there is only one star where there is a difference of 0 2 in magnitude.

I feel sure that any of your correspondents who have time at their disposal, if they try this method, will agree with me that a very correct magnitude may be obtained with an opera-glass.

I am very pleased to see that Mr. Gemmill has found traces of a period of five days in η Ursæ Majoris. The period I obtained for it was:

d. h. m.
P. = 4 17 36

but this did not represent the observations very satisfactorily. I have been waiting for this object to be well placed for observation, and then hope to try again. **T. E. Espin.**

Wallasey Rectory, Birkenhead.

THE LUNAR SNOW-LINE.

[19915.]—SINCE letter 19463, p. 302, I have been away in the Singphu country east of Asam, on one of my periodic searches for a route hence to China, and I now see "F.R.A.S." refers to that letter at p. 351, Dec. 16.

I was pretty close to the snow on Dapha Boom, but the elevation is only 15,000ft. At the same time I am aware that had I been able to carry out the experiment he refers to, the little square of black velvet laid on the snow in sunshine would have sunk in, while the white calico square would have remained on the surface.

Snow being white (and not black), I cannot see how this bears on the question, or demonstrates the impossibility of its existence on the moon's surface. When I registered a temperature of 172° F. in the sun at 300ft. above sea-level, I took it for granted that the *same rays* at some 30,000ft. above me would not have melted snow; and in this I am, I think right; and hence we can, and do, have perpetual snow under a vertical sun in the Tropics (even with a *comparatively* dense atmosphere). Why, therefore, not on the moon, where there is practically no atmosphere?

Sibsagar, Asam. **S. E. Peal.**

WATCH-REPAIRING.

[19916.]—MANY thanks to F. C. Putley. If you wait with a little patience you will, no doubt, see why I "cram the art, &c." My instructions for putting in a new pinion are genuine, and may be easily done by any amateur. I admit that Fig. 27 and Fig. 28 are not just what I wanted them to be, but as I shall eventually treat this subject again, I must ask you to wait. I want the amateur to have a little practice before we go into art properly. Why don't you read instructions as well as look at my drawings, and, if you don't believe it, just make some turns according to my instructions? You will be surprised that so simple an arrangement can turn out such a good job.

You must excuse me if I say you are mistaken if you think I ever recommend an amateur to *scrape* a hairspring, I said *draw* it. Did you ever draw one? I presume you never have, therefore, you you don't know anything about it; practice is one thing, theory is another. If a hairspring is properly drawn, it is the best way to weaken it. I shall give full instructions for drawing hairsprings in a week or so. I recommend the bouchon for the potence slip, but it won't do as a rule for any other part of a *verge* watch. It may be freely used in a Geneva, or small pivot watches, unless the hole is much worn, in which case it is useless; the holes in verge watches generally wear oblong, or egg-shaped, and it is necessary that the hole should be put in the same place that it originally occupied. My method does not mean repitching: it simply means that the new hole shall occupy the same position that the old hole did before it became worn out of shape, and it is as simple as A, B, C.

You must have been a very unfortunate being. I have let Geneva watches run down ever since I have been in the trade, and I have never had any accident. Do you think there is sufficient power in the spring to pull off an escape-wheel pivot? Do you mean a French horizontal timepiece? I have known these to act in that way, but only very common ones. You are bound to let down spring in lever watches—you have no option. I will simply suggest, "Live and learn." You will have plenty of chances to criticise when I begin "extra repairs." **A Fellow-Workman.**

[19917.]—IT is much more easy to find fault with the good work of others than to do the good work ourselves. Mr. F. C. Putley condemns "A Fellow-Workman," but why does he not do better work himself? I have asked a number of questions through the "E.M.," and the only answers I have got worth a penny are those of "A Fellow-Workman."

"Amateurs" may be considered those who, through some fault or other, have not been permitted to learn their trade correctly, yet have a considerable knowledge of a good deal connected with it. Those who know nothing of the trade whatever, and require to be told how to take a watch or clock to pieces, would do well to leave the trade alone. A voluminous article is extremely undesirable, as the young workman neither has the time nor the patience to go through it. French bouchons are very undesirable in repairing a wide hole, and to rebush and repitch is the only proper way to do it. Some tell us to use punches to repair holes with, which advice I trust no workman will ever take. In my opinion, "A Fellow-Workman" is by far the most able horological correspondent connected with the "E.M." **Guyot.**

THE TIN-POT BATTERY.

[19918.]—HAVING called Mr. Bennett's attention to the letters of "W. W. H. G." and J. H. Anderson in your last issue, I am authorised by him to state that, in the course of his experiments, he tried both the modifications of his battery to which these gentlemen refer.

As regards the first, the porous cell, or an equivalent partition, can only be dispensed with when a weak and inconstant current is required. The sacrifice of strength and constancy by the omission of such a partition is most marked. "W. W. H. G.'s" cell would only ring his bell for 1½ hour without rest. A properly-constructed tin-pot cell would ring it more powerfully for five or six weeks without stopping.

In respect to the second, Mr. Anderson will find after a time that, owing to a local action between the can and the granulated carbon, the iron will become rusted, and ultimately eaten through. This result is not difficult to understand, it being a case of two conductors of different potentials in contact in the same solution.

John McWhirter.

The National Electric Company (Limited),
Glasgow, April 10th.

DYNAMO-MACHINES AND GALVANIC BATTERIES.

[19919.]—I FEAR "Conrad" (19882, p. 81), will produce more wrath in those who make a machine on his plan, than the machine itself will produce current. He really appears to be under some very serious misapprehensions as to the actions which go on in these machines. Certainly he is in error as to the action of the Brush machine, and also as to his views of what he calls well-known laws. He appears to have mixed up the actions upon the wires, and those upon the cores. In the Brush machine the principal agency is the increase and decrease of magnetism in the core; direct action upon the wire is scarcely employed. As a consequence, it is at the moment when the iron projections, in passing the field magnets, take up the strongest magnetism into that arc of the armature which lies between the north or south poles of the field magnets (which are not, as he seems to think, those which face each other), and again when they leave those poles, that the strongest currents are produced. That is to say, they are produced almost entirely by gain and loss of magnetism, together with a smaller amount due to what De Moncel calls the polar introversion, which occurs in the various parts of the iron.

In his own design I fear he will find he has done the things he ought not to have done, and left undone the things he ought to have done; he simply increases and decreases magnetism in his core, thus generating an alternating current. But the best way of decreasing N. magnetism is to convert it to S. magnetism, which gives a current in same direction. As to the heating of the core, I think it will be found just the same as if the magnetism were reversed—less powerfully, of course, but only proportionally so to the less effective result produced.

The secret of getting current out of magnetism is to make the greatest changes possible, and to put the conductor in circuit just when the greatest change occurs. "Conrad's" plan fails in both; he minimises the changes, and by connecting only opposite bobbins, and it appears only putting in circuit the pair which have most and least magnetism, he carefully escapes utilising the change of magnetism, which occurs not at those points, but in the whole revolution while the bobbin is slowly gaining and slowly losing magnetism.

It is doubtful whether "W. H. G." (19903, p. 107) has made any improvement upon Mr. Bennett's soda-battery by substituting crushed carbon for iron; but, whether or not, he has done nothing new. In fact, the only point of Mr. Bennett's battery is its simplicity and cheapness of construction and the use of iron borings. The soda-cell was well-known before, and has been patented probably several times. With iron borings the negative element may be an old can, though I think the tin would be dissolved off and transferred to the zinc. But if carbon is packed in a tin can, it will be advisable for the cell to be stood in a saucer, as it will not be very long that the liquid will remain in it, for it will soon be eaten into holes.

I do not know where caustic soda is to be had at the price named, which is about the retail price of soda crystals, which will not act; but it is easy enough to procure a solution by boiling them with caustic lime—not in a tinned saucepan. The chief defect of the soda cells is that the air which must have access soon destroys the caustic soda and converts it to carbonate. **Sigma.**

SCIENTIFIC RESEARCH AND THE ROYAL SOCIETY.

[19920.]—WILL you allow me to call your attention to a somewhat notable fact in present scientific doings? You know that some years ago, through some extraordinary and benign influence, the then Government of the day were induced to grant *out of the public funds* the sum of £4,000 for the particular and express purpose of aiding the cause of "scientific research." This sum was confided to the Royal Society as the most fitting body to select those whom it might think most worthy of help, and who, in the ranks of the "outsiders," as the late Astronomer Royal phrased it, were thought to have in any way merited or earned some public recognition and help.

You will recollect that it was in your journal that I first called the attention of astronomers to the fact of the impossibility of really utilising the many and costly observations of the Transit of Venus, while the difficulty of the "Black-drop," as it is called, was still unaccounted for, and its true cause, at least, but partially known. It has always been contended by astronomers—and is so still, I believe—that it is solely owing to some occult influence exerted by the planet on the light which comes from the sun as it nears and passes the ;planet, thus preventing the clear *outlines* of the *planet* and the *sun* from being seen to touch each other *sharply* and *clearly* with well-defined outlines.

It is thought generally, I believe, and certainly by the Royal Society, that *light*, in passing by the outline or edge of any body is, by the influence of such body, *deflected* or *inflected*, or both together, and so *bent* (or split) out of its closest and straightest path; and thus, when it reaches the eye-retina, must needs make a confused, or *shaded*, or undefined outline. I cannot but think, on the contrary, that this singular appearance is owing solely to the *size* or linear dimensions of the source of the light, whether of the sun or the flame of a rushlight.

Sir, at the last Transit, as you will remember, many thousands of pounds were expended, not here alone, but all over Europe, in the observations of the Transit, and that the *result* was simply *nil*. I must contend that the same failure *must* needs occur at the next and coming Transit if the same course of action be pursued, and the above facts be passed by without another examination and analysis. As a subject of scientific research, I must contend that it is well worthy of note and further inquiry, and I have petitioned the Royal Society to give it a passing thought, and a little help or aid out of the fund at their disposal. I have suggested a new *eye-piece* to the Transit telescope, which I feel sure would, at least, much lessen, if not eliminate, the difficulty, and have asked for help to do this. I have also endeavoured to show that the words *inflection*, *deflection*, *irradiation*, are consequently obsolete, and without definite meaning here.

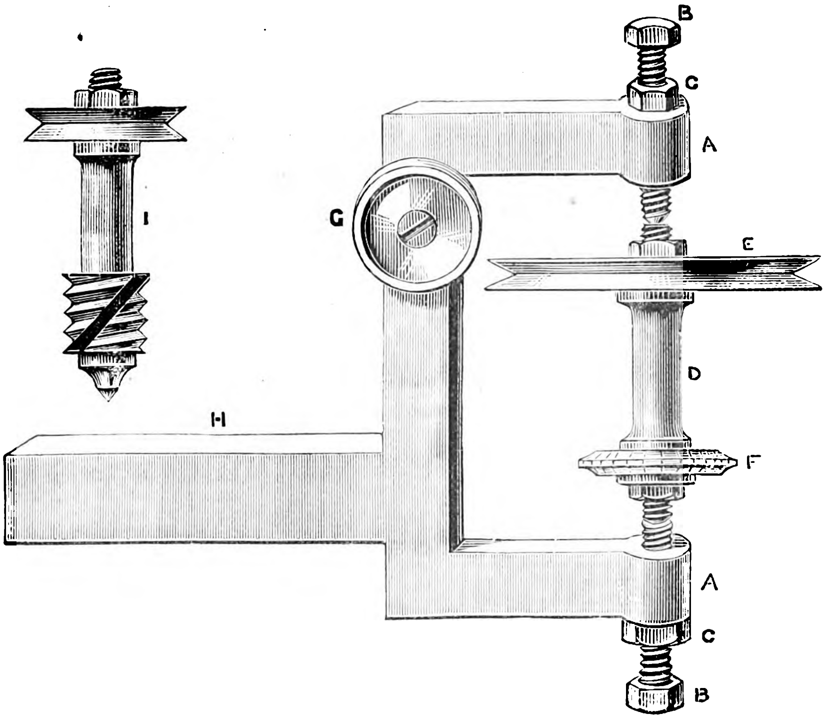
My sole object in asking you to insert this note is to induce the Royal Society, with whom the matter wholly rests, to institute a further inquiry into the difficulties and perplexities of this curious subject, and thus to, in time, admit it into the category of objects of scientific research; and, in the end, to make the coming observations of the Transit of Venus more certain of true results than the last.

Would it not be as well, I would venture to ask, in the future, to *divide* this large sum granted for scientific research, giving a portion to *each* one of the leading scientific societies—e g., the Astronomical—thus to deal more carefully, and in detail, with the separate items of the fund?

C. Bruce Allen.

WHEEL-CUTTING FRAME.

[19921.]—I AM now about to describe a simple, but very efficient, tool for cutting the teeth in such brass wheels as an amateur is likely to require. The illustrations given in books, Northcott for instance, of wheel-cutting frames describe them as requiring two slides, a vertical and horizontal, worked by leading screws, and capable of being swivelled round at any angle, the cutters also being driven by a spur-wheel and pinion. These are of course very elaborate and costly tools; but the one I am now describing will, I can vouch from experience, do the work equally well, though perhaps it will not cut a heavy gear as fast, with the exception of spiral wheels which I have never had occasion to cut, and for which the frame requires to be set at an angle, and to have a traversing motion independent of the slide-rest. In making this tool, of course it will have to be proportioned to suit its own slide-rest. The frame is of wrought iron, and any handy smith can make it. The two bosses A A are tapped with a $\frac{3}{8}$th screw, and in doing this I had to use a special tap with a long plain shank turned down to the size of the bottom of the thread at the small end; this was passed through one boss, and the point of it entered the hole in the other, which it just fitted, before the tapped part commenced to cut, and when one hole was tapped it was changed to the other one in the same way, so that both holes were of necessity tapped in the same line. It may be possible with great care to tap the holes true with a set of ordinary taps; but I have made myself a set of three taps of different sizes of this pattern for tapping opposite holes, and I can never make a mistake with them. B B are two steel screws with the points hardened; the upper one has a male centre and the lower a female one, between which the spindle runs, having contrary centres to correspond. The reason of this is that they may better retain the oil when in the upright position, than if both screw-points were male. C C are two lock-nuts which keep the screws from getting loose while in use. The spindle D is also of steel, with its ends hardened. F is a gear-cutter which is secured by a nut, and which can readily be taken off and exchanged for another, of any shape or size required; these cutters can be bought at all tool-shops, and always have the same sized holes through them. E is a brass-grooved pulley of 2½in. diameter, which I have found amply large for any work that I have done, and is keyed on to the spindle and secured by a nut; the spindle must be made long enough to allow E to clear the top of the wheel which is being cut. G is one of a pair of grooved pulleys which guide the gut band to the overhead, after passing round E. The axles of these pulleys I have made pretty long, so that they may take up their own position, according as there is a larger or smaller pulley on the spindle. H is the shank which is secured in tool-holder of rest, and should be packed up to the proper height, so that the centre of cutter F may be in a line with the lathe-centre. The teeth of the wheel to be cut are, of course, spaced by division-plate of lathe, and the cutter, while revolving horizontally, is fed up to its cut and traversed by slide-rest. In a similar manner, with a properly-shaped cutter on spindle, taps and reamers can be fluted, but when working on steel the cutters must be kept well lubricated.



I is a hob for cutting worm-wheels, such as are used on eccentric or oval chucks. It has a pulley at one end which may be smaller than the one on the other spindle; at the other end is cut a screw of the same pitch as the tangent screw which is to work in the wheel; this has flutes similar to a tap, but cut spirally instead of longitudinally, and the object of this is that as only two or three threads touch the wheel at a time, the spiral groove gives it a better lead than a straight one. Most authorities tell you, when cutting a worm-wheel, to first partly cut out the teeth, one by one, with a single-point tool in a fly-cutter, spacing them with the division-plate, and afterwards finish them with a hob. But my plan is as follows, and it succeeds admirably. Chuck the wheel to be cut on a mandrel between centres, and turn a semicircular groove in it, the diameter of your tangent-screw at the bottom of its thread; then put the index point into the first hole of your division-plate, and with a point-tool in the slide-rest make a mark at the bottom of semicircular groove; then take an outside screw-tool of the same pitch as tangent screw, and placing the first point of it in the mark just made, and the other points in a line with the groove, give it a slight tap of a hammer. This will mark three or four dots; then with the point-tool still in the slide-rest, try if the space between the dots will correspond with any even divisor on the division-plate; if it does, then the teeth of the wheel will come out even also, but if spaces do not come out even, then you must turn a little more off the wheel, and try again. When I have got the spaces right, I take a small cold chisel with the corners rounded off, and with a slight tap of a hammer make a transverse indentation at each dot; three or four are enough. I then take off the carrier from the mandrel, so as to allow it to revolve freely between centres, and with the worm-cutter in the frame fastened in the slide-rest, I bring it up so as to engage in the first of the indentations on the wheel. These indentations give the cutter a grip so as to start it; and on driving it from the overhead, the wheel at once commences to revolve, and the hob to cut the teeth out; and by keeping it pressed up to its work, the teeth are finished in a very few minutes. Sometimes, when it is not necessary to have a close fit between the worm and wheel, and when there is considerable strain on it—as, for instance, the wheel which drives a rose-cutting frame at the end of stem—I make the wheel a narrow spur, with teeth the ordinary shape, and the worm can then be cut very deep.

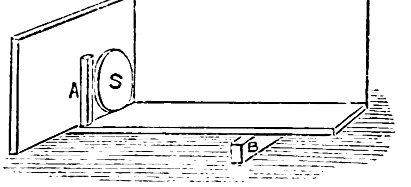
F. W. G.

GRINDING AND POLISHING GLASS SPECULA.

[19922.]—To understand the mode of testing specula that I have found the most convenient, the amateur must bear in mind what I explained to him in my last letter (p. 57), that the focus of the outside rays of an ellipse parabola or hyperbola is longer than the focus of the inside rays when tested at the centre of curvature. Now, we can have various ellipses and various hyperbolas, but we can have only one parabola, so we have only to calculate how much longer the outside rays, or the rays from any other zone, are than the inside rays of a parabola, the diameter and focus of our speculum to be tested, and then measure the actual lengths of the foci of the corresponding outside, or any other zone, of our speculum, and we at once can see what figure it is. Thus, if the outside zone rays are not so long as for a parabola by calculation, then we know we have an ellipse, as to what eccentricity it is immaterial to us, for we want only the parabola. If they are longer than the inside rays ever so little, then the figure is an ellipse only just removed from the sphere, and what we have to do is to make them still longer, till they correspond with the required proportion; then we have the parabola. On the other hand, if the outside rays are longer than the calculated proportion, then we know we have the hyperbola, and we must shorten them, or lengthen the inside rays, till we get the required proportion, when again we have the parabola. We must first know, therefore, by what rule to calculate the foci of the various zones. Now, there was a discussion in our columns some time ago on this point, and a difference of opinion seemed to exist; in fact, the rule I use is, I believe, different to Dr. Draper's. I hope our mathematical friends will now come forward and give us the aid of their skill in this direction. Surely there are readers who can settle it once for all for us. I cannot help thinking there is the will to help others as much in our mathematical friends as is exhibited in our mechanical friends. I will now tell them the rule I have found to give results that correspond as near as we can measure with the actual testings on a celestial object as to coincidence of the foci of the various zones. It may not be mathematically correct, but I believe it is very near. It is as follows:—Divide the square of the semidiameter of the zone by double the focal length for parallel rays; or, in other words, the radius of curvature (so called). The amateur will observe that this rule gives four times the aberration as the spherical aberration for parallel rays (see p. 57, sec. col.). I hope our mathematical friends will be on the look out for any error in our mathematics at all times, as we shall be glad to be corrected into the truth; and to have to own at any time that we have been mistaken is only to say, in other words (I wish we could always feel so when set right), that we are wiser now than we were before. While studying the above rule, the thought at once occurred to me that, Could I devise for the amateur sufficiently accurate and easily-constructed means to measure the proportion existing among the foci of the various zones, I should give him what he could use at once without waiting till he got the experience of a With or a Calver, for all he would have to do would be to see that the shade came on exactly the same on each side of the zone he was measuring, and he would have its exact focus, as I was careful to dilate upon in my last letter as being the first lesson he had to learn, so that he need not go beyond his first lesson in the Foucault's testing to apply this form of the test. Now, one great advantage of this mode of testing is that it gives the exact figure, for it is easy to see when we have experimentally determined the various focal lengths of the various zones, whether the figure is a regular one or not, and this by simply comparing these lengths with the calculated lengths for the parabola, and thus this mode of testing becomes a fearful tell-tale.

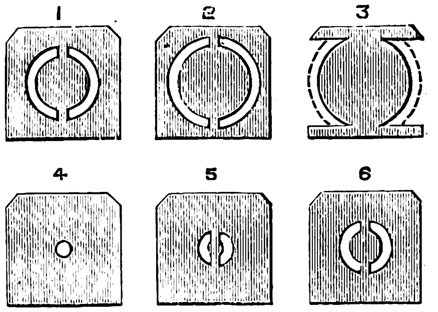
I will now proceed to describe as briefly as possible, consistent with what I consider necessary, to enable the amateur to make the apparatus and carry out the testings, and I hope if any amateur has any difficulty, either in making or understanding the description, he will communicate with me direct, and I will either communicate with him direct or give the explanation in some future letter in our columns, as my object is to make the thing plain once for all. It would be interesting and instructive to those who happen to have by them the communication of our old correspondent Mr. Tydeman, to read his description of the Foucaults test; it is in Vol. XIII., p. 464. He will then see that we have made some advance since then, when he compares it with the way I am about to give him. Fig. 1 is what I call the speculum trough. It is made of three pieces of board. I should advise the amateur to make it out of 11in. broad board, then it will do for testing a 12in. or 15in. speculum, should he go on to that size. Each piece may be from 18in. to 24in. long, ¾in. thick will be sufficient; they need not even be planed. S is the speculum in position, with a strip of wood, A, not quite so thick as the speculum, tacked on to the back board, to prevent the speculum from rolling out by accident; B is a piece of wood, to move backwards or forwards, and thus to throw the image of the hole in the chimney higher or lower, and thus make it level with the hole; now, by moving the right-hand end of the trough from him or towards him, the amateur can put the image of the hole just on the edge of the shutter.

FIG. 1



The amateur must now make six stops out of ordinary cardboard, as represented in Fig. 2. They should be made out of pieces about 6¼in. square (for our supposed 6in. speculum), so that they may fully cover the face of the speculum; but the centres from which the circles that form the zonal openings are struck should be just as high as the centre of the speculum; thus the stop will project about ⅛in. on each side of the speculum, and about ¼in. above it; the top corners are cut off, so that I can feel which side is to be placed top when leaned against the speculum. No. 3 is a circle 5in. diameter, with the bottom of the square left on to support the 5in. circle over the centre of the speculum when placed against it, thus leaving the outer zone ½in. wide; the top of the square is left on also, so that the left-hand side of the zone shall be exactly like the right-hand side in symmetry; for I find that to compare two areas of light as to the amount of light, which is the important thing here, I must have the two areas equal and symmetrical in shape. I have represented the edge of the speculum by dotted lines; the other figures will speak for themselves. I need only observe that the circles are for No. 2, 4in. diam.; No. 1, 3in. diam.; No. 6, 2in. diam.; No. 5, 1in. diam.; No. 4 is a simple hole 1in. diam. As to this last stop, I now never use it, for it is impossible to tell with sufficient accuracy how the shadings come on with so small a circle; but I thought it well for the amateur to try for himself, so that he may get the experience; but besides, this centre is always covered by the shadow of the small mirror. To calculate the foci of the zones, which are all ½in. wide, I take as the diameter of the zones a middle line on each; thus the outer zone middle line would be 5·5in. dia.. the half of this 2·75, the square of this 7·56. Divide this by the radius of curvature, which in our supposed case of 60in. focus would be 120, therefore the dividend would be ·063—*i.e.*, the focus of the outside zone would be for a parabolical figure ·063in. longer than the centre ray of stop No. 6, and so on for all the other zones, which would be as follows:—

FIG. 2.



No. of stop	1	2	3	4	5	6
Dia. of zone	5½	4½	3½	2½	1½	0
Aberration	·063	·042	·025	·013	·005	0

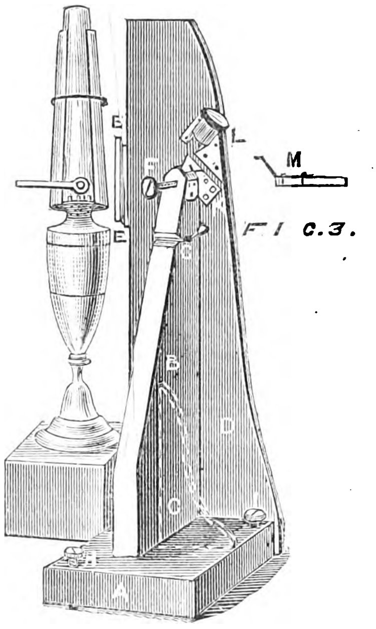


FIG. 3.

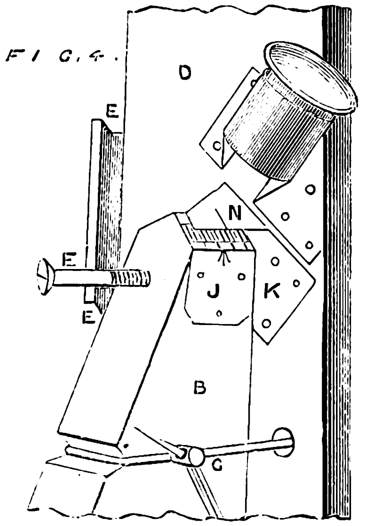


FIG. 4.

Now for the measuring apparatus and lamp. These are represented in Fig. 3. A is a piece of wood, the side A 6in., the other side 8in. In my case it is 1¼in. thick, but this was because that was the thickness of the piece of wood I used up for this purpose, but 1in. thick will be enough. B in mine is about 1½in. thick. but 1in. will do, especially if there be a bracket C (marked in dotted lines); but using thick and hard wood I needed no bracket. I should advise the amateur to put a bracket in any case. B is screwed firmly to A from the underside of A. D is wood from ½ to ¾ thick, hinged to A at D's lower end by two small hinges put as far apart as possible. These hinges ought to have no shake, even when opened and shut singly, and then they will not allow the piece D to twist when used together, and as far apart as possible. E E is the shutter tacked on to the back of D. This shutter is made of sheet-zinc, with the edge bevelled and made straight and smooth. It is 4in. long, is bent as shown in this Fig. and in section in Fig. 2, p. 57. It projects from the edge of D about 1¼in., as shown in section at M. F is a screw—in my case an ordinary wood-screw, with all round the head notched with small nicks, to act as a milled head. I could have made this and all the other screws and metal in brass, and finished it all as well as a mathematical-instrument maker could, even to the varnishing; but I have purposely adopted the simplest means, so that the amateur may not be discouraged, but feel that he can make all that is required; and to help others, we must put ourselves under the same conditions, with all their disadvantages, then we can properly feel for others, and help them, with our skill, to get over their difficulties and disadvantages. Well, D is kept against the point of the screw F, by the elastic-band G; all this is shown on a larger scale in Fig. 4. I must warn the amateur that this screw F must be made to turn very easily with the thumb and finger, as, in fact, the other two screws, H and I, must. H is a ¼in. ordinary Whitworth screw, with a six-square head; but this may be a wood screw—an objection to a wood-screw is that its thread is rather coarse; but, still the amateur may not despair if he has to use one. I have let in a nut on the under-side of A, and made H to fit loose through the wood. This screw is to adjust the shutter exactly to the focus of the outer zone, when the index near to F is set to ·063 to start with; therefore we will call it the adjusting-screw, for it is evident that when screwed down it will lift up the end of A, and throw back the shutter E E away from the speculum and *vice versâ*, so that we can set the shutter exactly to any place in the cone of rays to commence our measurements from. Of course the rough adjustment is done by pulling or pushing the whole affair along the table or bench that it rests on, being careful to keep the shutter not far from opposite the centre of the chimney, and about 1½in. from the hole, as I explain at p. 57 in former letter. The lamp will sometimes have to be moved to keep the proper relationship between it and the shutter. I is another screw like H, and its effect will be to move the shutter at right-angles to the movement produced by H, so that the effect of screwing I down will be to pass the shutter from left to right across the cone of rays. Now, as we can screw down I very gently, we can watch the shadings on the speculum with the greatest ease and comfort, stop it at any point, bring it back by unscrewing I, and then pass it over again, and thus study the indications over and over again, till we have thoroughly mastered the lesson or satisfied ourselves as to what we are seeking to find out. This screw I call the shutter screw, because it is to shut off the light by moving the shutter across the cone of rays, and thus produce the shadings we have to judge from; this screw is an immense comfort, as compared with the square of our friend Mr. Tydeman of 10 years ago, as likewise is the screw, H; but it was the old square of our friend that led me to the improved idea, and I only hope my improvement will lead someone else, it may be 10 years hence, to a still further improvement; the fact is, we are all dependent on those who have gone before us, and our legitimate boasting is often very little compared with our actual boasting; the fact being a large mind never boasts, but ever feels that the ocean of knowledge is still before him. But to return to our description. At the corner of A, behind B and C, there is a stud on the under side, projecting about ¼in., which rests on the table and keeps A above it, so that there are three points on which the whole affair rests—viz., the stud, the adjusting-screw, and the shutter-screw: it rocks, therefore, on the stud in two directions at right angles to one another by means of the two screws, which screws, by the way, ought to have rounded points, but only just removed from the flat; in this respect the ¼in. screws are better than the wood screws, although by putting a bit of metal under each of the points of the wood screws, these would do as well as the ¼in. The measuring part at the top of B is represented on a larger scale in Fig. 4 (the same letters refer to the same parts as in Fig. 3). J is a piece of sheet-zinc having divisions to the 100in. tacked on to the top of B and bent as shown, for the projecting part N of the sheet-zinc K to slide over, with one line as shown for the index near to N. The part K is extended on D at the back of B, so that the point of the measuring-screw F shall push against it, and not against the bare wood. L is a piece of sheet-zinc, bent as shown, to hold an ordinary watch-maker's eyeglass directly over the index N and the divided part of J, the eyeglass being carried with the index N, both being on D. It is always right for reading off the position of the index on the divided part of J; any lens will do that is about 1 or 1½in. focus, placed at the bottom of L, and at such distance from N as to see it distinctly. The divisions on J are long division every 10th in., short division every 100th in., with each 5th or middle division a little longer than the 100th divisions. The amateur can easily divide this for himself if he can borrow a straight edge or rule divided into 100ths. The middle long division on J has an arrow to it, as shown, to indicate 0, or the starting-point to reckon from. The single line on N ought to be at the end of the division furthest from D. When the measuring-screw is drawn back so as to allow D to be pulled against B by the elastic band G. The division on J need not be more than 4-10ths. The amateur, if he cannot get a rule divided to 100ths, can get his zinc divided at any rule-maker, or, I should think, any mathematical instrument maker. Mr. Lancaster, for instance, would, I have no doubt, get it done for him if he would send the piece of zinc by post, but he must mark with ink or any other way that will not scratch the surface, where he wants the divisions to be put; the single line N he can put himself, after he has bevelled or thinned down the edge; he has only to put a straight edge at right angles to the edge of N, and draw the point of a sharp penknife with its back towards him along the edge of the straight edge, a small square would be most handy for this purpose. Now, he may easily divide his plate J with a square and straight edge, or rule with 100th in. divisions thus: Place the back of the square against the edge of the straight edge with its blade over the divisions, fix the piece of zinc on the other side of the straight-edge, and with its surface to be divided on a level with the top of the straight-edge; he must firmly fix both the zinc and straight-edge together on a piece of board; first draw his long lines to bound his divisions as to length, as shown above J; there will be three of these long lines; he ought to polish the face of the zinc, or make it smooth before he begins. Now let him put the point of his sharp penknife with its back towards him into one of the divisions of his straight-edge, opposite to where he wishes to begin, on the left hand end of the lines he has to divide between, keeping the penknife about like he would hold a pen; now gently move the back of his square along the straight-edge till the blade just touches the penknife. Now draw a line on the zinc along the edge of the blade of his square; make this a long division—i.e., from the one long outside line to the other long outside line, and right across the middle long line. Now put the point of the penknife into the next 100th division on the straight-edge, and gently push the square up to it. Now draw another line on the zinc between two of the long lines only; this will be the first 100th division, and so on, at the 5 line, draw it so as to be a little longer than the 100ths, but not so long as the 10ths. Doubtless, his straight-edge will be divided in somewhat similar way. Let the amateur be careful to keep his penknife always exactly in the same position from the beginning to the end of his dividing operations, and let him not be discouraged if he fails with his first attempt by making mistakes in the length of his divisions, or in not getting them all the same width. Let him get another piece of zinc, and try again; he will be amply repaid for the loss of several pieces of zinc by the experience he will gain, and the pleasure of having divided his own plate. I thus divide mine with ease, and have no difficulty. To finish the description of this part, I may observe that the height from the table or bench to the middle of the shutter or hole in the chimney, or the divided plate J, all of which are on a level, is, in my case, 14in. This I find a convenient height.

I see I must leave the description of the lamp, and how to use the whole together, for my next letter; but this is no more than I expected. I would only most cordially invite any amateur to communicate direct with me as to any point I have not made plain. Thus I hope we shall clear up some of the old mysteries hanging about specula, and figuring, and Foucault's testings, &c., which were like so many bugbears frightening the amateur from so pleasing and instructive a pursuit; only let me remind him of what, perhaps, he learned as a boy: "If at first you don't succeed, try, try again"—i.e., if the object be worthy of the pursuit. **H. A. Wassell.**

Addenbrook Villa, Love-lane, Stourbridge.

THEORY OF THE ACHROMATIC OBJECT-GLASS.

[19923.]—I am endeavouring, in my humble way, to prepare an essay on the above subject. Our generous and accomplished master in practical matters, "Prismatique," has already promised assistance in the practical part; but he is at present, I know, very busy; and Mr. Wassell will, I have no doubt, go into the matter when he has finished with the mirror. Meanwhile, I think it will serve some useful purpose if I embody what relates to the theory in the form of an essay. Through the kindness of one correspondent, I have some particulars of the proportion of curves, and method of computing them, used by Tulley. If any other reader has similar particulars respecting the practice of other famous names, such as Fraunhofer, A. Ross, P. Dollond, and others, and would send some account of them, either to this paper, or through you, Sir, to me, it would furnish a history of the progress of the theory of the o.g., such as could be found in no other journal. I confine my request to particulars of the work of *deceased* artists, as the object of such an essay would be merely to show the development of the theory, not to give a particular account of the practice of any one artist. **Orderic Vital.**

AUTOMATIC AIR v. AUTOMATIC VACUUM BRAKES.

[19924.]—It has already been mentioned that the battle of the brakes is now being fought upon the question of which automatic brake shall be adopted, air or vacuum.

Before proceeding to express an opinion upon either of these systems, it will be of advantage to correct an idea somewhat generally held, that an automatic brake cannot be made to work without valves; it should be clearly understood that it is perfectly easy to construct such brakes to work with air-pressure or vacuum, without any taps, valves, or other so-called complicated parts; but all such brakes have and must have the fatal defect of being slow in action. After any brake trials or experiments have been conducted, the question is frequently asked, "Why is it that the Westinghouse Automatic brake always proves itself to be the best?" The reason is that its action is as nearly as possible instantaneous, the retarding power therefore is brought into effect with the least loss of time and distance; and this very great advantage is due to the use of the triple valve and high pressure. Mr. J. E. Harrison, the Engineer-in-Chief of the North-Eastern Railway, in his Report to the directors of that company, mentioned that the triple-valve had been made a regular bugbear by the opponents of the system, but he considered it a model of ingenuity and simplicity. The triple-valve is nothing more than a piston and slide-valve moving together as one piece. It is fixed between the auxiliary reservoir, which is charged with compressed air, and the brake cylinder; when the piston is pushed *up* the communication between the reservoir and cylinder is closed and the brake is "*off*," when, in consequence of the pressure in the main brake-pipe being reduced, the piston moves *down*, a direct passage is instantly opened, through which the air rushes from the reservoir to the cylinder, and applies the brake in a moment. This useful triple-valve has been called "complicated," but it will be seen that its action and construction are most simple. The next question which must naturally arise is, "If an automatic vacuum brake were constructed with a triple-valve, would the results obtained be equal to those of the Westinghouse Automatic Air brake?"

Most certainly they would not. A triple-valve would very greatly improve the action of a vacuum brake, but it is perfectly well understood that any amount of improvements in details can never make a bad system into a good one, nor overcome difficulties caused by the principle being wrong from the commencement.

In a letter which appeared in the English Mechanic, June, 1878, and in my pamphlet on "Railway Accidents," February 1881, I dealt fully with this question, and pointed out that the vacuum principle had the inherent defect of having only the pressure of the atmosphere to work with, whereas the compressed air system could be applied with any desired power.

The Westinghouse Automatic brake is generally worked with a pressure of 70 or 80lb. per square inch; this permits the pipes, cylinders, and other parts to be of small dimensions. On the other hand, a perfect vacuum gives a pressure of about 15lb. per square inch, but practically, a partial vacuum of 12lb. is all that can be obtained to work the brakes.

To make the low pressure of 12lb. exert the necessary power, the areas of the cylinders must be made fully six times as large to perform the same work as the high pressure of 70 or 80lb. There is no difficulty in *constructing* vacuum cylinders or sacks of the required size; but the very important point is, that every increase of size of course increases the cubical contents of the apparatus, and consequently a greater quantity of air has to be moved to apply and release the brakes; hence slow action *must* follow.

An automatic vacuum brake (as used on the Midland Railway for instance) is of such a large size to obtain the required power, that no less than 2,600 cubic inches of air must enter the pipes and cylinders upon *each carriage* in order to apply the brake with full power; therefore, in a train of 16 carriages, 41,600 cubic inches of air must pass into the apparatus, at the low atmospheric pressure, and it is stated that in practice this will occupy nearly *ten* seconds.

In the Westinghouse Automatic brake it is not necessary that the pressure in the brake pipe should be destroyed, but only that it should be reduced 20 per cent. Here, again, we see the great advantage of the triple valve: instead of having to discharge *all* the air from the brake-pipe, it is only necessary that the pressure should be reduced enough to cause the pistons in the triple valves to move down, and thus open direct communication between the auxiliary reservoirs and the brake cylinders, which instantly applies the brake with full force. In the Westinghouse system the space in the pipe and lower part of triple valve upon each carriage is about 330 cubic inches (and as only 20 per cent. reduction is required to put the brake *full on*), it follows that only 66 cubic inches of air per carriage have to be discharged, or upon a train of 16 vehicles, 1,056 cubic inches.

Having before us these details, it is easy to draw up the following summary.

Upon a train of 16 carriages, an automatic vacuum brake (having no triple valves) requires 41,600 cubic inches of air to be moved at a low pressure, which takes about ten seconds, whereas the Westinghouse Automatic brake only requires 1,056 inches of air to be discharged at high pressure, which practically takes about 1¼ second.

In this short summary we have, in a few words, the principle of the two systems clearly illustrated, and we can now give an answer to the question "why the Westinghouse brake has always proved itself to be the best." Instantaneous action, produced by the use of high pressure, controlled by that most ingenious piece of mechanism the triple valve. **Clement E. Stretton.**

Saxe-Coburg-street, Leicester.

RAILWAY BRAKES.

[19925.]—My attention having just been called to letter 19911, of Mr. C. E. Stretton's, on p. 109, I wish to correct an error or two into which he has fallen. It may be that he has been misled by the last Brakes Return; but not having seen this, I cannot say.

The system we have adopted is W. Parker Smith's Automatic Mechanical Brake. It is *not* a vacuum. It can be applied by driver or guard, and from any part of the train; it can also be applied at full power on three revolutions of the carriage or engine's wheels, or with any less power that may be desired; it can also at any moment be taken off or reduced, and reapplied. The connection between coaches is accomplished for attachment or detachment in a second or two. I myself believe it will be *the* brake of the future, satisfying, as I believe it does, *all* the requirements of the Board of Trade, who will shortly have a report thereon. It has run now with us about 5,000 miles without a failure. **J.**

Liskeard and Caradon Railway Company,
Liskeard, 8th April.

SCREWDRIVERS.

[19926.]—Seeing Sir Edmund Beckett's letter (19857, p. 63) describing his improvement in screwdrivers has induced me to send the method I use to prevent the ordinary screwdriver having such "persistence in slipping out of the nick."

When a screwdriver has a tendency to slip sideways, it is because it is ground too thin, and the point rests upon the bottom of the screw-nick. But if the point is ground very slightly taper, and to such a thickness that it will not quite reach the bottom, it will then jam tightly in, and have no tendency to slip. Of course, one driver cannot be made to do for very many different sizes of screws, but it can be made to do for several, and it is not well to use the same driver for many sizes on account of the width.

Journeyman Organ Builder.

L. AND N.W.R. "PRECEDENT" ENGINES.

[19927.]—As numerous correspondents have at different times asked for the dimensions of these engines, the following details may be acceptable:—

Cylinders .... 17in. by 24in.

	ft.	in.
Wheels, leading	3	6
,, driving	6	6
,, trailing	6	6
Wheel base..................	15	8
Distance between leading and driving-wheels	7	5

	ft.	in.		ft.	in.	
Firebox, length inside ..	4	9¼	top,	4	10⅝	bottom
,, breadth ,, ..	3	5¼	,,	3	6	,,
,, height from top of firebars ..	5	9¼				
Tubes, length	10	2¾				
,, diameter		1⅞				
,, distance between centres		2½				
,, number	198					

	ft.	in.
Boiler, diameter outside..........	4	1¼
Blast-pipe, diameter inside		4⅞

Working pressure ...... 120lb. sq. in.
Heating-surface, tubes .. 980 sq ft.
,, ,, firebox 103·5 sq. ft.

Total .... 1083·5
Grate area .... 17·1 sq. ft.
Area of tubes ...... 2·96 sq. ft.

	Tons.	cwt.
Weight, empty	30	10
,, working order	32	19
,, ,, driving-wheels	11	10

Tender—Wheels, 6; diameter, 3ft. 6in. Water, 1,800 gallons.

	Tons.	cwt.
Weight, empty	12	1
,, full	24	5
Total weight of engine and tender in working order..............	57	4

The driving and trailing-wheels are fitted with steam-brake, and tender with hand-brake, also Ramsbottom's apparatus for filling the tender while in motion.

Perhaps some correspondent can tell me why a "Precedent" engine is working the 4.0 p.m. fast express from Euston, as a "Lady of the Lake" used always to be used; also whether the "Charles Dickens" is a new engine?

E. W. J.

MEDICAL REPLIES.

[19928.]—Turkish Bath for Home Use (46295).—A sort of steam closet into which steam—suitably guarded and under control of patient—could be let while the patient sat with his head out, is probably the cheapest and most useful approximation to a Turkish bath. I have seen an admirable home-bath constructed by Dr. Edward Haughton, of Upper Norwood, and I have no doubt that any reader of the English Mechanic who called upon or wrote to Dr. Haughton, would get just the help now asked for. Dr. Haughton has paid great attention to such domestic baths, and to therapeutic bathing of all sorts.

Skin Disease. (46556).—"Sufferer" is probably the subject of a rare disease named "sycosis," and one which, when allowed to become inveterate, is very difficult to cure. Sycosis is a disease of the hair-follicles of the beard allied to true ringworm of the hairy scalp, and it consists of a cryptogamic growth, which infests the bulbs and follicles of the hairs, causing eruptions of which each hair is the focus. Blood medicines are quite useless, as the disease is as purely local as is the itch itself. Plucking out the hairs generally and continuously, and poulticing the skin every night with a linseed poultice, smeared slightly with softsoap, and then washing skin carefully clean, and applying some agent which will soak into the hair-follicles, and kill the vegetable parasites which now infest the texture of the skin, is the line on which cure will be arrived at. But this treatment wants delicate handling, and I can only indicate the guiding principle here. Just as a gardener will kill weeds on a gravel-walk by sprinkling the surface with salt, so these parasites must be killed in the texture of the skin. But it is of no use to smear applications on the outside of masses of scab; all such matters must be cleared away by epilation and preliminary poulticing.

Deafness (46566).—Read last week's reply.

Stoppage of the Eustachian tube means obstruction of the passage which leads from the drum of the ear into the throat on a level with the floor of the nostril. 2. Probably needs constitutional treatment for the purpose of producing a healthier condition of the lining membrane of the tube. Consult the best doctor in your neighbourhood, and do not attempt to deal with the matter yourself.

James Edmunds, M.D., &c.

Grafton-street, Bond-street.

DYNAMO-MACHINE.

[19929.]—Further particulars from "Conrad" would be very acceptable. 1st. Size of field-magnets, quantity and size of wire on them, purpose for which dynamo is used—plating or lighting? Are the field-magnets connected or independent of each other, and does the armature-spindle work through holes in the poles S. and N.? From the sketch, I should take it the field-magnets were wound from end to end, passing at the back of the circular pole, and connected only at one end; and it appears to be a very simple affair to construct. But full particulars would greatly assist amateurs in making one. A sketch, more in detail, showing commutators and connections of wires from bobbins, and the manner the current is taken from armature through field-magnet wires, and thence to the work, would be a great assistance. Also, the amount of power required to work it, and amount of current produced under favourable circumstances. Any information as to dynamos is now very welcome to the readers of the "E. M."

H.

ORNAMENTAL SLIDE-REST.

[19230.]—In the ornamental slide-rest of "F. W. G." (19872), the principal advantage over Holtzapffel's pattern seems to be in the tool-box, which is better adapted for ordinary cutters, though it may be a question whether it is as well fitted for the reception of drills and eccentric cutters. There are two or three points, however, in this slide-rest, which I should like to bring under "F. W. G.'s" notice.

1. As to the V-shaped thread of the leading-screw.

A square thread works to better advantage in producing motion in a slide-rest; and in the case of backlash, caused by wear, I fail to see how the arrangement proposed (H) will remedy it. The form of the space between the threads of a V-screw is a V when new, and a wider V with the point cut off when it is worn, approaching, in fact, the form in a square-threaded screw, and as clamping will not remedy backlash in a square screw, it will fail to do so in the V-screw, for the same reason. There would seem, therefore, to be no advantage in favour of the V-screw.

The best way to prevent backlash is to cut the nut in two, transversely, and join it again by four screws in the corners (the nut should be drilled and tapped for the four screws before sawing it in two), by means of which it can be clamped to the threads of the leading-screw; but in a direction perpendicular to that proposed by "F. W. G."

2. Would not the lever M work much better if the pillar O were fixed in the hole P, instead of in the lever?

3. It is proposed to raise the level of the slide-rest, where required, by washers, instead of a "screw ferrule."

I think, if "F. W. G." examines one of Holtzapffel's ornamental slide-rests, he would allow that the beautiful working of the "screw ferrule" is a welcome substitute for the innumerable washers that would be required to produce a like result in raising the level of the rest.

Another of your correspondents brought under our notice, a few weeks ago, a compound oval and eccentric chuck, the oval chuck being made eccentric by clamping the sliding portion at the proposed eccentricity with screws. As there is always a small space between the two surfaces, it occurs to me that there is great danger of bending one, or both, by the process, and so completely spoiling the oval chuck. The danger would be diminished by inserting a thin piece of brass between the surfaces; but there would still be risk of damage.

M. A.

"JUMPING" OF ETHER STOPPERS.

[19931.]—Mr. W. Broughton, referring (letter 19900, page 107) to the jumping out of the stoppers of bottles containing ether and other volatile liquids, recommends the use of an india-rubber finger-stall drawn like a cap over the stopper and neck of the bottle. A cheaper and equally effective remedy is to loosely wire the stopper down, so that it may have about a quarter of an inch of play. This method has an advantage over the former, in that it allows vapor to escape when the pressure within the bottle becomes excessive. When any of the contained liquid is required for use, the wire can easily be pushed to one side, and as easily replaced.

Alfred W. Soward.

RAMSDEN'S DIVIDING-MACHINES.—
Part II.

[19932.]—"The wheel was now taken off the lathe, and the bell-metal piece D was screwed on as before directed, which, after this, ought not to be removed.

"From a very exact centre a circle was described on the ring C, about 4-10th of an inch within where the bottom of the teeth would come. This circle was divided with the greatest exactness I was capable of, first into five parts, and each of these into three. These parts were then bisected four times; that is to say, supposing the whole circumference of the wheel to contain 2,160 teeth, this being divided into five parts, each would contain 432, which, being divided by three, each would contain 144, and this space bisected four times would give 72 – 36 – 18 – 9; therefore, each of the last divisions would contain 9 teeth. But, as I was apprehensive some error might arise from quinquesection and trisection, in order to examine the accuracy of the divisions, I described another circle on the ring C (Fig. 7) 1-10in. within the first, and divided it by continual bisection, as 2,160, 1,080, 540, 270, 135, $67\frac{1}{2}$, $33\frac{3}{4}$, and as the fixed wire (to be described presently) crossed both the circles, I could examine their agreement at every 135 revolutions (after ratching could examine it at every $33\frac{3}{4}$); but not finding any sensible difference between the two sets of divisions, I for ratching made choice of the former, and as the coincidence of the fixed wire with an intersection could be more exactly determined with a dot or division, I, therefore, made use of intersections on both sides before described.

"The arms of the frame L (Fig. 7) were connected by a thin piece of brass, of $\frac{3}{4}$in. broad, having a hole in the middle 4-10in. diameter; across this hole a silver wire was fixed, exactly in a line to the centre of the wheel; the coincidence of this wire with the intersections was examined by a lens of 7-10in. focus, fixed in a tube which was attached to one of the arms of L. Now, a handle or winch being fixed on the end of the screw, the division marked 10 on the circle K was set to its index, and by means of a clamp and adjusting-screw for that purpose, the intersection marked 1 on the circle C was set exactly to coincide with the fixed wire. The screw was then carfully pressed against the circumference of the wheel by turning the finger-screws *s*; then, removing the clamp, I turned the screw by its handle 9 revolutions till the intersection marked 240 came nearly to the wire. Then, turning the finger-screw *s*, I released the screw from the wheel, and turned the wheel back till the intersection marked 2 exactly coincided with the wire, and, by means of the clamp before mentioned, the division 10 on the circle being set to it index, the screw was pressed against the edges of the wheel by the finger-screw *s*, the clamps were removed, and the screw turned 9 revolutions till the intersection marked 1 nearly coincided with the fixed wire; the screw was released from the wheel by turning finger-screws *s* as before, the wheel was turned back till intersection marked 3 coincided with the fixed wire; the division 10 in the circle being set to its index, the screw was pressed against the wheel as before, and the screw turned nine revolutions, till intersection 2 was nearly coincident with the fixed wire, and the screw released, and I proceeded in this manner till the teeth were marked round the whole circumference of the wheel. This was repeated three times round, to make the impressions deeper. I then ratched the wheel round continuously in the same direction, without ever disengaging the screw, and in ratching the wheel about 300 times round, the teeth were finished.

"Now it is evident that if the circumference of the wheel was even one tooth, or ten minutes, greater than the screw would require, this error would, in the first instance, be reduced by 1-240th part of a revolution, or two seconds and a half, and these errors, or inequalities of the teeth, were equally distributed round the wheel at the distance of nine teeth from each other. Now, as the screw in ratching had continually hold of several teeth at the same time, and thus constantly changing, the above-mentioned irregularities soon corrected themselves, and the teeth were reduced to a perfect equality. The piece of brass which carries the wire, was now taken away, and the cutting-screw was also removed, and a plain one (hereafter described) put in its place. At one end of the screw was a small brass circle, having its edge divided into 60 parts, numbered at every sixth division, as before mentioned. On the other end of the screw is a ratchet-wheel C, having 60 teeth, covered by the hollow circle *d* (Figs. 4 and 5), which carries two clicks, that catch upon opposite sides of the ratchet-wheel. When the screw is to be moved forwards, the cylinder *s* turns on a strong steel arbor, F, which passes through, and is firmly secured to, the piece *y*; this piece, for greater firmness, is attached to the screw-frame G, by the braces *v*. A spiral groove, or thread, is cut upon the outside of the cylinder *s*, which serves both for holding the string and also giving motion to the lever I, on its centre, by means of a steel tooth *n*, that works between the threads of the spiral. To the lever is attached a strong steel pin *m*, on which a brass socket *r* turns; this socket passes through a slit in the piece *p*, and may be tightened in any part of the slit by the finger-nut *f*. This piece serves to regulate the number of revolutions of the screw for each tread of the treadle R.

"T (Fig. 1) is a brass box, containing a spiral spring; a strong gut is fastened and turned three or four times round the circumference of this box; the gut then passes several times round the cylinder *s*, and from thence down to the treadle R. Now, when the treadle is pressed down, the string pulls the cylinder *s* on its axis, and the clicks, catching hold of the teeth of the ratchet, carry the screw round with it, till by the tooth *n* working in the spiral groove, the lever I is brought near the wheel *d*, and the cylinder stopped by the screw-head *x* striking on the top of the lever I; at the same time, the spring is wound up by the other end of the gut passing round the box T (Fig. 1).

"Now, when the foot is taken off the treadle, the spring unbending itself pulls back the cylinder, the clicks leave the ratchet and screw at rest, until the piece *t* strikes on the end of the piece *p*; the number of revolutions of the screw at each tread, is limited by the number of revolutions the cylinder is allowed to turn back before the stop strikes on the piece *p*.

"When the endless screw was moved round its axis with a considerable velocity, it would continue this motion a little after the cylinder *s* was stopped. To prevent this, the angular lever *η* was made, that when the lever I comes near to stop the screw *x*, it, by a small chamfer, presses down the piece *x* of the angular lever. This brings the other end *y* of the same lever forwards, and stops the endless screw, by the steel pin *u* striking upon the top of it. The foot of the lever is raised again by a small spring pressing on the piece V.

"D, two clumps connected by the pin *a*, slide one on each arm of the piece L, and may be fastened at pleasure by the four finger-screws *e*, which press against steel springs, to avoid spoiling the arms. The piece *q* is made to turn without shake between two conical-pointed screws *f*, which are prevented from unturning by tightening the finger-nuts *n*.

"The piece *m* is made to turn on the piece *q* by the conical-pointed screws *s*, resting in the hollow centres *c*.

"As there is frequent necessity to cut divisions on inclined planes, for that purpose the piece *γ*, in which the tracer is fixed, has a conical axis at each end, which turns in half-holes. When the tracer is set to any inclination, it may be fixed there, by tightening the steel screws *β*."

Description of the Engine by which the Endless Screw of the Dividing-Engine was Cut.

Fig. 9 represents the engine of its full dimensions, seen from one side.

Fig. 8 shows the upper side of the same, as seen from above.

"A represents a triangular bar of steel, on which the triangular holes in the pieces B and C are accurately fitted, and may be fixed at any part of the bar by means of the screws D.

"E is a piece of steel, whereon the screw is intended to be cut, which, after being hardened and tempered, has its pivots turned into the form of two frustums of cones, as represented in the drawing of the dividing engine, Fig. 5. These pivots are exactly fitted to the half-holes F, T, which are kept together by the screws *z*.

"H represents a screw of untempered steel, having a pivot I, which turns in the hole K. At the other end of the screw is a hollow centre, which receives the hard conical point of the steel pin *m*. When this point is sufficiently pressed against the screw, to prevent its shaking the steel pin *m* is fastened by tightening the screws Y.

"N is a cylindrical nut, movable on the screw H, which to prevent shake may be tightened by the screw O. This nut is connected with the saddle piece P by means of the intermediate universal joint W, through which the arbor of the screw H passes. A front view of this piece, with a section across the screw arbor, is represented at X. This joint is connected with the nut by means of two steel slips *s*, which turn on pins between the cheeks T on the nut N. The other ends of these slips *s* turn in like manner on pins (*a*). One axis of this joint turns in a hole in the cock (*b*), which is fixed to the saddle piece, and the other turns in a hole *d*, made for that purpose in the same piece in which the cock *b* is fixed. By this means, when the screw is turned round, the saddle piece will slide uniformly along the triangular bar A.

"K is a small triangular bar of well-tempered steel, which slides in a groove of the same form, on the saddle-piece P. The point of this bar or cutter is formed to the shape of the teeth intended to be cut on the endless screw. When the cutter is set to take proper hold of the intended screw, it may be fixed by tightening the screw *e*, which clamps the two pieces of brass, G, upon it.

FIG. 8.

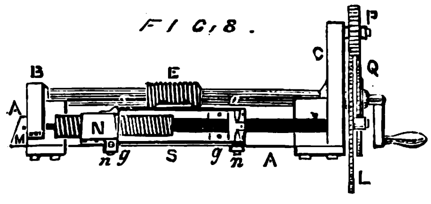
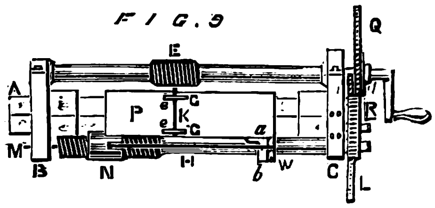


FIG. 9.



"Having measured the circumference of the dividing-wheel, I found it would require a screw about one thread in a hundred coarser than the guide-screw H. The wheel on the guide-screw arbor H, and that on the stud E, on which is the screw to be cut, are proportioned to each other to produce this effect, by giving that on the arbor I, 198, and that on the arbor Q, 200. These wheels gear with each other by means of an interior-wheel R, which serves also to give the threads on the two screws the same direction.

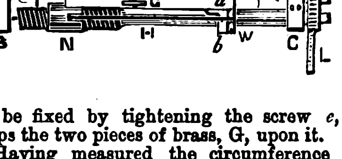
"The saddle-piece P, is confined on the bar A, by means of the piece *q*, and may be made to slide with a proper degree of tightness by means of the screw *n*." **Orderic Vital.**

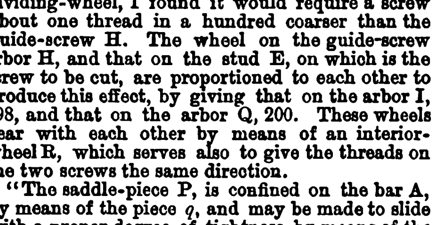
(*To be continued.*)

ATTACHMENT TO ELECTRIC-BELL FOR CONTINUOUS RINGING.

[19933.]—In the hope of benefiting some of the readers of the "E.M." I beg to send the following method of producing continuous ringing from an ordinary electric-bell. The method works well; is inexpensive; and anyone with very ordinary intelligence, could make and fix one for himself. Of course the bell must have a contact breaker; A, bell; B, hammer, in the centre of which is screwed or soldered a piece of metal projecting outwards half an inch. The head of my hammer is a flat, circular one, with a hole in centre; *c*, piece of brass hung loosely on the screw, to which wire is attached, leading to bell as shown; D, screw and wire attached leading to battery. On the bell being rung, the oblong piece of brass, *c*, is liberated, falling on to D, making a new circuit producing continuous ringing until *c* is lifted up.

J. W. Fisher.





OVENS HEATED BY GAS COKE.

[19934.]—The systems are various for raising heat in more or less confined spaces to the baking points of breads. We find them ranging from the expiring wood ash heap of the Australasian bushman, the camp oven suspended over, or immersed in, more lively embers, the many shapes of ship ovens, mostly iron, heated by hot air from the cooking fires, the movable firegrate burning coal in country places, and still largely used, and the common furnace fixed in one corner of the oven. Over these, and claiming to rank as scientific, we have the complicated hot-air ovens of Paris, the complex system of iron pipes containing water, radiating heat after being heated to a high temperature by placing one end of the pipes, spiral shaped, in a burning furnace, and lastly, though not including all, the almost automatic "travelling" or biscuit oven.

Something more cleanly than the first, and more simple and inexpensive than the last three is required by bakers, who, as a rule, are not what could be called rich, are generally tenants, and are excusably reluctant to spend in experiments on their landlords' property. Yet it is a mystery to some minds why bakers in the south, and particularly in London, cling to the use of smoky coal, and frequently waste money in altering the furnace and fittings to consume smoke before it passes from the oven. While there is, and rightly too, a statute to prohibit the excessive emitting of smoke in towns, there is no law to compel the use of smoke-producing fuel. How then, it may be asked, shall we heat our ovens? This problem, and others of more vital interest in the production of bread, the canny and matter-of-fact Scotch baker has solved years ago. And it is curious that the solution of "no smoke and yet plenty of heat" was discovered, not where fuel was dearest, but in Glasgow, I believe, in the heart of coal-fields. The bakers there and throughout Scotland find there is no difficulty, on the contrary, greater ease, cleanliness, and far less cost in heating ovens with smokeless fuel, and that fuel they find in perfection in gas-coke of fine quality. Whether the ovens of the future will be so heated, or by hot-air from a fire without the oven, or by air-gas burning outside or inside, remains to be seen. But before entering into details of these coke-heated ovens, I would like to make a few remarks on the experiments with a model gas-air oven at the Smoke Abatement Exhibition, South Kensington, before a deputation of master bakers. The substance of this letter has appeared in the *Miller*.

Practical bakers who have read the lucid report of Mr. Pringle will, I think, agree with me that these experiments are very inconclusive for or against the use of air-gas for oven-heating. My remarks, I may be permitted to observe, are founded on the report, and also an experience of seven years regulating oven heats with pyrometers, heating a number of ovens from a new and damp state, and the daily heating of a steam-press with air-gas three times the reported size of the model oven at South Kensington. Such experience being given for what it is worth, it seems to me, then, that the failure of the model oven to bake bread to the satisfaction of the deputation was mainly due to the want of several days' prolonged and thorough heating of the mass of lime and brick, and the low heat, on the day of the inspection, before the dough was put in. Those who have had experience of heating up new-built ovens know that three or four weeks pass of daily heating and working before the bottom crust is at all satisfactory. Even if the model oven had been heated daily for weeks before the 8th and 9th February, no other results, I venture to say, could have been obtained from the heats given in Mr. Thomson's memo. than those reported by Mr. Pringle. The model, it seems to me, has not got fair play. Lighting the gas supplying it on the 9th February, with 140 deg. left from the previous day, and putting in dough when the heat was 345 deg., was unskilful heating, and the heat too low. The oven should have been heated to 600 deg.—50 deg., allowed to cool to 350 deg., and the dough put in. When, for instance, our last batches of loaves are out on Saturday, the pyrometers show 340 deg. of heat left, and on the following Monday, before lighting, they have never been seen lower than 250 deg. An hour and a half after lighting they show 650 deg., when the batch is being put in 400 deg., while in 370 deg.—60 deg., and 350 deg. when withdrawn. These heats are for close-packed 4-lb. loaves, for open-placed crusty-baked loaves 50 deg. less would be.

Bakers, it will be observed from Mr. Pringle's report, are not the only men who work by rule-of-thumb. Knowing how reliable, cheap, and common Messrs. W. H. Bailey and Co.'s pyrometers are, it is surprising to read of scientific exhibitors using a mercurial thermometer to test the heat of an oven requiring to be heated over the boiling-point of mercury. And the effort to produce saleable or eatable pastry out of an oven at 320 deg., from which bread had just been withdrawn, deserved success but hardly comment. These are errors of manipulation, and might have been avoided by the employment of a practical baker skilled in oven pyrometer heats. But Mr. Pringle's report shows that the model has vital structural defects, in the admission of hot air by the roof only, and the want of indicated means of ventilation to carry off the waste poisonous products of combustion. This latter, in the underground, low-roofed, badly ventilated London bakehouses, would be a fatal objection. The experiments of numerous gas-air experts have long since shown that double the heat required by the baker can be got from non-illuminating gas. The difficulty, then, ventilation being provided for, lies in the distribution of the required heat. While the admission of hot air by the roof only to the small model might, by proper heating, be sufficient for it, it is difficult to see how a full-sized oven could be so heated to bake crumby bread. I am assuming that the sole of the oven rests on a solid bed. If the space beneath the sole is hollow, then the remedy will be found in a study of the structural details of the Paris hot-air ovens. These are more or less hollow, and the heat beneath the glazed tile sole, resting on a framework of iron, is kept up by hot air from chambers maintained continuously at a high temperature, and admitted by a damper or dampers into a network of hollow tubes. Several of these ovens will be found illustrated in "Cassell's Household Guide," Vol. III. Except in one instance, I am not aware that these hot-air hollow or cellular ovens have been used successfully for baking close-packed loaves. The instance I refer to, and I only write from report, is that of a bakery in Dunfermline, where one or more of these ovens, heated with hot air from the outside, are in use, and the sole is not stone, brick, or tile, but *iron*.

Meantime, and with an earnest wish for success to the inventors of the model oven to perfect the application of controlable heated air, and an apology should my foregoing remarks require it, I would beg the attention of my brother craftsmen to the accompanying working plan (Fig. 2) and section (Fig. 1) of a line of three gas coke-heated ovens. They are in operation in Dundee, where almost all the ovens are on the same plan and coke heated, as also in Edinburgh, Glasgow, and throughout Scotland.

FIG. 1. SECTION THRO A.B.

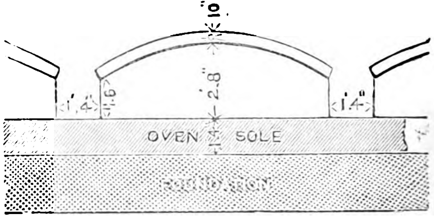
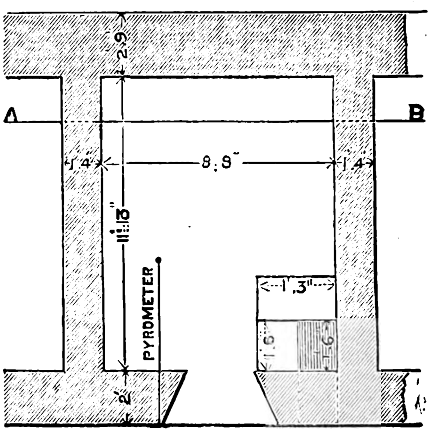


FIG. 2. PLAN.



A glance at the lower right-hand corner of the plan will show that apart from breadth in proportion to length, which is a matter of convenience for working and not indispensable, the main difference between these ovens and the usual coal-heated London oven is seen in the position of the firebars. These bars are, as shown in plan (Fig. 2), within the oven. In the usual coal furnace they are within the front wall, and not inside the oven. In these coke ovens the space where the coal firebars would be is a hollow or "blind furnace," a foot square, lined top, sides, and bottom with firebrick, into which any burning coke may be drawn before the batch is put in. Also by this blind furnace which is fitted with a special iron frame and outside door, the firebars can be cleared of clinkers, and new bars replace old ones; but coke is usually fed to the fire by the oven mouth. A sheet-iron fender circling the fire prevents the coke and ash from spreading over the oven. The ashpit is beneath the firebars, and has an opening from the outside front. And the vents, not shown in plan, over the oven mouth, and the blowing vent, opening within the oven, fitted with the usual damper, are the same as in a coal furnace oven. When a pyrometer is fitted it should be placed on the side furthest from the fire, a little lower than the top of the oven mouth. But this will depend on the height of the roof. If the roof is, say, 30in. at the highest above the sole, the pyrometer should pierce the wall at 15in. or midway.

The heating of these ovens goes on all night, and gives no work or trouble to heat in the morning. This to men working in the stifling and sickening heat of summer in underground bakehouses, where one or many ovens are being heated so fiercely that the furnace doors outside are often of a red heat, would be no slight boon, to say nothing of the time saved, and the lighter work to those who have charge of the oven. Sufficient coke is put on in the afternoon before leaving off work, and the door left slightly open, or the door shut and the damper withdrawn a bit, and the coke burns slowly down to an impalpable dust, leaving the walls and roof as white as chalk. A clean out with damp scuffle (swab on end of long pole) is all that is required to prepare the oven to bake morning rolls, another clean out, and the batch may be put in when ready. The heat then should be between 350 and 400 degs., and as the firing or heating has been slow it is deep and lasting, baking the full of the oven of close-packed 2lb. loaves in one and a-half hour, or 4lb. loaves in two hours.

At a very slight expense for a new and special furnace casting, with door attached and firebars to match, the present coal furnace, with the bars within the wall, will heat the oven with gas-coke. My ovens are so heated, and have the firebars within the wall. They were unfortunately built before I saw this plan with bars within the oven. The front walls are 2ft. 6in. instead of 2ft., the furnace 15in. wide and flush at the top with the roof of the ovens. The furnace-door casting enters in 8in., the firebars 1ft. 10in., thus the door casting and bars together are exactly 2ft. 6in., the width of the front wall. My ovens being wider and shorter than that in the plan, it is easier to feed coke by the furnace door than by the oven-mouth; we can either use coke, coal, or wood, but with coke alone, after lighting up with wood, we find no difficulty in the morning in heating the ovens as thoroughly as with coal. This presupposes coke of fine quality and kept dry. As it gives out an intense heat and the fire is so near the outside, I do not think it advisable to put on coke in the afternoon to burn all night. But were I to build again, it would certainly be as this plan shows. Gas coke costs 3s. 6d. per ton at Glasgow. A ton will heat one oven in full work for near three weeks. **W. A. Thoms, F.R.M.S.**

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[45809.]—**Lunar Craters.**—In reply to E. T. Scott, I would ask him to reperuse my letters 19086, p. 570, August 19, 1881, and 19463, p. 301, Dec. 2, 1881. We must accept the verdict of experts as to the almost total absence of air and water (as liquid), on the moon's surface. In cooling steadily she has shrunk and solidified (at the surface at least), and what I urge is this—as this cooling goes on, the later traces of moisture are gradually ejected from the somewhat warmer interior, causing the mist and haze seen by observers, and that after condensation it falls around the orifice in a circle to form a piled ring, and that as the moon cools more and more, the phenomena is less and less energetic in the main, and may end at last in simply causing mounds or lumps, while in former times, when the ejection was more copious and forcible, it formed vast walls or circles of mountains (condensed precipitate); solid matter, ejected at times in a rush, being piled close to the orifice, as in the central cones. The surface modelling of our earth is mainly due to sub-aërial and sub-aqueous erosion, and not due to precipitate piled up, except on our poles. The forms of our earth are easily understood, whereas the peculiar surfacing on the moon, at least as far as the craters and walled plains go, is unlike terrestrial forms, except volcanic. I take it that her peculiarity in this respect is due to an ejection (perhaps for ages) of the moisture from the interior, and its deposit on the exterior in the characteristic rings, and latterly lumps. Hence, also, the vapour and haze seen.—S. E. PEAL.

[45892.]—**Calorific Intensity (U.Q.)**—The problem is: Given a certain number of units of heat which would be given off from the combustion of 1lb. of fuel, say, olefiant gas, with the temperature of the gas before combustion, and the quantity of air necessary to consume the gas, to find the temperature of the products of combustion. Let us take as an example the fuel mentioned—namely, olefiant gas, and set out the facts which will form the basis of our calculation. The formula of the substance in question is C_2H_4, and it contains 24 parts by weight of carbon combined with 4 of hydrogen, or, expressed centesimally, 85·71 of the former to 14·29 of the latter. The units of heat evolved in the combustion of C_2H_4 are, in round figures, 12,000 (11,858, Favre and Silbermann; 12,030, Dulong); in other words, the heat evolved by the burning of 1lb. of olefiant gas would raise about 12,000lb. of water from 0° C. to 1° C., or (although in strictness it is not a fair deduction), 1lb. of water from 0° C. to 12,000° C. The products of the combustion are carbonic acid (CO_2), and water (H_2O). Carbonic acid is produced by the combination of 12 parts by weight of carbon and 32 of oxygen, water by that of 2 of hydrogen and 16 of oxygen. Therefore, 1lb. of olefiant gas produces by its combustion 3·14lb. of CO_2 and 1·29lb. of H_2O, thus:—

12 parts of C oxidise to 44 of CO_2
1 ,, ,, ,, $\frac{44}{12}$,,
·86lb. ,, ,, $\frac{\cdot 86 \times 44}{12} = 3{\cdot}14$lb. of CO_2

And—
2 parts of H oxidise to 18 of H_2O
1 ,, ,, $\frac{18}{2}$,,
·14lb. ,, ,, $\frac{\cdot 14 \times 18}{2} = 1{\cdot}29$lb. of H_2O.

It requires (3·14 × 1·29) − 1 = 3·43lb. of oxygen for its complete combustion, which quantity is contained in 14·96lb. of air thus:—

22·92 parts of O are contained in 100·00 of air
1 ,, ,, ,, $\frac{100}{22{\cdot}92}$,,
3·43lb. ,, ,, ,, $\frac{3{\cdot}43 \times 100}{22{\cdot}92} =$
14·96lb. of air.

This air contains 14·96 − 3·43 = 11·53lb. of nitrogen. The specific heat of carbonic acid is 0·2164, of steam 0·477, and of nitrogen 0·244. That is if a certain amount of heat is necessary to raise a given weight of water through one degree C, only ·2164 of that heat is required to raise the same weight of carbonic acid, only 0·477 of it to raise the same weight of steam, and only 0·244 of it to raise the same weight of nitrogen through the one degree. Now to our calculation. We start with a heat-proof vessel containing 1lb. of C_2H_4, together with 14·96lb. of air, all at (say) 0° C. After the combustion we have 3·14lb. of CO_2, 1·29lb. of H_2O, 11·53lb. of N. Required the temperature. If CO_2, H_2O (steam), and N had each the specific heat of water, the answer would be (subject to a correction referred to later on) 1,000 / 15·96 = 752° C; but, unfortunately for the simplicity of our calculation, they have not. Remembering the meaning of the term "specific heat," it will be evident that if we multiply the weights of the products of combustion by the respective specific heats of those products, we shall obtain figures which represent, so far as specific heat is concerned, equivalent amounts of water. Our 3·14lb. of CO_2 are equivalent, then, to 3·14 × 0·2164 = ·68lb. of water, our 1·29lb. of steam to 1·29 × 0·477 = ·61 of water, and our 11·53lb. of nitrogen to 11·53 × 0·244 = 2·81lb. of water; or our 15·96lb. of mixed gas are equal in specific heat to 4·11lb. of water. We must, therefore, divide our 12,000 heat units (which, we remember, would raise 1lb. of water through 12,000° C.), not by 15·96, but by 4·11. On doing so, we get as answer, 2922, which would seem to be the temperature in degrees centigrade of the mixed gases in our vessel. But it is not, because at this high temperature the steam produced in the experiment remains as such. The 12,000 units of heat are only evolved where the steam is permitted to condense; where it is not so permitted, as in the present instance, this figure must be reduced by the value of what is usually called "the latent heat of steam," or, in other words, the heat absorbed in the mechanical work of transforming water at 100° C. into steam at the same temperature. The "latent heat" of a pound of steam is equivalent to the heat required to raise a pound of water through 537° C. As in our experiment we have 1·29lb. of steam, the heat latent in it would, if used in raising the temperature of a pound of water, do so to the extent of 1·29 × 537 = 692·73° C. Deducting this figure from our 12000, we get 11307·27; dividing this, as before, by 4·11, we obtain 2751, which is the temperature required. If we had started with any temperature other than zero, our final temperature would have required correction by that amount. I have given the steps of the calculation in detail; but, in actual practice, such questions are worked by formulæ. For the case of a compound of carbon and hydrogen burned in atmospheric air the formula is:—

$$I = \frac{kc + h\,(k' - 4833)}{c\left(\frac{11}{3}s + 9\,s'\right) + h\,(26{\cdot}63\,s' + 9\,s'')}$$

where I = calorific intensity of products of combustion expressed in degrees centigrade, k = calorific power of carbon expressed in units of heat evolved, c = weight of carbon in reference to any unit, h = weight of hydrogen in reference to the same unit, k' = calorific power of hydrogen also in units of heat evolved, s = specific heat of carbonic acid, s' = specific heat of nitrogen, s'' = specific heat of steam. It will be seen that it is unnecessary to determine experimentally the calorific power of the particular compound under investigation; it is the sum of the calorific powers of the constituents of that compound, and these latter are, therefore, used in the formula.—ALFRED W. SOWARD.

[45907.]—**Automatic Musical Instruments.** Since my reply on p. 12, I have discovered that the publication of Needham's design, on p. 514 of this paper for Aug. 2, 1878, was preceded by a picture of the McTammany organette in Frank Leslie's paper for July 13, 1878. The organette is there represented as being worked by the feet of the inventor, who is also playing the violin. The instrument is one of the large size, blown by ordinary pedals, and a party of ladies and gentlemen are present. The patent, I believe, dates from the caveat, which was filed some time in 1876, whereas Needham's was not filed until 1877. I hope that information may be of use to "Nun. Dor." I see that "A. S. L." claims to be the first to combine reeds and perforated paper, which may probably be the fact, but I gather that he used *pressure* bellows, which sufficiently accounts for his indifferent success. Had he tried the suction principle, he would have succeeded. McTammany's instrument uses springs and levers with pins to enter the perforations, and is made with reeds or pipes (the latter being called melopeans). The orguinette illustrated on p. 105, No. 733, shows only one of the forms patented, and its name indicates that it is not altogether an original production—org*u*inette would not have been used had "organette" been available.—GRAY'S INN.

[46127.]—**Snails.**—There is a kind of slug or shelless snail which used to be considered good for lung-diseases. It is a sort of silver-grey colour, very smooth and tender, and seldom more than about an inch long, and is called in Ireland, "Drouktheen." I have known people who would swallow them like oysters as fast as they could catch them, and considered them very beneficial to weak lungs. Another way of using them was to put a lot in a cup, and put powdered loaf-sugar on them, when (if the right sort) they will melt entirely away, turning into a syrup, which is then taken, and to which used to be attributed all the virtues, and more, which are now claimed for cod-liver oil, which seems to have superseded it. I have not heard of it for a long time, but forty years ago or so many believed in it and used it.—G. J. H.

[46161.]—**Pumping to Pressure.**—I cannot, unfortunately, refer to the number containing the particulars you gave of your case; but, if you will advertise your address, I will do my best to help you all I can.—LABOR OMNIA VINCIT.

[46210.]—**Wheatstone Bridge.**—"R. P." says "lead wire from between the two 10-ohm coils to E." Surely this is wrong. Should it not be led to battery contact C? Will "R. P." give dimensions of his astatic galvanometer.—A. A. W.

[46218.]—**Solder.**—An easy-running silver solder is made of fine silver 1oz., shot copper 6dwt. 12gr., and spelter 2dwt. 4gr.; a common solder is made of silver 20, shot copper 12, and spelter 3 parts. The spelter should be as pure as possible.—G. S. H.

[46241.]—**Slate Roof.**—The answer to this question would appear to be because the rule has been found to give an accurate result. Where is the rule given? There should be an explanation, which is probably that part of the weight is taken up as thrust.—B. F.

[46260.]—**Railway-Brake Formula.**—How can such formula be devised? The distance run in feet in a given time must vary to a certain extent with the speed, and also with the condition of the rails; similarly if distance is known, you must have the speed before you can find the time, and then only approximately.—NOT A DRIVER.

[46273.]—**Making Small Tin Goods.**—The goods referred to by "C. R. K." are stamped up, and cannot be done with simple tools: machines and power are required.—NUN. DOR.

[46283.]—**Timber.**—Laslett's "Timber and Timber Trees, Native and Foreign," Macmillan and Co., would suit, I think, though if I recollect, it does not give prices. Mr. Laslett was Inspector of Timber to the Admiralty for many years.—NUN. DOR.

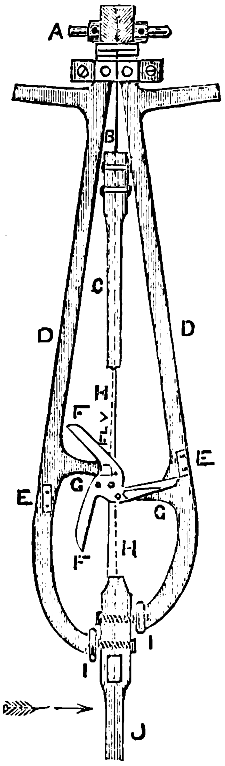
[46296.]—**Harmonium or Organ.**—I noted the query of "Beta," and his appeal to myself, amongst others, but have been unable to reply before. I am glad to see, however, that he has received some excellent replies. I suppose his instrument has the ordinary 10in. keys, and the question is, How to add two rows of reeds—a question which is complicated by the fact that the instrument has a sub-bass. The best plan would, I think, be to sell and begin again; but as that is not the question, we will see what can be done. I should not think of reversing the A. O. reeds and putting them under pressure of wind; but I see no reason why a harmonium pan should not be fitted at the back, if your correspondent will sacrifice the sub-bass. The harmonium reeds will need a good deal of smothering up; but there is no difficulty about that, and the only thing that would be any trouble would be making the double pallet action throughout the register. I presume the sub-bass is worked by the double pallet. The touch would be the same then over all the keyboard. The harmonium pan would be simply inverted where the sub-bass is now, and might be screwed to the soundboard or let into it—sufficient room for a 4in. pallet being all that is required. The "slot" in the soundboard would thus be 4½in. wide, and 33in. long. Leather round edge and secure pan by means of screws and hooks. What would in a harmonium be the well of the pan is thus open to the air; that would be boxed in, and would contain the valves admitting wind to the registers, and the stop-action would be simple. I see no reason why that should not be done; but I do not advise it, for unless the harmonium reeds are filed down they will take an awful lot of wind, and here a prime question comes in—How large are "Beta's" bellows, or can larger be put in the case? Assuming there is no difficulty on that score, the main point is to see that nothing is done to render it difficult to get at the back row of existing reeds. An additional A. O. tubeboard might be planted vertically at the back, or if balance-keys were used, inverted over them (which is, I think, best, as it leaves all clear below for getting at the reeds, and, according to size of case, gives opportunity for producing effects which are not to be had from reeds mounted on one soundboard), as I suggested to "A. H. D.," on p. 501, Vol. XXXII. By the way, it would be interesting to hear how that gentleman is progressing with his instrument; he had harmonium reeds on an exhaust wind. The long keys are not absolutely necessary, if you conclude to use another A. O. tubeboard, for a frame can be made with bent wires to depress the plungers of the additional rows, or push them up, as the case may be; but this frame must be made readily removable, and may be impossible if your stop-action is anywhere else than at the ends of the rows.—Organon.

[46320.]—**Motor.**—In view of the difficulties, I am not sure that a powerful spring would not be best. A weight would need to be either very heavy or to have a fall of many feet. If light, therefore, I hardly think, for a portable machine, that it would answer. I have also thought of compressed air; but would the pumping the air-chamber be inadmissible?—Sunlight.

[46329.]—**Chromate of Calcium.**—To "Analyst."—I would be glad of your information. I want it for battery purposes, and would like to make about 14lb. at a time. It is stated in Sprague's "Electricity" as $CaCrO_4 = 156$.—W. P.

[46368.] — **Clock.** — I once had "Anxious Amateur's" difficulty with an American clock. Try unscrewing the winder the wrong way (apparently)—*i.e.*, to the left instead of right. In my case this unfastened the winder; the hand-setter is held on by friction only; pull straight and hard, and it will probably come off.—Calne.

[46381.]—**Three-Legged Gravity Escapement.**—To "Alfojoe."—I send a sketch and description of a three-legged gravity escapement, which is almost a literal transcript from a book on clocks, by J. W. Benson. This illustration represents a regulator-escapement as it would appear in a front view; the pallets are lifted by the three central pins. The locking-teeth vary in size, from 1in. to nearly 2in. The horizontal pieces projecting from the top of the pallets form the adjustment for the arc of the pendulum. The great advantages possessed by this escapement over all other gravity-escapements, &c., are as follows:—1. It requires no oil. 2. The angle of the detent-planes reduces the friction to almost nil. 3. As the impulse and the unlocking are in one direction, the escapement is unlocked without recoil of the impulse arms. 4. No impending force to the pendulum from inertia of impulse-arms. 5. The hold in the stops can be increased or diminished to any practical extent by reason of the inverted impulse-arms. 6. Less affected by any disturbing forces of the train in proportion to the pressure on the stops. 7. Will bear more weight and give more power to the train without increasing the arc of oscillation. 8. No possibility of tripping under any increase of motive power. 9. The minimum arc of vibration to unlock is eight-tenths of a degree. Other escapements of similar construction require from 4 to 7°. 10. Take less weight for the motive power in proportion to the difference of pressure and draw on the lockings. 11. Is unlocked by gravitation, instead of by the pendulum, and at the time of impulse. 12. Requires neither fly nor remontoire, and so reduces the weight of the motive power by about half. 13. The impulse giving motion to the pendulum increases as the force of gravity on the pendulum decreases. A great advantage over those escapements in which the unlocking is done by the pendulum when its momentum is nearly expended, and at the extremity of its arc of vibration. 14. The angle of the detent-planes can be set so as not only to offer no resistance to the unlocking, but to give an actual impulse in the same manner as the impulse pallets of a dead-beat escapement. This completely frees the impulse which gives motion to the pendulum from any retarding influence of the train. 15. The arc of vibration is more equal in this than in any other gravity escapement. 16. It is not so liable to stop in consequence of a diminution of arc from the variation of motive force in the train. 17. It will answer for regulators as well as for turret clocks, its arc of vibration being from 1° to 3°. There is another form of this escapement called the double three-legged escapement. In general principle, it is much the same as the single. There is this difference: that there are two locking-wheels, acting on opposite sides of the pendulum, with one pallet only on each side, so that the locking-wheels act alternately. There are several minor advantages claimed for this form of escapement, which I need not enumerate here, as it is beside the question. Explanation of reference letters in illustration:—A, support cross-bar; B, suspension spring; C, pendulum rod (portion); D, frame (adjustable); E, pallets; F, three-legged locking-wheel; G, impulse arms; H, rod extension; I, adjusting screws; J, rod extension; arrows indicate present motion.—Alfojoe.

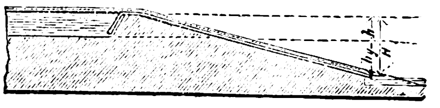


[46422.]—**Organ.**—You simply require another beam, with splayed backfalls under your present one, and made to rise and fall. The second beam must, of course, be splayed to the octave. It may be attached to the key by a second sticker, or, if you have not room for that, by a block on the present one. Mind that the coupler only pulls down the pallet, and not the key, or else it will play all the octaves up the keyboard.—Journeyman Organ Builder.

[46433.]—**Potato Disease.**—As an Irishman who is now putting down his thirty-second crop of potatoes, I hope I may venture to supplement Mr. Adam's answer, which is quite correct as far as it goes. I open my drills from 28in. to 30in. wide, according to kind of potatoes—thirty for Champions. I put the farmyard manure in the drill and lay the potatoes, or cut setts on it, then, when the plough has gone one way and half-closed the drill, I have the mixed kainit and other artificial manure spread along; it thus does not come in actual contact with the potatoes, and when the plough comes back on the other side and finishes the drill, it is mixed in the earth in the middle of the drill. It is a very general practice to put the potatoes under the farm-yard manure, but I find it better to put them over if the drills are made large enough and opened deep. I find nitrophosphate (Hill's) much better for potatoes than any superphosphate, and now always use it mixed with the kainit. I also found phospho-guano, if good, better than superphosphate, compared by money value, of course. Well rotted manure certainly is the best for any crop, and bulk for bulk, of course, is much more valuable than fresh made; but if a corresponding quantity of the latter is given to them, I have no hesitation in saying that there is no crop in either field or garden in which it makes so little difference to have the farmyard manure well rotted as potatoes, and I know many experienced farmers who say that if they really get a corresponding quantity of it they will be actually better on fresh-made manure, but the bulk of farmyard manure reduces so much in rotting that well-rotted manure is always apt to be given really more liberally than the other. Of course, in speaking of fresh-made manure, I mean that it should be properly made under cattle, made up in a compact solid heap, or better still, pit, and not left exposed to wind and weather; if the weather, while it is being made, is very dry, it should be moistened with water from a barrel or water-cart, and never be let get dry. Loose, dry, unrotted sops, put into a drill, are of course nearly valueless.—G. J. H.

[46437.]—**Soda-Lime.**—If the soda-lime is required for the determination of nitrogen in manures, &c., the following method may be employed:—Take equal weights of slaked lime and Na_2CO_3, and mix well. When it is required for use, heat sufficient in a porcelain basin, and allow to cool. When heated with this, nitrogenous substances give up all their nitrogen in the form of ammonia. The substance is so readily prepared that it is best not to attempt to use it again. "Agricola" will find full directions for analysis of soot in Fresenius's "Quantitative Analysis." Before choosing a balance he had better get catalogues from good dealers (Jas. Wooley, of Manchester; Townsend and Mercer, Bishopsgate-street, London, &c.—Magnus.

[46449.]—**Underground Siphon.**—To give the discharge of water by a siphon, it is necessary to know the differences of level between the surface of the water in the pond that has to be drawn from and the discharging orifice of siphon pipe. Supposing the pond to have a continuous supply of water, and equal to that discharged by the siphon, the level will then be constant. But if the pond has to be drained, the levels will vary; so will the quantity discharged vary. Now, if the descending pipe has a length of 300ft., and an inclination of 1 in 4, the horizontal distance will be 291·60ft., and the vertical fall 72·90ft. By my formula a pipe of 2in. bore, at an inclination of 1 in 4 (long pipe), will discharge at a velocity of 586ft. per minute, and a 2in. bore pipe contains approx. ·133 gals. in a foot of its length. Therefore, the discharge in gals. is 77·938 per minute.

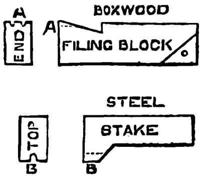


v = velocity of flow in feet per minute.
d = diameter of bore of pipe, in inches.
R = ratio of inclination = $\frac{L}{H}$

$$v = \sqrt{\frac{690{,}000 \cdot \times d}{R}}$$

I checked off my figures by "Box's" formula, and made it 75·342 gals. per minute, a difference of about 2·50 gals. per minute. I will leave it to you and others to say which is right. There is one other matter to be considered; that is, the length of the ascending pipe from bottom of pond to the top of siphon; this cannot, in any case, exceed 34ft., vertical height. The inlet aperture or mouth should be made as near as possible the true "vena contracta," so that the entering water may flow therein with as little friction as possible and unimpeded. The friction of the water, in passing through the ascending pipe, will, to a certain extent, retard the flow in the descending pipe.—Tubal Kain.

[46457.]—**Jewellery Repairing.**—To remove old rivets from brooch-joints, file off burr from small end, place large end on tool (illustrated below), with pin over groove, B, and drive out with punch or joint-pusher and hammer. Holes in new pins are opened by means of joint broaches, to be bought at any jewellery material dealer's. Repointing is managed by placing pin in pin-tongs or hand-vice, and filing same whilst revolving towards you in a groove, A, of filing block (shown below). Hard soldering is much to be preferred to soft soldering in almost every case, but soft soldering is quicker and the articles require less cleaning after. To hard solder, clean the parts to be joined, also solder; place on a piece of charcoal, cover joint and solder with powdered borax and water mixed to a paste. Heat with spirit-lamp and blowpipe (not blowing too hard at first), until solder has run evenly to every part required; when set, dip in water to remove superfluous borax, which would otherwise cause some trouble in removing. The silver solder you had better buy ready for use. Joints and catches you can buy in great variety to suit different purposes at the material dealer's. Any other information will be gladly given by—C. M. R.



[46460.]—**Tortoiseshell.**—If the tortoise is buried in the earth for about two months and then taken out and cleaned, all the soft parts of the body will come away readily. A brother-in-law of mine has repeatedly adopted this plan with success. The shell may be polished by any of the modes in use among horn or bone polishers. All loose epidermis must be removed, and rough uneven parts rubbed down or scraped. Finish off with fine sandpaper, followed by rottenstone and oil, with plenty of friction.—Alfojoe.

[46463.]—**White-Lead.**—I am afraid that Hugh Tunnadine has fallen into error in his answer to this query (p.111). He says: "If, on the addition of a small quantity of sulphuric acid to some of the white-lead you perceive effervescence, you may be sure it contains something which ought to be absent." So far from this being the case, one may be sure that if the addition of a small quantity of sulphuric acid to a sample of "white-lead" produces no effervescence, there is something absent which ought to be present, namely—white-lead itself. The substance in question, when in its pure state, is a hydrated carbonate of lead; but as met with in commerce, it is commonly adulterated (and often, to a large extent) with sulphate of barium, sulphate of lead, lime, and chalk. There is no simple "rule of thumb" method of testing the purity of white-lead; but if "Creta" has the means of performing an analysis, I will tell him how to proceed on his inserting another query.—Alfred W. Soward.

[46465.]—**Midland Bogie-Carriages.**—The longest bogie-carriages are 54ft. in length between ends of frame. In 1876 the company possessed 68 bogie-carriages—25 Pullman drawing-room cars, 11 Pullman sleeping cars, and 32 bogie carriages—all of which are carried upon two 4-wheeled bogies. The working of these was found so satisfactory that a number of 6-wheeled bogie-carriages were ordered. These are the largest yet constructed. I give a few dimensions, since they may interest some of your readers:—

	Ft.	In.
Total length of frame	54	0
Width over panels	8	0
Width outside steps	8	6
Width of bogie frame	6	6
Distance from centre to centre of bogies..	36	0
Wheel-base of each bogie	10	6
Dia. of bogie-wheels	3	7

Three first-class compartments to hold 18 passengers, four third-class compartments to hold 40 passengers, and one luggage compartment. The centre of the roof is raised above the level of the outside and fitted with glass panes, affording additional light and ventilation. The latest carriages, however (1878-1881), are four-wheeled bogies without the raised roof, all built at Derby. The Scottish Joint Stock (M.S.J.S) possess 30 bogie-carriages (10 six-wheeled and 20 four-wheeled bogies). The six-wheeled bogies have not the raised roof.—Meteor.

[46481.]—**Boiler-Pump.**—I am much obliged to "Was-Heil" for his information, but he does not go far enough. He says I shall require to find how full the pump is at each stroke. I should esteem it a favour if he would tell me how to find this.—Slocum Podger.

[46489.]—**Bicycle-Making.**—I beg to tender my thanks to "Sunlight" for his answer to the above, and in reply to his question as to what parts I want information on, I venture to ask him for a few hints on the fitting of wheels; as, according to his opinion, I have not gone the right way about it. Having purchased everything except bearings in the rough, the hubs not being drilled, would it be possible to drill them in a lathe, and if so, what will be the best way to hold them to insure the holes being at the right angle? In fitting neck in backbone, I have made a fair fit, but find that the centre is not at its right angle, as, when it is adjusted in head, the back wheel will be some 6in. behind front. To remedy this I shall have to file neck to fit at a different angle in backbone, in which case it will fit rather loosely. Will brazing hold it sufficiently, or will it require pin? I would rather do without pin, if possible. I may mention that I do not intend to do the brazing myself, but to get it done by a practical man.—An Amateur.

[46493.]—**Lathe.**—Do you mean to cut off square bars, or to turn them? Have you a lathe already, or do you wish for sizes, &c.? as I fail to quite grasp your meaning. The size of back-gear would depend on the size of the head-stock, and the size and weight of fly-wheel and the height of centres. Would a 4½in. or 5in. centre lathe suit you?—Sunlight.

[46497.]—**Fortified English Cities.**—Taunton, Tiverton, Exeter, and Barnstaple were at one time entirely surrounded by walls, and stood sieges in Cromwell's time. The time of dismantling cannot be fixed, as they fell into decay and were removed bit by bit. The walls of that unique city, Chester, are still standing, and it forms a pleasant walk on the top of them around the old portion of the city. —Working Tom.

[46498.]—**Cement for Glass.**—Use Canada balsam, which can be obtained at any artist's colourman. This is used by opticians to cement their lenses together, and is perfectly transparent. —Peganredstuff.

[46498.]—**Cement for Glass.**—Try Canada balsam or clear glue (gelatine), to which has been added a small quantity of bichromate of potash. The latter soon loses its yellow tint, and becomes unaffected by damp when exposed to daylight.—W. T. B.

[46498.]—**Cement for Glass.**—I should advise as the cheapest and easiest made the following:—2 parts common black pitch and 1 part guttapercha, melted and worked together till mixed; or two parts shellac, 1 part Venice turpentine, melted together. These would want using warm. They are both impervious to weather influences. Marine glue would also effect your purpose, though more expensive—recipes for which you will find in back numbers.—Fellow Workman.

[46499.]—**Lathe.**—The proper and only way to fix the wheel on the crank-shaft is to get the wheel bored out so that it will just slip on the shaft. If the shaft be a square one, then my advice is to get a collar shrunk on the square shaft. Have this turned down and the wheel-boss bored to fit it. Then cut a keyway in the wheel-boss, and a keybed on the shaft. The shaft itself may run in either centres or bearing; but you should see if it is made to run in centres; if so, the ends will have a piece of steel welded in, and a countersunk hole in it for the centre. The shaft end and centre must both be dead hard. If your shaft has not centre ends already fitted, I should prefer to run it in bearings, and for these antifraction metal is very good.—Sunlight.

[46501.]—**Exposure of Gelatine Plates or Films.**—"Beginner" must measure the aperture of lock of his stops and square their diameters. The products will give their relative speed, thus: suppose the full aperture to be 6-8in. the No. 5 stop to be ⅝in., and the No. 1 2-8in. in aperture. The relative speed will be calculated thus: 6 × 6 = 36, 5 × 5 = 25, 2 × 2 = 4. No. 1 will take nine times the exposure of the full aperture, No. 5 one-third longer. "Beginner" will find in my "Filmographic Manual" a number of suggestions regarding exposures on different subjects, which are of value to beginners.—A. Pumphrey.

[46503.]—**Jamming of Tapered Journals.**—The taper shown by "Glatton's" diagram is far more than I used in lathe-mandrels when manufacturing such. The angle should be as small as possible, because the larger diameter wears soonest, and in order to prevent the sticking of the cone, a shoulder is provided.—J. J. A., Liverpool.

[46504.]—**Air and Steam.**—If two vessels are filled, one with steam and the other with air, both heated up to 248° Fahr., or the pressure of two atmospheres, and connected by a tube fitted with air-tight cocks, and the communication between the two vessels opened, supposing that no heat is lost by radiation, the pressure in the vessels will remain the same as before the communication was opened. Secondly. If there is no loss of heat, there will be no condensation of steam. Thirdly. If the mixture of hot-air and steam at 248° Fahr. was compressed to say one-third of its volume, there would be no condensation, supposing there was no loss of heat; that is to say, if you keep a regular heat your steam stands at the same pressure, and if your steam stands at the same pressure, it is an impossibility for it to condense, because, as your steam begins to condense so the pressure begins to decrease.—Snowball.

[46507.]—**Wax.**—Paraffin wax is colourless, and will not damage the most delicate colours; but it is doubtful if wax is better than a flexible varnish for a fabric.—W. T. B.

[46509.]—**Analysis of Soils.**—"High Farmer" should procure Church's "Laboratory Guide," published by John Van Voorst, Paternoster-row. It contains a vast amount of information on analysis of manures, soils, and agricultural products; but, as an amateur in agricultural chemistry, I often find the processes too condensed to be easily understood without a teacher. With its assistance I have of late made considerable progress in "agricultural analysis," and can safely recommend it to "High Farmer" as a trustworthy guide. Whilst on soils, allow me to ask if any of "ours" can inform me where I can obtain an account of Professor Way's researches on the retentive power of soils, and how he produced artificially the double silicates of alumina and soda, alumina and lime, &c. I have, during the past winter, been experimenting on the power of soils to hold soluble phosphates, and found that a quantity of water equal to a rainfall of about 5in. washed out within 1 per cent. all the soluble phosphates added to the soil. In one case I obtained 12 per cent. more of monocalcic phosphate than I added. The soil, in this instance, contained naturally 3 per cent. of calcic phosphate. In carrying out these investigations, I filled a large-sized flower-pot with soil, placed the manure on the surface, added rainwater in small quantities at a time, and collected the drainage in a beaker placed below the pot. Can any of our chemists give me the results of similar experiments?—Agricola.

[46510.]—**Photography.**—The simplest, cheapest, and most reliable means to change dry-plates in the field is an opaque bag, with sleeves and indiarubber bands to pass over wrists, and two non-actinic apertures opposite each other, through one of which can be seen the necessary operations. The bag occupies little space, is light, and useful for many purposes besides that for which it is specially designed. All changing-boxes are expensive, liable to get out of order, and are a constant source of trouble and vexation. Hare's is the best.—W. T. B.

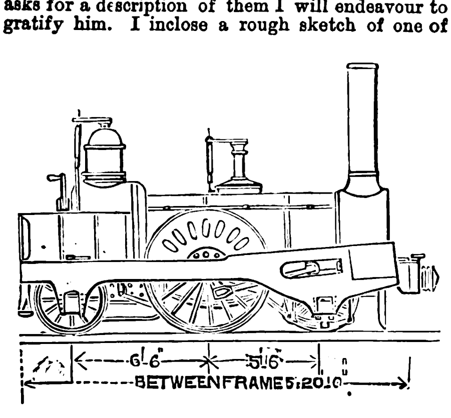
[46510.]—**Photography.**—Perhaps the plan I use, with complete satisfaction, instead of a changing-box, might suit "F. C." It is a bag of thickest black calico doubled. The front and bottom are kept rigid by cardboard. When not in use it collapses and occupies little space. There is a sleeve at each end wide enough to admit dark slide, box of plates, and my arm. Elastic bands round the ends of the sleeves keep them tight to my arms and effectually exclude light. There is a tape band at the top which goes round my neck, and the bag hangs level with my elbows. As I have to manipulate by touch, the backs of the plates are marked before going out, by gumming to each a small piece of paper, which is easily felt by the finger. With this I am able to change any number of plates when out for a day. The whole thing cost me about two shillings. If "F. C." wishes, I shall be happy to give further particulars as to shape, dimensions, &c.—W. H. S. W.

[46511.]—**Yellow Stains and Tin Dishes.**—Where the yellow stains do not arise from faulty plates, they can be removed by soaking in a saturated solution of alum, with two ounces citric acid added to each pint. A yellow stain sometimes is produced by allowing white light to fall on the negative before it is quite "fixed." Tin dishes well coated with black varnish may be used for development.—W. T. B.

[46511.]—**Stains on Gelatine Films.**—The dark colour of your negatives is most likely the result of continuing the action of the developer too long, possibly owing to the exposure having been too short; or the stains may have come, as often do, by washing between development and insertion in the hyposulphite solution: pass direct from the former to the latter to avoid the chance of stains. Tin developing dishes are quite as good as any other material; for the alkaline or iron development of gelatine negatives I have used them exclusively for twelve months.—A. Pumphrey.

[46516.]—**Caledonian Engines.**—The classes "Netherby" asks about are:—(1) 1 to 29, 6ft. coupled, cylinders 17 by 22. This lot comprises several sets which vary in date. Builders, Dübs and Neilson. (2) 30 to 41: Neilson, 1872, 7ft. coupled, cylinders 17 by 24. (3) 42 to 48; Dübs, 1874, 7ft. coupled, 17½ by 24. (5) 49 to 58: 6ft. coupled, Neilson, 1874, cylinders 17 by 22. (6) 59 to 64: 6ft. coupled, Jones and Potts, 1850, cylinders 15½ by 20; (7) 65 to 75 (originally to 76; 76, however, blew up at Carlisle, and was replaced by the first of the 8-footers in December, 1859): 7ft. singles, cylinders 16 by 20 (originally 15½ by 20), Greenock, 1855; (8) 76 to 87: date from 1859 to about 1864: 8ft singles, cylinders 17 by 24. (9) 88 to 91: St. Rollox, 7ft. singles, cylinders 17 by 22; built as main-line engines, but replaced in 1875 by the new 8-footers 113 to 116, now stationed at Carstairs. (92 to 97, and 103 to 107: Already described, vide last vol.)

98 to 102, and 108 to 112: 7ft. coupled, St. Rollox, 1867-8, cylinders 17 by 24; 113 to 116: 8ft. singles, St. Rollox, 1875, cylinders 17½ by 24; 117 to 122; 7ft. coupled, Neilson, 1868, cylinders 17 by 24; 123, 124: 7ft. coupled, Crewe type, Perth, 1869, cylinders about 17 by 22; 125 to 129: Bogie Express, 7ft. coupled, Neilson, 1877, cylinders 18 by 24; 130 to 139: 6ft. coupled, Dübs, cylinders 17 by 22; 294 to 299, and 306 to 309: 6ft. singles, cylinders 16 by 20, Perth, S.C.Ry.Co.; 300 to 305: same, but have no domes, Sharp Stewart, Manchester; 311: now broken up; was a Crampton engine, with 7ft. wheels, and cylinders 16 by 20, and belonged to the S.N.E.Ry.; 312 to 319: 7ft. singles (originally S.N.E.R.): built Vulcan Foundry Works, Warrington, 1866, cylinders 16½ to 17 by 22; 310: 7ft. single, similar to 88 class, by Barclay, Kilmarnock. These dates are the original, not rebuilt, dates. The number of tubes varies very much even in engines of the same classes. 88 to 91 class have from 144 to 160; 312 to 319 have from 150 to 202; 294 about 228; No. 305 about 188 tubes. I write this, because, when writing letter 19042, I did not think that they would vary to such an extent. A great many of 65—75 are scrapped. Yes, "Netherby" is quite right with regard to the old Greenock-built singles; their stroke was only 20in. As he asks for a description of them I will endeavour to gratify him. I inclose a rough sketch of one of those built by Taylor, Warrington (Nos. 10 to 15), the dimensions of which are as follows:—Cylinders, 15in. by 20in., stroke placed 6ft. centre to centre; steam ports, 1¼in by 10in.; exhaust ports, 3in. by 10in.; boiler barrel, 3ft. 6¾in. diam., 9ft 9in. long; tubes, 158, 1¾in. diam., and 10ft. 1½in. long; inside firebox, 3ft. long, 3ft. 6in. broad, 3ft. 8in. deep; carrying-wheels, 3ft. 6in.; driving-wheels, 6ft.; safety-valves, two, 2½in. diam., graduated to 90lb. pressure per sq. in.; extreme bearing, 12ft. 0⅝in.; rail to top of chimney, 13ft. 6in.



	Tons.	Cwt.
Wright (in working order) on leading-wheels	5	15
Weight (in working order) on driving-wheels	9	15
Weight (in working order) on trailing-wheels	3	10
Total	19	0

I will simply give the leading dimensions of some other classes. Nos. 33 to 38, 6ft. coupled; cylinders, 15in. by 20in.; Nos. 2 and 16 (afterwards 77 and 78) "Bloomers," cylinders, 9in. by 15in.; leading and trailing-wheels, 3ft. 1in.; driving-wheels, 5ft. 1in.; working pressure, 200lb. per sq. in. Older classes still belonging originally to the Glasgow, Paisley and Greenock, and also the Gamkirk Railway were then in use. Some of the former had 12in., other 13in. cylinders, and 18in. stroke, single driving-wheels 5ft. dia.; the cylinders were inside. The fastest train run by the old 6ft. singles was timed at over 51 miles per hour. That was from Edinburgh to Carstairs, 27 miles 37 chains, in 32 minutes. They however, seldom ran to time with that train, notwithstanding that it rarely exceeded 4 vehicles, or 22 tons, and was much oftener less. The line referred to is a very heavy one, the first 18 miles 33 chains being a continuous rise, including gradients 1 in 100, 1 in 115, 1 in 120, and even steeper, and the remainder, which falls towards Carstairs, is quite as steep. The express from Glasgow to Carlisle in 1849 was allowed 2 hours 40 minutes running home, five stoppages. The following was its running:—

	Miles.	Min.	Speed.
Glasgow, south side to Gushet Junction	—	2	—
Gushet Junction to Motherwell	12	20	32·7 m.p.h.
Motherwell to Carstairs ..	15	28	33·21 ,,
Carstairs to Beattock	34	52	39·23 ,,
Beattock to Lockerbie	14	20	42·0 ,,
Lockerbie to Carlisle	26	38	41·05 ,,

Coke consumed on this run with 7 carriages was from 11 to 14 cwt., according to the state of rails. In 1850 the 10.30 a.m. express was allowed 3 hours 22 minutes, five stoppages included, to run from Glasgow, Buchanan-street, to Carlisle, 105 miles, a little slower. If I have not given the dimensions fully enough that can be easily remedied.—Carstairs.

[46520.]—**Gas-Engine for Launch.**—It has been already tried. See remarks I made on the first attempt about 1½ year since. Subsequently a great improvement has been made. Now such an engine could be made that would be quite equal to a steam-engine. The chief difficulty is that of handling the boat, or, in other words, to manage the reversing, &c. The first launch had an arrangement fitted to it, so that by the action of one lever the screw-shaft was made to run, so that the boat went ahead or astern, or the shaft ceased to revolve altogether. But this was attended with several drawbacks: one was that, supposing the engine was driving the boat ahead, and it became needful to promptly reverse, it could not be done instantaneously, as although the screw-shaft would stop, still, the engine had to be slowed down, or the clutches would be likely to be smashed, as the shock due to suddenly coupling the shaft and fan, which would be at rest, or nearly so, with the engine perhaps going some 120 a minute, would be very great; therefore, it becomes imperative to slow the engines down to, say, a moderate speed. Recently, I have evolved the theory of a reversing-engine, so that the engine and shaft would be rigidly connected, except when the boat was stopped for a short time for any purpose; but that involves the application of an air-pump and chamber. Where the starting and stopping are not likely to be wanted at a moment's notice, then the first plan is far best, as the engines are always running and making their gas. As yet I have not given the question the time and thought I should like; but, suffice to say, that a gas-engine can be applied to a launch without difficulty, so long as momentarily stopping and starting is not needed. The gas-making arrangement is perfect, and water for the cylinder jacket would be, of course, drawn from the sea. There is one point that I would like, in fairness, to mention—viz., that the engine would be larger and heavier than a steam-engine of the same size. Against this fact we must, in equal fairness, mention the gain of weight due to no boiler being needed, and the space also gained from the same cause. I am fully certain that a little time will show the application of gas-power to marine propulsion on a small scale, and I believe I was the first who applied a gas-engine to such a purpose.—Sunlight.

[46530.]—**Rotary Water Motor.**—You would not get an economical rotary motor, neither could you get enough power without far more water than a ¾ pipe would convey. The only motor that would be economical of water, and yet give you the required power, would be either a "Haigh" or a "Megy," both of these being reciprocating forms utilising the full pressure of the water. The rotary forms do not do this, and, unless you can get permission to make a copy of one of the well-known reciprocating motors, I quite fail to see how you will attain your desired end. I would gladly help you in the matter; but have you, for instance, the necessary tools to construct a motor with, if you even had the necessary plans?—Sunlight.

[46531.]—**Yacht-Deck.**—I should consider yellow pine very good, as it is light, durable, and good in appearance if properly got up. As to width, I should advise 4in. well spiked down.—Sunlight.

[46531.]—**Yacht-Deck.**—Use yellow pine, as you have been advised; pitch-pine not so suitable, too heavy, hard to work. Size of planks about 6in. by 1in., edges to be grooved to take a loose tongue, put in with white-lead. The deck beams to be securely fastened to the hull timbers. To fasten the deck-planks, bore with a bit a flat button-hole, say ½in. deep, ¾in. dia., then drive in spike and fill up hole with a wooden plug; ¾in. good dia. turned edgeway of grain, dipped in thick white-lead paint, and plane deck all even when laid; but ends and places where likely to leak caulk in ordinary way. "Yachtsman" cannot do better than to get a shipwright apprentice to give him a hint or two on the spot.—Working Tom.

[46536.]—**Shaft.**—Do you mean that the pulley on the new shaft is out of the vertical line 30in.? If so, you will have trouble, and the strap is likely to keep slipping off. With pulleys with much rounding it might, with a light load in proportion to the transmitting power of the strap, keep on. But it would be a most unsatisfactory plan.—Sunlight.

[46536.]—**Shaft.**—Shaft will work properly with an open belt, the way "G. O. W." wants his shaft to run, and he can determine the exact position of the pulleys before fixing, by making a drawing to scale, say ¼ full size, and taking care when the belt leaves one pulley it makes direct to the face of the other pulley, and when it leaves the driven pulley it must be in such a line as to go direct to the driving-pulley. Note—there is only one place and position to fix the pulley, to keep the strap on; no guide-pulleys required. Let "G. O. W." prepare two pulleys of the size he requires ready for fixing. Fix up his shaft and put on his pulleys, but not as yet cut any key-ways on the shafts. Let him put the band on, having just tightened the pulleys, his shafts running empty for easy working; and if the strap does not keep on, send sketch to show which way he wants the shafts to run, and size of pulleys; if the strap keeps on, cut key-ways on shafts and tighten up.—Working Tom.

[46538.]—**Utilising Water Power.**—To "Sunlight" and Others.—I am sorry to say that I cannot hold out much hopes to this querist. The power is but the weight of the water multiplied by the vertical height, but less pipe friction also. A gallon of water is calculated at 10lb., therefore the gross power would be 1,050 pounds per minute. Deduct from this first friction of the length of small pipe, and then the loss due to the motor, and there is very little left. Motors of the class mentioned must be good to yield 60 per cent. useful effect, and most generally they range from 45 to 50 per cent. only. Allowing that a first-class one is used, but about 1-50th of a horse-power is obtainable, if we make no allowance for friction. The utmost, I believe you could possibly get, would be an available power equal to about 400 foot-pounds per minute.—Sunlight.

[46541.]—**Ants.**—Pour ordinary paraffin oil into the ants' nests and about their haunts. This will kill all there and disgust their visitors.—W. T. B.

[46542.]—**Broken Steam-Gauge.**—To "Sunlight" and "Jack of All Trades."—You may perhaps patch up your gauge with soft solder applied with a soldering-iron; but be careful to apply only sufficient heat to run the solder. Do not heat the tube more than necessary; then clean off the excess of solder, when the joint should show no sign of a line, which would be the case if the crack was not entirely filled up. A mercury gauge is easy to make, whether for pressure or vacuum. For which purpose do you require it? If for pressure, except for 20 or 30 pounds or so, it is a very cumbrous form of indicator. On hearing for which purpose you want it, I will, with pleasure, send you sketch of an approved and recent form of instrument.—Sunlight.

[46548.]—**Coned v. Grooved Pulleys.**—I take it your query should have been "Flat v. Grooved" pulleys; as such I will answer it. A grooved pulley transmits power for small purposes far better than a flat one, and as the strap does not need to be so tight, there is far less side strain. But to transmit large powers the sectional area and surface could not be increased to suit except at a great cost. There is another drawback with the grooved pulley also, and that is its inadaptability to be used with fast and loose pulleys. And it cannot be shifted from one groove to the other. A V-grooved pulley should have a V-shaped strap, the point being taken off, so that it cannot bend at the bottom. I have several of these in use doing far better than the round strap in the V-groove. I believe in this journal it was recommended to use a round section groove with the round belt. But that I take to be an error. Unless the belt fits the round of the pulley tightly, it does not transmit its power properly, and as it stretches in use its diameter gets less, and hence it drives on the bottom side only. A V-pulley and strap of same section does not get a bad fit by wear, as it wears equally downward, and it takes great wear to reach the bottom of the groove, and until it does the belt drives full power. I do not so much advocate the round belt in the V-pulley, as the surfaces in contact are not so ample. But a V-belt will transmit power better than any other form for small work.—Sunlight.

[46550.]—**Instantaneous Photography.**—All really good very rapid gelatine plates by reliable makers are sufficiently sensitive to be impressed by the exposure of 1-100th of a second. The labels attached to parcels of plates are often very misleading, and no makers' plates are always alike. Use a quick-acting lens of short focus, and alkaline developer, with a minimum of pyro and as much ammonia as the particular sample of plate will bear without fog; develop in a very subdued light. —W. T. B.

[46550.]—**Instantaneous Photography.**—There is a lot of nonsense talked about this class of work; every subject cannot be taken instantly at any time. If you have rapid gelatine preparations and you do not get your pictures quick enough, you may do a little by increasing the amount of ammonia in your developer, or even wetting the picture front with an ammoniacal solution. If this will not give you the speed desired, use a larger aperture to your lens. If that is not enough, use lenses of shorter focus, take small negatives and enlarge the positives from them.—A. Pumphrey.

[46555.]—**Induction Coil.**—The dimensions of primary given are about the same as in my coil which gives 8in. spark for about $5\frac{1}{2}$ miles of No. 36 wire. As you appear to have about 10 miles on, I think you should get a longer spark, though it is possible, as the wire is so fine, that the smaller quantity of electricity passing becomes dissipated in the brush discharge without forming a spark. I think it would have been better to have confined the secondary to about 6in. or 7in. of the middle of the primary, as the inductive effect there is much greater than near the ends. However, before doing anything more I should try a mercury-break. Put the present break out of action and join a thick platinum-tipped wire to the spring. Connect the contact-screw to a small quantity of mercury in a beaker, or other deep vessel, and cover with an inch or two of spirits of wine. If, on making and breaking the circuit by the platinum-tipped wire at the mercury surface you get a better spark, a permanent mercury break can be arranged, as in the description of my coil in No. 779. See also Nos. 782, 93, 97 for further particulars of coil. I have never succeeded with the platinum-brake, though others appear to make it answer.—J. Brown, Belfast.

[46555.]—**Induction Coil.**—A coil of your dimensions will require quart-sized Groves to get full effects.—J. F. Hewitt.

[46562.]—**Drying Gelatine Emulsion-Plates.**—I should recommend "J. G." to use a paraffin oil-stove, the combustion of which does not in any way injure gelatine-plates; and as to ventilation, a chimney let into the roof and provided with a cap to keep out light and wet would probably answer every purpose.—W. Robinson, jun.

[46563.]—**Washing Photographs.**—A siphon-trough, with sufficient pressure of water to keep the prints in constant motion, answers admirably, and will effectually wash them in two or three hours, provided the apparatus is not over-crowded.—W. Robinson, jun.

[46563.]—**Washing Photographs.**—If you refer to recent back numbers, you will find I described two forms of automatic photo. washers. One is a rotary one, actuated by the water supply itself, the other by a small bucket-wheel. Either of these would meet your requirement. And if you propose to be your own constructor, I shall be happy to furnish any further details you may find needful.—Sunlight.

[46564.]—**Organ.**—The front pipes of an organ should be of metal, if they are intended to speak. They should be of 8ft. pitch, open diapason, if the soundboard is constructed to receive them. In some small old-fashioned organs the front pipes (if pipes they may be called) are made of wood, in the form of an ordinary metal diapason, and then gilded. Such as these are, of course, only for ornament. In this case, it is rather difficult to advise, apart from a personal examination of the organ in question. It is necessary that the description of the instrument should be more detailed and explicit.—G. Fryer.

[46569.]—**Boiler.**—If yon have room enough, an egg or dish-end boiler, 6ft. by 2ft. would answer very well, with a good-sized grate for burning rubbish. You might be able to buy a good, second-hand one that would stand 10lb. working-pressure. If you haven't the room to spare, go in for a vertical boiler, 5ft. by 2ft. 6in.—Labor Omnia Vincit.

[46569.]—**Boiler.**—With 10lb. steam you could not get 300 a minute with a 3in. cylinder. Where is the friction to be dealt with? The pressure is so low that except under most extraordinary circumstances only could you get near to the speed you name, and a very light load would still further reduce the speed. I fear you are under a misapprehension also on another point, and that is, if the engine is not strong enough to stand over 10lb. steam, it surely would not endure being driven at 300 a minute. Therefore, you must, if the engine will not stand more pressure than 10lb., be mistaken in assuming it was constructed to run at a high speed. You may rely on it, that if it won't stand the pressure it will break down with the speed, even if it were attainable. I would, therefore, ask you what you propose to do, as I really could not help you as the matter stands. The best I can do is to give you dimensions of a boiler that would supply the needed volume of steam. But the speed you will not get, except you can carry more pressure. I am most pleased to help you if it can be done in a practical way.—Sunlight.

[46570.]—**Weight of Metal.**—Find the capacity of the ladle in cubic inches, and then multiply that by the decimal approximate ·263; the product is the weight (about) in pounds. Exact accuracy is not possible by this method, but the error should be but trifling either way. The constant ·263 is for cast iron; ·283 would give steel; ·3037 brass. Will this help you at all?—Sunlight.

[46570.]—**Weight of Metal by Measurement.**—Multiply the cube contents in inches by ·26 for the weight of cast iron in pounds, or use the simple rules given last year in reply to query 42517 in Nos. 825, 828, and 831. For crane ladles, which are always of cylindrical form, these calculations are convenient; but it is somewhat troublesome to find the contents of a hand or wheel-ladle by measurement, if it is like the convenient elliptic pattern which I have in use, or of any irregular shape, and, therefore, the practical method is to lay aside the castings and scrap from the first pouring, and weigh them; or, if it is desirable to know the capacity of a new ladle of this kind, before it has been used, it may be filled with water, and the weight of water multiplied by 7 (the approximate specific gravity of molten iron). I need scarcely add that before applying the water test the ladle must be lined with clay, as thick as the usual coating of loam; and, as the lining is a variable quantity, the capacity of the ladle will vary proportionately.—Oakland.

[46572.]—**Sound in Pipe.**—The noise is pretty certain to arise from condensation and back-suck of the water. If it be so, the remedy is to carry the steam-pipe into the tank with a bend well above the water-level. At the highest point an inlet-valve should be fitted, so that it falls to its seat by gravity. On steam being turned on, it is partly condensed by contact with the water. A vacuum is thus formed, which the valve would at once destroy, and so prevent the existing noise.—Sunlight.

[46574.]—**Photo-Bath.**—Although opinions differ as to the origin of the stains (commonly called "oyster-shell" markings) referred to, generally speaking, I think they will be found to arise from a disordered condition of the nitrate bath, a scum of reduced silver being formed on the surface of the solution, and a portion of which attaches itself to every plate that is dipped. Filtration, taking especial care that the filtering medium is thoroughly clean and free from impurities, will generally cure a new bath, and act as a temporary expedient in the case of an old one; but to effectually cure the latter, it will probably require to be rendered slightly alkaline, and to be "sunned" for a day or two, after which filter and acidify as usual. Endeavour also that as little time as practicable shall elapse between sensitising and development, and place some blotting-paper in the lower corners of the dark slide, to absorb the solution that drains from the plate. In very warm weather, or the nature of the subjects requiring a prolonged exposure, a sheet or two of damp red blotting-paper placed against the back of the plate is also of considerable service.—W. Robinson, jun.

[46585.]—**An Organ Smothered.**—It is evident, from the wording of this query, that "Unhappy Organist" knows the cause of the organ sounding as it does. To effect the cure, you must remove the cause. All that can be done, in such a case, is to remove the instrument to another part of the church where there will be greater *resonant* power, or a greater amount of space for the transmission of the sounds produced from the pipes. This, I believe, is the only cure. Many organs are ruined in tone and power by their being placed in chancels and other parts of the church where there is not sufficient room between the roof and the tops of the pipes. For this reason many organs have been removed from the gallery, and placed in the lower part of the church. The querist would do well if he were to study the science of acoustics.—G. Fryer.

[46591.]—**Adjustable Plane.**—It entirely depends on one or two facts. The first would be what the patentee of the one in the market claims in his patent. If you could tell me that, I could then better answer the question. A second fact is whether you could invent a plane that would do what you require, and yet not enroach on the claim of the patentee's specification. Then there is the question, Is the present plane patented in England, or only in the States. To make a copy of the existing tool, if it be properly protected in England, would be a direct infringement of the patent, and I should strongly advise you not to do so. The best help I could give you is that if you get a copy of the specification (if patented in this country), and submit it to me, I would then advise you whether it was practicable to make another form without infringement.—Sunlight.

[46593.]—**Automatic Musical Instruments.**—There is an organette manufactured which is blown by the feet, just in the same way as an American organ; but the music is produced by the same method as in the Orguinette, only on a much larger scale. This instrument, which may be obtained in London (one of which I have seen and heard) would, no doubt, satisfy the querist, as it is of greater power for the reason explained above. The sheets are stamped out by machinery. Being an American invention, I am unable to furnish a detailed explanation of the machine employed for this purpose.—G. Fryer.

[46594.]—**Heating Water.**—From the scanty particulars given it is not easy to give a satisfactory reply. As far as I understand you, I think you would do better to use the exhaust steam for heating the water. Fix a coil in the tank and turn the exhaust steam into it, and, if it does not interfere with anything else, take the outlet to the most convenient point. If the boiler is fed with cold water, you would save fuel by feeding it with the hot water from tank.—Labor Omnia Vincit.

[46595.]—**Patched Boiler.**—Make the patch to fit well on the plate first; then mix some good, red-lead putty. Put grummets under the heads of your bolts, and if you take sufficient care in putting it on it won't leak. For flanged steam-pipes, if faced, use red-lead; if rough, indiarubber washers.—Labor Omnia Vincit.

[46595.]—**Patched Boiler.**—In the first place, the patch does not fit on the boiler shell properly. This should be seen to in the first instance. I should make the joint with either a thickness of milled sheet-lead or with thin sheet asbestos. The former you can caulk into the joint, and so make it quite steam-tight. The latter on a fairly true joint will not leak. But in any case get the plate and the boiler-shell something like a fit.—Sunlight.

[46595.]—**Patched Boiler.**—"An Amateur" asks what packing should be used under a patch on a boiler? I think if the amateur follows these instructions he will have no more trouble with leakage. First, abandon bolts altogether, and use $\frac{5}{8}$ set-screws, countersink heads; first, drill two holes in patch, countersink nice smooth holes to fit set-screws with countersunk heads, all the better if turned up in lathe; drill two holes in patch, also two holes in boiler. Mind the screws work free in patch. When got nicely to fit, heat the patch red-hot, apply it to the place as quickly as possible, put in the two screws, and screw them up tight; then take a hammer and gently welt up the patch quickly, but not forgetting to screw it up tight. Let it remain till cold. Take off drill-holes every two inches, mark and drill boiler, but mind the screws all work freely in the patch. When fitted, take it off; and for packing, take some white-lead, mix a little red-lead with it to the consistence of soft putty; then take some cast-iron borings, hammer them as fine as possible, then mix with lead, and hammer all to the consistency of stiff putty; rub the boiler with a little oil and spread on the lead, screw on the patch as tight as possible, hammering all round, and when tight caulk round. I think if the amateur follows these instructions, he will have no more trouble with leakage. I put a patch on a firebox of an engine 16 by 10 over twelve months since, and have never seen one drop of water through it yet.—Cambridgeshire Boy.

[46599.]—**Photo. Portrait-Lens.**—Your lens is not properly corrected, or, in other words, it is not achromatic. No separation of the component lenses will achromatise it. You cannot do anything to it that will do any good, except it be sent to an optician to have it corrected. But this is likely to cost more than it is worth.—Sunlight.

[46601.]—**Object-Glasses.**—In reply to "Poor Amateur," I have failed to obtain any improved definition by the insertion of the plano-concave lens recommended by Mr. Arthur Hinde. I purchased it at a London optician's; it was made for me to order. Can Mr. Hinde inform me how I can test it as to its being made of flint glass, as I ordered it to be? A cheap astronomical telescope can be made with a plano-convex lens, 2in. diam., 6ft. focus for object-glass, and an eye-glass plano-convex of $1\frac{1}{4}$in. focus; this will magnify about 50 diameters, and is the highest power this length will bear. It will show Jupiter and his satellites, Saturn's ring, the phases of Venus, and the craters of the moon; but it will not take the whole of the moon's surface into the field at once; the object-glass will require to be stopped down to $1\frac{1}{4}$in. diam. for Jupiter and Saturn, and 1in. only to view Venus. I made one of this class and length some years ago: it answers very well, and I occasionally use it now, especially for looking at Venus. I very much improved it about 12 months since by adopting a compound Huyghenian eyepiece to it; this improved the sharpness of the image, and enlarged the field. The tubes are made of brown paper, similar to a rocket-case; an old cornice pole was used for the core of the larger, and a round ruler for the core of the smaller tubes. For further ideas as to fitting, study the articles on p. 535, English Mechanic, No. 881, contributed by "Aldebaran." The cost of the two lenses should not exceed 3s. 6d. I would not advise a "Poor Amateur" to make a longer one, at any rate to begin with, as if much longer it is so difficult to manage. My stand is made to screw by a pair of small clamps to the top sash of my bedroom window, which gives opportunity to raise and lower it; of course the sash should be wedged to keep it steady.—E. Y. J.

[46602.]—**Pendulum Spring.**—To "Nicholls."—You don't say in your query the make of the watch. If it be a watch like that one you did a few weeks since, you can get the size as before, and you should know about the strength. Hang it on balance and let it be about same strength as the other you put in, if watch be about same size and make. If you like to try the following it will be a little practice for you. Put hair-spring in about the proper size; if too weak or too strong, change it, and so on till you get the right one; but you ought to be able to select one, put it in, and regulate in about an hour comfortably.—NICHOLLS.

[46604.] — **Incandescent Lamps.** — Three quart Bunsens will not work a Swan lamp, which is a thread of carbon inclosed in a vacuum glass bulb; the incandescent lamps that work with three or four Bunsen cells are made with platinum iridium wire alloy, and are little better than platinum wire inclosed in a tube.—J. SUTCLIFFE.

[46604.] — **Incandescent Lamps.** — I have lighted Swan's lamps with batteries several times. With six Grove's cells the filament is just red. 25 to 30 cells are wanted to give a good light with one or two lamps. 50 or 60 cells light six lamps very well, and they give a better light than they usually do with dynamo current, that from the batteries being steadier. If the lamps are to be lighted for some time, it is best not to have all the cells in circuit at first, but to add them by degrees as the battery becomes weaker. By this means the light can be kept very constant for some hours.—JOHN HENRY KNIGHT.

[46606.]—**Back-Gear Headstock.**—First tell me, Have you a single-geared headstock already, and do you wish to convert it into a back-geared one? Or do you wish to make a new back-gear headstock? I would then tell you how to proceed. In the one case it is a question of adaptation—in which case I should want to know the size and length of present cone pulley, and the distance between the bearing inside the headstock, so that I might calculate the size and widths of the wheels that go on the mandrel.—SUNLIGHT.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last A. W. Soward has answered 45892.

45923. Brazing Bicycle Forks in, p. 522.
45930. Cupola Work, 530.
45956. Magnetic Variation, 530.
45959. Bourdon Pipes, 530.
45965. Musical Wire Gong, 530.
45974. Jute and Cotton, 531.
45981. Test for Oils, 531.
45987. Siemens Dynamo Armature, 531.
45988. Microscopical, 531.
45992. Compensating Expansion Balances, 531.
45995. Embossing and Gilding on Glass, 531.

46215. Stamping Ink, p. 625.
46219. Viola, 625.
46221. Calculating Watch and Clock Trains, 625.
46227. Ground Pipeclay, 625.
46228. Grinding Sandstone, 626.
46233. Magnets, 626.
46236. Watch Mandrel, 626.
46239. Movable Hand Drilling Machine, 626.
46244. Differential Calculus, 626.
46254. Parasol Rods, 626.
46264. Panoramas, 626.
46265. Dumbleton's Screw-Cutter for the Lathe, 626.
46266. Lathe Division Plate, 626.
46270. Jeweller's Plate-Glass Cases, 626.
46274. Process Printing, 626.
46275. Press Tools, 626.
46276. Newtonian Telescope, 626.
46279. Visibility of Nebulæ, 626.
46280. Microscope Stand, 626.
46287. Paper Box-Making, 626.

AT a recent meeting of the Société d'Encouragement, Paris, M. Dumas in the chair, Colonel Goulier brought forward, in the name of the committee of mechanical art, a new instrument invented by M. Cuvillier for measuring considerable thicknesses correct to 1-100 of a millimetre. It consists of a divided rule with two fingers, one fixed and the other movable. The former is cylindrical and capable of revolving on its axis but eccentrically, the eccentricity being a millimetre. After measuring the thickness of an object within a millimetre by the rule, the cylinder is turned until the piece is held tightly between the two fingers, and the angle through which the cylinder has turned gives the fraction of a millimetre making up the correct dimension.

THE Siemens "regenerative" gas-burner has been adopted for the purposes of lighting Holborn, from the Circus to Gray's-inn-road. In Holborn twenty-four lamps have been erected, the consumption of which ranges between 22ft. and 24ft. of gas per hour, with an average illuminating power per lamp of 130 candles.

QUERIES.

[46607.]—**Fuller's Battery.** — I have had this battery recommended to me as very constant. Will someone kindly describe materials used in making and charging? Is it fumeless—is it suitable for shocking purposes, and experiments with electro-magnets and induction coil.—C. M. R.

[46608.]—**Strength of Battery Current.**— Is there not a simple plan of testing the strength of current when used for shocking by placing a magnetic needle between some coils of insulated wire and marking the amount of deflection on a dial? Is this reliable? If not, can you suggest a simple and reliable plan?—C. M. R.

[46609.]—**Crystals of Sodium Carbonate.**—Can any of your readers inform me how the monohydrated crystals of sodium carbonate are prepared? Is it much used on the large scale? And is the process by which it is manufactured patented? I have seen Lunge's Vol. II., p. 276, on this subject.—W.

[46610.]—**Rheumatism.**—Will Dr. Edmunds kindly give the querist an opinion as to the benefit, or otherwise, of vegetarianism for a woman of 30 years of age, who is afflicted with rheumatism, but has never had rheumatic fever? And whether the use of the portable Turkish bath is calculated to eradicate this disease? The patient has taken a course of salicylate of soda—with apparently little benefit.—HUM.

[46611.] — **Tombstones.** — Would "Jack of All Trades" be kind enough to let me know what kind of black cement is used for filling in the letters on tombstones, and how to apply it?—DAVID MCKAY.

[46612.]—**N.L.R. Engines.**—To "METEOR."—I want dimensions and sketch of the newest type of the above locomotives, of inside and outside-cylinder types, having a cab in place of a mere weatherboard, and being also, I believe, of somewhat larger dimensions than the old ones. I have seen the sketch in Vol. X. of the "E. M.," but it is not what I want—being one of the old style.—E. E. R. TRATMAN.

[46613.]—**Organ.**— 1. Will Mr. Dresser kindly say what description of felt he uses for pallets, and how thick it should be? 2. Is the windbar fixed into the ends of the wind-chest and on to the soundboard bars with glue in addition to screws? 3. I wish to make of wood pipes the bass octave of the smallest of the three Open Diapasons, for which Mr. Dresser has supplied scales, and the CC of which measured 5½ dia. What scale shall I use in wood? 4. What kinds of wheel-runners are best for an organ of 8 stops—metal or wood—and how fixed?—W. C.

[46614.]—**Tricycle.**—To "SUNLIGHT."—What is the reason that tricycle cranks are all made direct angles? Would it not be better to set them at right angles or triangles? If made the latter, they would always start without assistance. Would they require a balance-weight if made at triangles?—EX.

[46615.]—**Western of France Railway.**—Can Mr. Gobert, Mr. Clements, or other correspondent, favour me with sketch and detailed dimensions of the express engines, with tender, which run on the Chemin de Fer de l'Ouest from Dieppe to the St. Lazare station, Paris, and also ditto of the Chemin de Fer du Nord?—E. E. R. TRATMAN.

[46616.]—**Leclanche Battery.**—Having purchased three improved Leclanché cells (without porous pots) and connected them as directed, zinc to carbon, I find that in two days the zinc in the cells in which the carbon forms the copper pole gets quite black, whilst the others remain bright. Will W. J. Lancaster, or some other electrician, tell the cause and remedy?—ODD FELLOW.

[46617.] —**Sewer Gas.**— Can any reader of the ENGLISH MECHANIC suggest a simple mode of testing whether sewer-gas is forcing its way into a house through closets or bath-drains?—C. G. N.

[46618.] — **Connecting Bourdon Stop with Pedals** —Will "J. D.," "An Adept," or some other of our contributors, kindly favour me with the best plan for connecting a bourdon stop (placed at the back of a small organ) with the pedals? The pedals are now connected with the Stopped Diapason by the Great to Pedal coupler—that being the only bass on the organ at present. Also, as to what length I should cut the pine boards for the 8ft. and 4ft. pipes, and the length of blocks?—the diameters being respectively 8in. × 7in. and 4in. × 3½in.—G. E. S.

[46619.]—**Tricycle.**—Having fitted up a tricycle, geared level, which was rather hard work in mounting hills, I have now fitted a 2⅝in. wheel to crank, gearing with intermediate wheel 5⅝in. with 4¼in. wheel on hub, dia. of spoke-wheel 44in.—What size have I speeded the spoke-wheel down to? The spoke-wheel and hub-wheel are the same in both cases. Perhaps "Sunlight" or some of "ours" will kindly show the question in plain figures?—EX.

[46620.]—**Pantelephone Transmitter.**—To MR. JOHN C. FRANK.—I want to make the above form of transmitter, and shall feel greatly obliged if you will give me the following information—viz.: The size of diaphragm, and if you have tried a cork one; the resistance of the coil you use, and the amount of battery-power required for transmitting? Have you tried carbon and platinum, and if so, did you find it better to use carbon only? What is the size of the carbons, and how large are they at the actual points of contact? What receiver do you use?—A. J. S.

[46621.]—**Dynamo Electric Machines.**—I have made a dynamo-electric machine similar to one described in another paper by Mr. Urquhart. I have made the iron ring of armature of one continuous length of No. 18 soft iron wire, and I have wound the coils of c. c. wire (8 in number, each about 30ft.) directly upon the iron wire ring, and soaked the whole in melted paraffin. In place of a permanent magnet I have used an electro-magnet which I had by me. The pole pieces are of annealed cast-iron. The ends of the coils are connected up exactly as described. I have revolved the armature at about 1,200 turns per minute, but cannot get the sign of a spark, or the deflection of a galvanometer, neither when the magnet is excited by a separate battery or connected to the collecting brushes. Should the coils of wire be insulated from the iron wire ring? Can any reader assist me? as I am—IN WANT OF HELP.

[46622.]—**Occultation.**—On Thursday, March 30th, whilst examining the moon with a power of 70, a star was noticed a short distance from the unilluminated limb, which, after a short interval, was seen to be steadily nearing the moon. A reference to the *Nautical Almanac* showed that no occultation took place about this time—the nearest being that of 14 Sextantis at 13h. 52m. 23s. So implicit was the trust placed in the "Nautical," that no further attention was paid to the star until it forced itself upon my notice by its evident moonward path. It was now closely watched, and at 9h. 12m. 48s. (local time) was instantaneously "snuffed out." No star is as near the moon's assigned place for March 30th, 9h., as π Leonis, and the occulted star certainly appeared of the fourth magnitude. π Leonis was searched for in the vicinity of the moon, but could not be found. Clouds prevented me observing the reappearance. Can "F.R.A.S.," or any other reader of the "E. M.," account for this singular occurrence? The instrument used was a 3 7-10in. achromatic, and the watch might have an acceleration error of about 3m.—W. S., Sheffield.

[46623.] — **Numbers of Midland Coaches.** — Could any of your readers inform me of the plan on which the Midland Railway number their coaches? I have lately seen three bearing the same number.—DUNBRITTON.

[46624.]—**Heating Room for Drying Powders.** —Will some reader kindly inform me how I can best dry powders in a room, and how best to heat the room economically?—DELTA.

[46625.]—**Wife's Liability.**—To MR. WETHERFIELD. —A wife separates from her husband without an order of protection, and commences business on her own account. Gets into debt, and refuses to pay, though she has a stock of goods on her premises. What chance is there for a creditor? Whom must he sue?—the husband (still living in the neighbourhood), or the wife.—KARL.

[46626.]—**Chemical Balance.**—Instructions (with full working drawings) to make a 15in. balance that will weigh 500 grains in each pan, and turn with 1-1000th of a grain, will much oblige. I have made a 12in. that indicates 1-100th of a grain, but cannot succeed in making it more delicate in indicating weight in pans when loaded with 500 grains in each. Hope some of the many competent and old contributors will come to the rescue.—HYDROCARBON.

[46627.]—**Measuring Polarisation in Batteries.**—Could any of your readers kindly inform me, through your valuable correspondence column, how to measure polarisation in different batteries? I can find nothing respecting this measurement in any of my text books. Also, what is meant by the "absolute" system of units in electricity?—ELECTRIC.

[46628.]—**Watch Escapement.**—I wish to be informed of the means watchmakers employ to examine the contact of the lever with the ruby pin in English lever, the plates being pinned together. Also, if levers are made having stone faces in the notch as the pallets have? And whether the fact of a watch, after it has been stopped by the finger, not going on again without swinging the balance, is a sign of defective escapement? —PENDULUM.

[46629.]—**Chemical.**—1. A large quantity of ammonium chloride has turned bluish from being left in a brown paper parcel for some time. How can I purify it? I am going to label afresh all bottles in the laboratory (containing the ordinary chemicals). Where could I get printed labels? What good book is there on organic chemistry suitable for fairly-advanced students?—W. G. WOOLCOMBE.

[46630.]—**Steam Launch.**—Can Mr. Lancaster or some of "ours" kindly give me any information on the following?—I am building a boat 18ft. keel, 5ft. beam; what size boiler and engine will it require to drive it at a speed of, say, eight knots per hour? What size will cylinders and length of stroke be, and also the size of the propellers? and what pressure of steam will it require? Any other information will oblige—NEW ZEALAND.

[46631.]—**Somerset House Analysts.**—How do these gentlemen obtain their situations?—Is it by examination? I should be glad of any information as to the mode of appointment as well as the salaries offered.—SOUTH KENSINGTON.

[46632.]—**London Examinations.**—Can any reader tell me what "mixtures" have been given for analysis of late years at the first B. Sc. Honours Examination?—ZERO.

[46633.]—**Organ in St James's Hall, London.** —As the scheme of this organ is a rather unusual one, will "L. R. D." kindly give particulars as regards the solo stops and the effect of the full organ? Also, pressure of wind and name of builder, if possible?—C. H. D.

[46634.]—**Fixing Electric Wires.**—(1) What is the proper way, and with what tool should domestic telegraph and bell-wires be strained, and how then be fastened and kept taut? (2) How should joints be made in same? Should joints be soldered, or how made secure in out-of-the-way places—as in the roof of a house when a soldering-iron would get too cold before one could reach the joint? (3) Through how many yards of wire should two Leclanché cells work a bell?—MEME.

[46635.]—**Imitation Marble.**—Can this be made with Portland cement mixed with other ingredients? Is borax used? Particulars of mixtures and mode of manufacture will oblige. Are any books published giving information on this subject? If so, please name them.—HYPO.

[46636.]—**American Cloth Sticking.**—I have a knee-hole table covered with American cloth which has become rather troublesome in consequence of my papers occasionally sticking to the cloth. Can anyone say how that may be cured?—B.

[46637.]—**Mount Cutting.**—Can anyone tell me if there is any simple way of cutting out square card mounts for photographs? I can cut them out with a sharp knife by laying the card on glass, but I cannot get the bevelled edge.—No Sig.

[46638.]—**Fresh Water Fish.**—I have a large pool of water used as storage for driving a water-wheel. It is supplied from a limestone district, which makes the water hard. Would it be possible to keep any kind of fish in this pool, and which would be most desirable to have?—Culvert.

[46639.]—**Waterwheel.**—Please inform me how to calculate the horse-power of a water-wheel 12ft. diameter 2ft. 9in. wide. Feed-pipe being 4in. hole, cast-iron, lead jointed for pressure from a reservoir 10 yards square, 2 yards deep, 100ft. from wheel at a rise of five yards above the discharge of pipe on wheel.—E. Morgan.

[46640.]—**Electric Dancing or Working Figure.**—Will any reader kindly give me a few instructions how to set about making one of the above? I want one that would stand on a small side-table, so that I could start it without being observed. I want one that will work for about 20 minutes. I have set up three cells of Mr. Bennett's battery, and I find they ring a 2½in. bell exceedingly well. Could I work the above with the same battery, as I do not want anything very expensive?—J. H. M.

[46641.]—**Electric Bells to Connect.**—I want to ring two bells with one battery—not both together, but one at a time. The battery is placed at house, and a bell at stables about 400 yards away. This bell is in working order. I want now to ring another bell at lodge gate about 200 yards from stables. Must I put down two more wires besides those running to stables to ring bell at lodge? Or, can I use the stable wires as far as they go—one or both? If so, how? Or, must I run one additional wire, &c.? A sketch showing connections and simplest and cheapest method would greatly oblige—F. H. M.

[46642.]—**Drilling Fluid.**—What are the best ingredients to use, and in what proportions, for a fluid to use in turning and drilling steel and iron? We use soap and water and olive oil in varying quantities, and as we use a lot, we want to know if there is anything better and cheaper in the long-run.—Kismet.

[46643.]—**Division Plate.**—Will one of our lathe correspondents kindly give the following information?—I want to get a division plate with holes from 360 down. What is the least number of rows, and their number of holes, with which I can divide from 2 to 360? As I shall want this plate to use in cutting change wheels, &c., and very often I require a wheel with an odd number of teeth, and not knowing what that number might be until wanted, it is for that reason I wish to have a plate that will divide anything between 2 and 360, with as few rows of holes as possible. I have been at it myself, calculating for several hours, but as I am constantly interrupted, I find it a very long job. Please do not advise a micrometer with change wheels, as I must have a division-plate.—Kismet.

[46644.]—**Painting.**—Through the instructions of Mr. King I have contrived to make a light cart, and am glad to say better than I anticipated. I am now at a loss as to painting. Will Mr. King, or some kind reader, instruct me? I have seen what is called dead painting (no gloss). I understand it takes the varnish better, and wears longer. How is it done? Will someone give me instructions, or cannot someone give us something like practical notes on painting?—the same as Mr. Davies has done on plumbing. It would be a great boon, not only to me, but to a great many contributors.—Cambridgeshire Boy.

[46645.]—**Astronomical.**—I should be glad if any of your astronomical correspondents would be so kind as to inform me of any book containing tables giving the value of 1″ (of arc) for every degree, or less, from the North Pole to the Equator. I know, for instance, that 1 sec. of time = 15″ of arc at the Equator. But what is its value at, say, N. Dec. 45°? Or if no book gives this, would "A Fellow of the R.A.S.," or some other correspondent give the value for every 5° or less (if not too much trouble)? as I fear I am not mathematician enough to calculate it for myself, from given formulæ.—J. Atkinson.

[46646.]—**Marking Ink.**—I had the following given me as a recipe for a marking ink, which requires no heating:—Dissolve one drachm of lunar caustic in ½oz. distilled or rain-water, add liquid ammonia until the precipitate formed is redissolved, and gum-water to make up the quantity to 1oz. I made some three weeks ago, but it is a long way from black yet. How long should the above take to go black? I put a small quantity in the sunlight. I have not tried it to mark with, but it has turned a greenish colour, and seems full of sediment. The other, which is indoors, but not exposed to the direct rays of the sun, is a dark browny red, and quite clear from sediment. Are the above proportions good, and can someone give me a better recipe (to require no heating)? What is the difference between lunar caustic and nitrate of silver—and will not either do just as well?—Kismet.

[46647.]—**Astronomical.**—Looking at the star Omicron Leonis the other night with a 3in. telescope, I saw a faint companion within 10″ following the bright star. I do not find this in Mr. Webb's book, nor is it marked as double in Mr. Proctor's small atlas. Is it new? I was looking for the red var. star R, which I could not find. What is its present mag.?—J. A.

[46648.]—**Chimney on Girder.**—A chimney-stack is to be carried by a girder. How is this done as regards the projection of jambs for fire-place? Would it be safe simply to corbel out the brickwork to the required projection?—Querist.

[46649.]—**Mounting Micro. Lenses.**—Will anyone tell me how many threads to the inch is the standard for screws used by opticians in microscope work? And, will anyone further tell me how to mount lenses in their brass seats? Is putty-powder (as sold by the chemists) suitable for polishing lens? Or, is there a kind specially prepared for this work?—Micro.

[46650.]—**Electrical.**—1. How can I determine strength of current in a battery? 2. If two currents are measured by two different tangent galvanometers in two different places, show what you would require to know, besides the deflection observed, in order to compare the strengths of the two currents?—H. W. Wager.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, April 12, and unacknowledged elsewhere:—

W. Billson.—Phosphor Bronze Co.—Rev. H. Ash.—W. A. McClintock.—Leroy and Co.—W. Granger.—Capt. King.—J. McAdorey.—S. Wood.—J. N. Dufty.—J. Dresser.—J. C. King.—Tempus.—W. Unsworth.—Idris.—J. H. H.—T. Mackenzie.—Surgeon.—W. A. S.—A Brother Exhibitor.—Grateful.—T. A. C.—G. Gilbert.—C. Newton.—China Rivet.—Propeller.—Dixhuit.—Engineer.—Capt. Curtis.—W. N. B.—P. Mooney.—W. J. R., Chelsea.—J. W. H.—Jack of All Trades.—S. Mills.—T. Mudd.—J. H. Anderson.—Fellow-Workman.—LL.B A.—A. B. M.—Jas. Lewis.—Sunlight.—Dr. Edmunds.

J. T. Stevenson. (If you will kindly say what sort of an alarm you require, we may be able to assist you. We have given all sorts, from a simple mechanical device to knock down a tea-tray, &c., to an elaborate electric arrangement to ring a bell until it is stopped.)—Mrs. Grocegreener. ("Properly diluted" is sufficient. The solution is not injurious, and all you have to guard against is using it too strong. In the red form it is used as it is for bathing wounds and ulcers, and you have merely to try it on your own tongue and get at the right degree for the dog. It is simply unpleasant, if too strong—that is all.)—An Amateur. (If you object to the shot, use a strong solution of common soda. Good corks and just a little carbonate of soda suffice for the rest. 2. Only by means of caustic to burn it out, which would probably be deemed worse than the "disease.")—A Sufferer. (Try acetic acid, protecting the surrounding skin with a shield; or use the soft plasters with holes in them, and the corns, relieved from pressure, will become callous and easily removable.)—Electro. (See pp. 110, 203, 489, last volume, especially p. 489, No. 879, and get the catalogue there mentioned. See also p. 33, No. 808.)—Weakness (Spectacles evidently not suitable; but it is purely a question to be answered only by examining the patient.)—W. B. Halbech. (Your criticisms of existing brakes have been made many times, and the description of your invention was given as fully on p. 18. Has it ever been tried?)—Aeronaut. (A balloon 48ft. high by 36ft. in diameter will carry three persons, and when full it holds over 18,000 cubic feet of gas. You can either increase the height or the diameter to obtain a capacity of 20,000ft.)—An Old Subscriber. (A plate containing 50 sq. ft. is rather a difficult job for a novice; but if you look again through the indices you will find references, and in the last number, p. 116, answer to "Mirror," a brief description of the mercury process.)—Erin-go-Bragh. (You can dip the rubber into bath of melted sulphur, or masticate it by a machine, and sprinkle washed flowers of sulphur in; but if you wish to experiment you should read the Cantor lectures on the Indiarubber Industries in Vols. XXXI. and XXXII., especially the portion on p. 562, No. 804. The lectures are published in book form for 1s. by the Society of Arts, John-street, Adelphi.)—Oh. (1. We do not know. 2. See an article on the "Micrometer" in No. 471. You will find several varieties described. See p. 253, last volume, and the indices generally for information; but as to making one, are you possessed of the requisite skill and the machine tools necessary?)—Dutch Subscriber. (The diameter of No. 14 Birmingham wire gauge is approximately 2·15 millimetres. See answer to H. J. Peerlhaup, p. 115, last week.)—Delta. (Practical directions for making bichromate batteries were given in Nos. 726 and 728, p. 585 and p. 630. See also p. 65, No. 731, and p. 137, No. 734.)—Hawksbee. (Do you not think that an elementary textbook would be the best authority? You will not find a direct answer; but by a little study you will see that such a question cannot be answered without other data. The ampère is the unit of current, and is the current through a circuit of E.M.F. 1 volt, and resistance 1 ohm. 2. It depends entirely upon the university. In some the writing of a thesis (which can be done sub rosâ by somebody else), and the payment of £20 is sufficient. If you mean to study, you have choice of Berlin, Heidelberg, Freiburg, Gottingen, &c., and the cost of living is less than here. The fees will vary, but at Berlin would be less than in London.)—Amateur. (See the indices of recent volumes under head of "Electric Motors," and adopt one of them, as we presume you mean the modern style.)—Country Bodi. (See previous reply. 2. Probably a coil of platinum wire made incandescent.)—David Williams. (We may do so by-and-by, or write a fresh article. 2. The grease can be removed by rubbing with weak solution of ammonia or by means of benzoline and blotting-paper, but as to re-dyeing that is not easy. See a recipe on p. 273, No. 792. You will want suitable plant.)—Jack. (For such things use the aniline dyes. There is nothing so easy, and nothing better.)—Ton. (Have you tried the German? You require a pyrometer, such as Bailey and Co., of Salford, make.)—J. Forbes Mitchell. (We do not understand what is meant by the term "transfer." If carbonic, for producing several copies of writing, any large stationer supplies it.)—Querist. (Portland cement, 1; sharp sand, 5. Yes. In back numbers you will find plenty about heating apparatus.)—Puzzled. (The instructions are clear and precise, and others have found no difficulty. We can suspect only that you have used common soda instead of caustic soda, or that you have placed the borings in the porous cell and the solution in the tin can.)—Jas. Lewis, Swansea. (Do you mean real Japan, or ebonising? If the former, varnish with proper Japan, and bake in a suitable oven.)—J. H. K. (We fail to understand the first question. If the dial is horizontal, it must make with the style an angle equal to the latitude of the place, the style preserving its parallelism to the earth's axis. If a vertical dial, the angle formed by the dial plane and the gnomon must be the complement of the latitude. See p. 592, No. 805, and the indices generally for much information on the subject. If Newport, I.W., will do, that is 15min. 5sec. slow compared with Greenwich mean time.)—G. Murphey. (It is sent post free for 12s. 6d. by the publisher, J. Tripolin, 5, Bartlett's-buildings, E.C.)—Amateur Electrician. (Sprague's "Electricity," Spons, and Prof. S. P. Thompson's "Electricity and Magnetism," Macmillan.)—H. S. (We believe we answered at the time. The Pharmaceutical Society publishes a pamphlet giving all the particulars. It can be had at the society's rooms, 17, Bloomsbury-square, W.C. It is not necessary to learn Latin—merely a few words of the language, and the technical meaning of a few phrases.)—E. S. B. (Given in all sorts of forms in back volumes. See p. 400, No. 797.)—A Four Years' Sufferer. (Your questions were really answered by silence. If any special attentions were necessary, they would have been mentioned.)—Edinburgh. (We are not aware that any one has succeeded in working a launch with such an engine, but see reply 46520 in this number.)—R. Barraclough. (The subject has been frequently referred to in our columns. You can easily make a gas-stove with a Bunsen burner, and if you like, heat water with it. See the indices.)

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Epps's Cocoa.—Grateful and Comforting.—"By a thorough knowledge of the natural laws which govern the operations of digestion and nutrition, and by a careful application of the fine properties of well-selected Cocoa, Mr. Epps has provided our breakfast tables with a delicately-flavoured beverage which may save us many heavy doctors' bills. It is by the judicious use of such articles of diet that a constitution may be gradually built up until strong enough to resist every tendency to disease. Hundreds of subtle maladies are floating around us ready to attack wherever there is a weak point. We may escape many a fatal shaft by keeping ourselves well fortified with pure blood and a properly nourished frame."—*Civil Service Gazette.*—Made simply with boiling water or milk. Only in Packets labelled—"James Epps and Co., Homœopathic Chemists, London." —Makers of Epps's Chocolate Essence for afternoon use.

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The charge for Exchange Notices is 8d. for the first 24 words, and 8d. for every succeeding 8 words.

◆◆◆

Organ Bellows and Windchests, several in good condition (ready for wind and pipes); books, musical instruments, or offers to W. Johnson, 12, Moxley, Wednesbury.

Large Plate **Electrical Machine** (3ft. diameter), conductor and stool, in exchange for other physical or chemical apps., or tricycle.—Lecturer on Physics, Central Science Schools, High-street, Marylebone-road.

Fretwork Machine new, prize Holly; exchange for violin and bow.—W. T. Kent, 68, Westbury-street, Swansea

Wanted to exchange 50in. Special Challenge **Bicycle**, nearly new (can be seen), for small sailing-boat.—A. W., 62, Cranham-road, South Bermondsey.

For **Engraving** Music Plates, one alphabet capitals, one alphabet small letters, punctuation; all the musical characters, new. Exchange for 48in. Bicycle, or other useful article.—Green, 13, Sepulchre-street, Sudbury, Suffolk.

Bicycle wanted, in good condition, in exchange for good ½-plate camera, lens, and apparatus. Send for particulars. —W. F. James, Fairfield, Chudleigh, Devon.

Launch Engine, new, 5 by 5in. stroke, exchange for 52in. Bicycle. Must be a good article.—Andrew Dryden, Amble, Acklington.

Forty-five 1s. 6d. monthly parts of "**Imperial Cyclopædia** of Machinery," by MacKenzie. For offers; a good lever watch wanted.—69, Newton-street, Millom, Cumberland.

"**Le Merveilleux**," by Lancaster, with lamp, bath, and dozen dry plates; new. Exchange architectural books, or water-colours.—Frank Toyne, Clarkgrove-road, Sheffield.

Tricycle, bell crank, 50in. driving-wheels, chainless, exchange for good secular or operatic musical box.—G. W. Wright, Sedgley-road, Woodsetton, near Dudley.

Brass-fitted **Shower Bath**, good order, for second-hand bicycle, guitar, or offers.—E. Wright, 7, Clements-road, Bermondsey, S.E.

Organ-pipes, wood and metal, taken from a church barrel organ. Also a keyboard. What offers?—W. Saunders, Dickleburgh, Norfolk.

Dulwich. Splendid 8-room **Villa**, mortgaged to Starr Bowkett Building Society for £300, free of interest, for 12½ years. Offers in exchange.—37, North Cross-road, E. Dulwich.

A Howe Treadle **Sewing Machine**, in good working order. Also two patent gas-fires, complete, new. Exchange tools, or offers —W. R. Slater, Sunderland.

Superior 4-keyed concert **Flute**, in handsome case; Cassell's "Natural History"; other articles. For lever watch, Wray o.g., or other offers.—T. M., Stretton-Stop, Rugby.

Wanted, 10 by 8 Rapid Rectilinear or **Symmetrical** lens, and 10 by 8 wide angle landscape lens, in exchange for Ross's No. 3 portrait-lens, cost £17.—L. 24, Barrington-street, Limerick.

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THE SIXPENNY SALE COLUMN.

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Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

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The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, APRIL 21, 1882.

TRIPLE EXPANSIVE ENGINES.

THE success of the compound principle in marine engines has been so great in recent years, that it is not surprising some adventurous spirits have sought to obtain greater economy still by means of three cylinders, expanding the steam from high pressure through three stages, and the discussion at the recent meeting of the Institution of Naval Architects may possibly help to throw some light on the subject, though it is evident that great diversity of opinion exists. The subject came up for discussion on a paper read by Mr. Kirk, of the firm of R. Napier and Sons, in which that gentleman described the triple expansive engines of the screw-steamer *Aberdeen*, one of a class which makes the long voyages between Australia or China and this country, in which even a small saving in coal becomes of considerable importance. In 1874, a vessel was fitted with engines of the triple expansive type, working with steam having a boiler pressure of 150lb. on the square inch; but unfortunately the boilers failed very early, and had to be taken out, so that the experiment came to nothing, and it was left to Messrs. Geo. Thompson and Co. to give an order which enabled another step in advance to be made. The engines of the *Aberdeen* are practically of the same design as those of the earlier vessel, being respectively 30in., 45in., and 70in. in diameter, with a stroke of 4ft. 6in. The boilers are two double-ended ordinary pattern, made in steel with six Fox's corrugated furnace-tubes, giving a total heating surface of over 7,000 square feet. The pressure is 125lb., there is no superheater, and while the high-pressure cylinder is not jacketed, the intermediate is surrounded by steam of 50lb., and the low-pressure cylinder with steam of 15lb. above the atmosphere. On her trial the vessel consumed 1·28lb. of coal per indicated horse-power, a rate which may be taken as equivalent to 1½lb. in ordinary work. The percentage of steam condensed in the jackets, carefully measured into a tank, was nearly four per cent. of that admitted to the high-pressure cylinder, and a subsequent experiment showed that the loss of steam between the high pressure and the low pressure, added to the steam condensed in the jackets, was about the same as took place when the steam was shut off from the jackets. That is simply what might be expected, but it does not show a real loss, for, as has been frequently pointed out, it is cheaper to use steam in heating jackets, than to lose it by condensation in the cylinders. In the case in question the high-pressure cylinder was not jacketed, and there was consequently a considerable loss of heat in expanding into the intermediate cylinder, the very point at which it is most important, not to lose any heat that can possibly be saved. It may be asked why, if three cylinders are an improvement upon two, why should not four be an improvement upon three; and the answer must be that, putting aside the cost of the machines themselves, such an arrangement would give an advantage. Triple expansive engines have been made with the high-pressure cylinder placed above what in the ordinary compound-engine would be the high-pressure cylinder, thus driving on two cranks; but this arrangement is obviously open to the objection that if the ratios of expansion are approximately equal in the different cylinders, the strains are unequal, and so are the several ranges of temperature. Hence Mr. Kirk concludes that it would be better to have two low-pressure cylinders, and to put the high-pressure on the top of one, and the intermediate on the top of the other. It may well be doubted whether the gain in passing steam through four cylinders thus arranged would pay for the extra cost, especially as there would be the friction of two extra slide-valves and their gear to deduct. Theoretically, there is a gain, but practically, there may be losses which experiment only can determine, and therefore the performances of the *Aberdeen* will be studied with much interest by marine engineers. Mr. Parker, who had an opportunity of witnessing a trial of the new triple expansive engines, read a paper on the economy of compound engines, in which, after pointing out that there is a loss in the ordinary two-cylinder compound between the expansion of the steam in the high-pressure and its admission to the low-pressure cylinder, during which expansion no work is done, he emphasised the fact that in spite of that loss, which is really considerable in the best designed compound, the latter engine is more economical than the single cylinder, for the simple reason that the range of temperature is divided into two, and the condensation in either cylinder is not so great as in a single cylinder engine. But a limit is reached in which expansion in the two-cylinder engine produces a greater loss than gain; hence the endeavour to obtain, with higher pressure and a longer range of expansion, a greater degree of economy by means of three cylinders—a vessel having been recently completed in which the pressure is as high as 150lb. The discussion on the two papers was opened by Mr. Denny, who gave a practical turn to it by stating that he had a steam tender fitted with a boiler capable of carrying 120lb. of steam, with which he would make some experiments. At present she is fitted with an ordinary compound engine, and Mr. Denny will work her for some time at 90lb. pressure, and take account of the fuel used; then he will fit a third cylinder on the top of the high pressure, and work with three cylinders and 120lb. pressure, and compare the consumption of fuel. The results will be laid before the Institution probably next year, so as to give an extended trial, and we venture to think that they will be of more real utility than half the arguments used by those who perennially debate this question. Mr. Longridge contended that for every engine there is a pressure and a grade of expansion which give better results than any other, and argued that the economy of the compound is not due to the principle, but to the circumstance that the engine is worked expansively. He expressed great faith in superheating, and asked whether it was beyond the skill of engineers to produce a good superheater. Other speakers dwelt on the advantages of high-pressures, and Mr. Cowper called attention to the action of his "hot-pot," and dwelt on the importance of bringing steam into contact with hot surfaces. Mr. McFarlane Gray, however, said that the theoretical gain by raising the pressure from 60lb. to 120lb. was 14 per cent., which, in practice, amounted to about 12½ per cent., and he asked whether it was worth while to use three cylinders to gain that percentage. That, we imagine, is a question to be settled by experiment, for, as Mr. Kirk mentioned subsequently, theory and practice do not always coincide. In the mercantile marine it has been conclusively proved that compounding is essential to economy, but Mr. Kirk does not see much advantage in steam jackets with high piston-speeds, though they are, he acknowledges, serviceable in the case of low speeds. They convert the low-pressure cylinder into a boiler, but he thinks that the steam thus made is better drained away. He fails also to see much good in the "hot-pot," because the steam is not heated up with waste heat, and so on—doctors differing, who shall decide except Experience? Mr. Parker replied to some remarks of Mr. Longridge's by the statement that 60lb. steam had been tried with single cylinders in the *Circassian* for two Atlantic voyages, and the result was a stupendous failure. Experiments with and without jackets had been made in the *Aberdeen*, and the result was that practically there was little to choose—that the jackets gave so slight an advantage that it is not worth while complicating a machine by their use; but he clinched the whole question by saying that the consumption per ton per mile was the only point to which owners would pay attention, and that that is so complicated with the efficiency of the screw and the ship that it is not easy to arrive at any just conclusion as to the relative merits of different patterns of engines. That is the dispute in a nutshell. No marine engineer would nowadays think of using single-cylinder engines if economy was his object, and as to the best type of compound, experience only can give a definite answer.

THE SELLON - VOLCKMAR SECONDARY BATTERY.

THANKS to the lively controversy which has taken place between those who represent the Faure battery and those who are the inventors or owners of the patents of the new "accumulator," the public are learning something more of the construction of the rival batteries than could be gathered from a perusal of the specifications filed by the patentees. As exhibited at the Crystal Palace, where it supplies current to the Lane-Fox lamps in the Alhambra Court, there can be no doubt that the Sellon-Volckmar accumulator is really a practical success—whether it is superior to the Faure must be left to experts to determine. At the Palace, a battery of 39 cells supplies current to 200 lamps, nominally of 20 candle-power, for a period which may be as long as seven hours if the battery is fully charged. The candle-power in this case is, we believe, really more than the nominal system of reckoning makes it, for the carbons, owing to the steady working of the secondary batteries, can take a stronger current than they can from the dynamos. The exact construction of the Sellon-Volckmar cell cannot be made public at present, as some of the patents are not yet completed; but sufficient is known to give an approximately accurate description of the chief points of the construction. Mr. Sellon, the vice-chairman of the Anglo-American Brush Light Co., has for some time devoted his attention to secondary batteries, and since August last has taken out four or more patents, and has acquired others. M. Volckmar, whose name is associated with that of Mr. Sellon, has also taken out patents; and it is, we believe, on a combination of these that the new battery has been constructed. At any rate, Mr. Sellon found it necessary to purchase the patent acquired by Mr. Swan last year, which we described on p. 414 last volume. A reference to that description will show that the main idea of Mr. Swan's invention was to secure as large an amount of acting surface as possible in a small space, while preventing the spongy lead from falling in a heap at the bottom. He accomplishes that by corrugating the plates, or by making them cellular like a honeycomb cut vertically; and, according to Mr.

Sellon, that is practically the plan adopted with the new battery. The plates have no supports, and are in appearance solid pieces of metal kept apart by pieces of prepared wood, and immersed in the usual dilute solution of sulphuric acid. In reality, the plates are full of interstices or holes containing the material which is acted upon by the exciting liquid, and the changes in the chemical condition of which afford the means of storing energy in a form that can be subsequently given out as electricity. Taking the actual words of Mr. Sellon, we learn that this material, which is for the time a secret preparation, but which, we may safely assume, is an oxide of lead, minium, litharge, lead dross, or finely divided lead in some form or other, forms, so to speak, a solid alloy with the plates themselves, though in what degree it can be a solid alloy and yet be changed and rechanged by the taking in and giving out of a current of electricity is not quite clear. Probably all that is meant is that the oxidisable material is in one with the lead electrode, and does not require the supporting wrapper of asbestos, felt, or canvas, which, from its perishable nature, is the weak point of the Faure battery as publicly described. This absence of supporting material for the spongy coat of lead appears to be the chief improvement, if improvement it be, of the Sellon form of secondary battery, and the patentee looks forward to the time when electrodes weighing half a ton or a ton each will be used, a number being arranged in strong masonry tanks forming the reservoir which is to be the counterpart of the present gasometers. M. Faure writes that in December, 1880, he had a French patent in which perforated plates formed the principal claim, and since August last he has instructed the manufacturers that all plates without exception ought to be perforated. Further in February, 1881, he obtained a patent in which the use of gauze or cloth made with lead or other wire is especially mentioned as a substitute for felt as the support for the lead material on the electrodes. How far the various patents are valid remains to be seen, but it is clear that a great deal will turn upon the actual wording of the claims, for both De Meritens and Tommasi have brought out secondary batteries which are practically formed of perforated plates—see pp. 356, 536, last volume—and it would at least appear to be doubtful whether "perforation," in its various modifications, can be claimed as an invention. Be that as it may, however, the published statements concerning the new battery claim that within a box of a capacity less than half a cubic foot, 62lb. of active metal is confined, which yields, when properly charged, an amount of current equal to one horse-power per hour, giving off from 360 to 400 ampères at any required rate up to 40 ampères per hour. That is the small size; the large standard size contains nearly 300lb. of metallic composition, and can yield five horse-power of electrical energy for an hour, or from 1,800 to 2,000 ampères at any rate up to 250 ampères per hour. As described, the battery is simple, consisting merely of plates of alloy (presumably one in which lead forms the chief component) about a ¼in. thick, perforated with as many holes about ½in. in diameter as it is possible to make. The holes are filled with the metallic composition or preparation, and the plates are connected alternately, or in series, with thick copper wires. The weight of a large standard size cell complete is about 380lb., and of that it is asserted that nearly 300lb. consists of the active material by which the energy is stored. Apart from other considerations, which are probably sufficient in themselves to determine the use of lead for storage batteries, the low cost of that metal places it at a considerable advantage over others, and whatever may be the final result of the controversy between rival inventors, it seems clear that the secondary batteries which are to play an important part in the future of electric lighting will be made of lead on the principle long ago utilised by M. Planté—unless, indeed, which scarcely seems likely, someone invents a battery the working cost of which is nothing, by reason of the products of the chemical action being of a greater commercial value than the substances employed in forming the cell. Regarding the existing storage batteries as being practically equal so far as cost and maintenance are concerned, it is obvious that the superiority of one over the other will be determined solely by the percentage of energy returned, and from a careful series of experiments, the report of which has been presented to the Paris Academy of Sciences, we know that a Faure accumulator properly charged yields about 60 per cent. of the energy of the current put into it, but it is just possible that a larger return may be obtained by modifications in the method of charging. It follows, therefore, that if the new battery can give a better return, it must be an improvement, and as a trial is, we believe, about to be made by some representative experts, their report will be awaited with considerable interest.

THE MANUFACTURE OF INCANDESCENT LAMPS.

We have from time to time described the processes adopted in the preparation of the various parts of incandescent lamps, and have also given some idea of the difficulties which rival inventors have more or less successfully overcome. Mr. Crookes, in the specification of a patent lately issued, gives an interesting résumé of the different processes through which a completed lamp has gone, with the special devices forming the subject of his invention. The specification is No. 3799, of 1881, and contains eight figures, showing the lamps in various stages. The actual shape of the glass envelope is not of much importance, but we will assume that it has to be made from a piece of tube, which may conveniently be of the full diameter of the intended lamp. One end of this tube is, then, drawn down to a small diameter in such a manner that when the operations are completed and it is removed, that end will be rounded off. The other end is closed, and being softened for an inch or so, is blown out to form an extension of a smaller diameter than the main piece. While still soft, with a two-pronged tool, this extension is doubled inwards, the two points of the tool making little pits at the bottom of the doubling, which may be said to resemble the finger of a glove, drawn in upon itself for half its length. At this stage the extension may be separated from the main tube, but, whatever plan is followed, the two little pits are perforated, and conducting-wires sealed into them directly if platinum is the metal, or with the aid of arsenic glass or white enamel, when other metal is employed. In that case the wires are coated with the enamel or special preparation, and incased in little cylinders of glass, which are readily united to the glass that may now be said to form the stem of the lamp. If the extension has been already cut from the body of the tube, we have the latter as the envelope, and the former as the stem, which can be finished in any suitable manner for connecting to the brackets or supports. If the wires are of platinum they may be imbedded in the glass without liability to speedy fracture from difference of expansion; but there is a serious objection to the use of that metal in the fact that its specific conductivity is only about 18, taking silver as 100. Copper, which is much cheaper, and has a conductivity only slightly less than that of silver, cannot be used with safety, on account of the difficulty of making a good and permanent connection with the glass, but that is avoided by Mr. Crookes by means of a compound wire, having a core of copper or silver with a sheathing of platinum. The carbon filaments, or bridges, are now attached to the wire terminals by any of the usual methods; but in order to increase their rigidity, Mr. Crookes makes them of flat section, and gives a twist of a quarter of a circle in placing them between the terminals. Several bridges and stems having been prepared, the carbons undergo the most important operation of all. They are placed in a glass vessel suspended from glass-covered wires passing through a stopper or plate of vulcanised fibre, which is so placed at the top of the jar as to afford facilities for closing the vessel air-tight by a mercury seal. At the bottom of the vessel is a little cup containing chloroform, or in its absence a tube is provided for passing that liquid into the jar. Other substances may be used, as is well understood, the object being to render the carbon filaments homogeneous. The apparatus being arranged, and the air exhausted, the resistance of each bridge is measured, and if it is found to be too high, a current is sent through, raising the filament to a glowing state, until sufficient carbon has been deposited to increase the conductivity to the required standard. Bridges thus prepared are ready for the final operation: they are placed in the envelope, and the stem and neck are securely joined by fusion; the lamp is then exhausted and sealed in the usual manner. We gave a description of the method of preparing carbon filaments patented by Mr. Crookes on p. 247 of the last volume.

PRACTICAL NOTES ON PLUMBING.—XXXII.*

By P. J. Davies, H.M.A.S.P., &c.

Door-Action Water-Closets (Fig. 180).

There are a great variety of methods for fitting door-action closets; but in point of fact, though many plumbers make a great fuss when fixing them, there is very little more to be studied than in fixing a seat-action closet, and it will be readily seen that either may be fitted to the other. Fig. 180 illustrates a very simple method of connecting the door A to the crank B, which crank is in its turn connected to the cottage-valve D; this valve may be fixed as shown, or under the closet-seat at L, or in almost any other position. It will be seen that, if the door is pulled open from the outside, that the wire M will pull the crank B, and work the valve D, and as long as the door is kept open will the water continue to flow, unless the valve is of the waste-preventing description. Of course the valve can be fitted with a regulator or other retarding mechanism at P to keep it open for any given time (see K, Fig. 188).

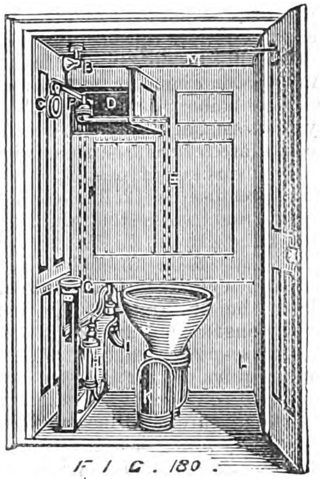

FIG. 180.

I cannot say that I am much in favour of door-action closets, although fitted in a sanitary point of view, seat-action being the preferable, and therefore when executing contracts of the door-action kind, endeavour to fix an additional pull-up valve as at G, H, I, which allows the user of the closet to flush the pan of the closet during the time it is in use; or if the extra pull is too much expense, I fix a pull to work the door-valve, as shown at K (Figs. 173 and 181).

Fig. 181 is a diagram of a door-action closet with the door opening inside. This arrangement is effected by fixing a pulley-wheel on the top part of the door-frame or lintel of the door, and with a chain connecting the door to the lever of the valve Q, as shown. This valve is also provided with an extra pull as at S, and an additional valve at C D, or the valves may be actuated by the use of a treadle or pedal as at A.

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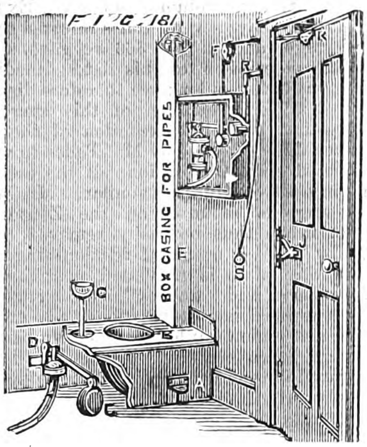


FIG. 181.

Fig. 182 illustrates another door-action closet, the door of which may be made to open either inwardly or outwardly, by fixing the cranked pull B as shown at Q, to point inwardly to the closet, and at right angles with the door: this however may be varied to suit circumstances. This valve may also be worked with a slotted pull-up pull H, I, or by treadle arrangement on opening the door, or otherwise.

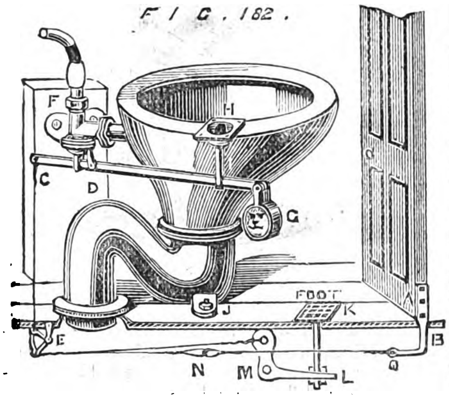


FIG. 182.

This diagram illustrates a pedal-action w.c.; also a pull as at A. The pedal is fitted to the riser of the w.c., and is so arranged that the pedal-lever will lift up the lever of the valve or pan-closet exactly in the same manner as the closet-lever does the valve-lever of the water supply. This treadle is also made to allow the lever of the closet to fall, notwithstanding it is kept pressed down, so that it becomes a waste-preventer.

Fig. 183 A illustrates a flap-valve for the end of a safe-pipe to prevent wind getting into the overflow pipe. A is the flap, B the seating, and C the inlet. These valves can be made with the lead pipe and a piece of copper for the valve, or can be bought ready-made. E, F, G, H, and C is a spreader for screwing into the closet basin, which is an improvement so far as the doing away with the putty joint; but I cannot say that the spreading qualities are at all times good. The same kind of spreader is at times used for the inlet to lavatory basins, which see further on.

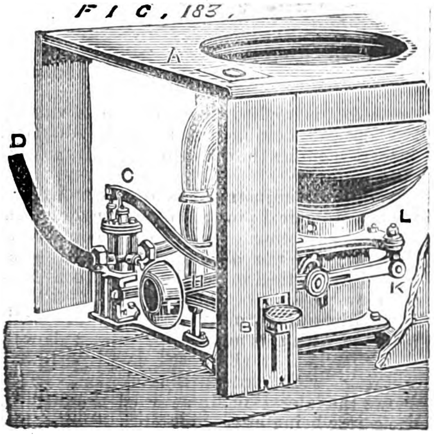


FIG. 183.

Urinals.—"Running Water Supply" (Fig. 184).

Perhaps the simplest kind of water-supply to serve, especially to public urinals, is the ordinary running supply through a pierced pipe down a stone slab, or a bent pipe as at G H (Fig. 184), which, of course, may derive its supply from any source. The pan B holds a large body of water, and has a standing waste that receives the overflow, and which can be lifted for emptying say once in 24 hours. The pan is sometimes made to empty itself by means of a siphon or other equivalent arrangement. This kind of urinal is greatly in use in the public buildings and places about London.

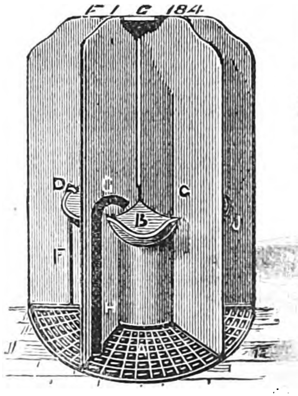


FIG. 184.

The next simple method of water-supply to urinals is the ordinary stop-cock, as shown at M I N (Fig. 185), and next the spring thumb valve, as shown at M N (Fig. 186), and P Q (Fig. 187).

Fig. 185 illustrates an "Angle Urinal," the water supply of which may be governed by a spring cock, stop-cock, or waste-preventing cock, as shown in section at O P Q (Fig. 185), or it may be constructed on the diaphragm (Fig. 161) principle. When these cocks are used, it is the general custom to fix them direct to the arm of the urinal by means of a putty joint, or at other times by a short length of leaden pipe to connect the cock and urinal. The outlet S of the urinal is generally fitted into a stink trap of some kind, and the urinal lugs T T screwed to a plugged wall. The proper height from the top of the lip V to the floor should be 2ft., and should not ever exceed 2ft. 4in.

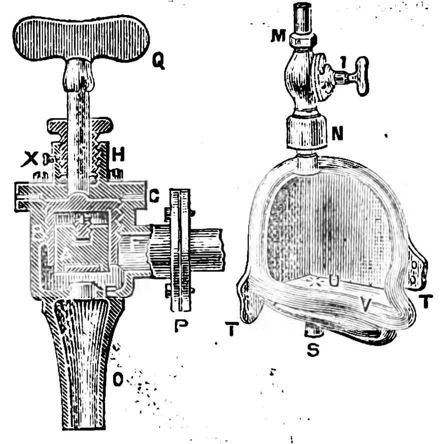


FIG. 185.

This is a section of a treadle urinal, showing the fitting with pipes complete. J K is the cradle union so frequently used to let into a wall, &c. K is the outgo, leading into the trap L. This trap should be fixed so that it can readily be cleaned out with spirits of salts, &c. I is the supply-pipe, which is made good to the arm of the urinal by means of a putty joint, or a really good plan is to have a socket, O section (Fig. 186), with centre pipe as at P, to enter the inlet, the socket O to be filled up with red and white-lead and simply pushed over the arm as at N (Fig. 185), when the surplus red-lead will be pressed out and joint made. O L (Fig. 187) is an elevation of the socket, but bent as at O, to show that the pipe may be brought in from behind, and the socket unscrewed at the flange to allow the urinal to be taken down at any time without disturbing the walls, &c.

A (Fig. 186) is a section of the treadle which is held up by the head of the stud (*) fixed upon the end of the weighted lever D. It will be seen that by placing the foot upon this treadle (as in the seat-action closets) the lever D is brought up, and so opens the valve to allow the water to run; but the moment the user of the urinal walks away, the water ceases to flow.

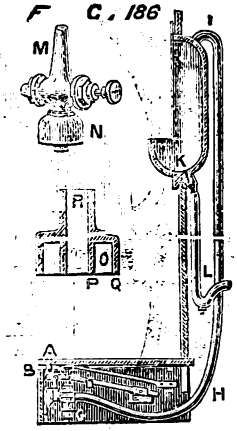


FIG. 186

Fig. 187 illustrates an elevation of the method of fitting up a lipped urinal for fixing against a flat wall with treadle apparatus. The frame employed for fitting the valve is an improvement on the last-mentioned in so far that it forms a safe to catch any water that may leak from the valve, &c. G is the waste or overflow pipe.

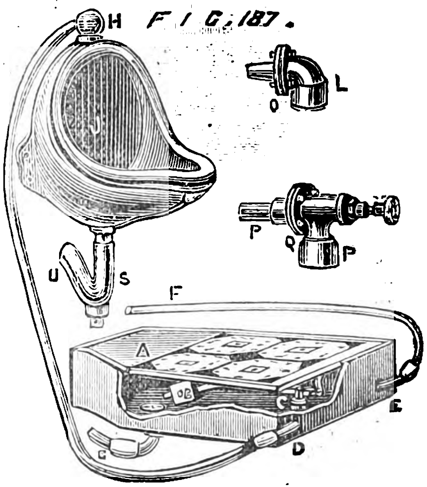


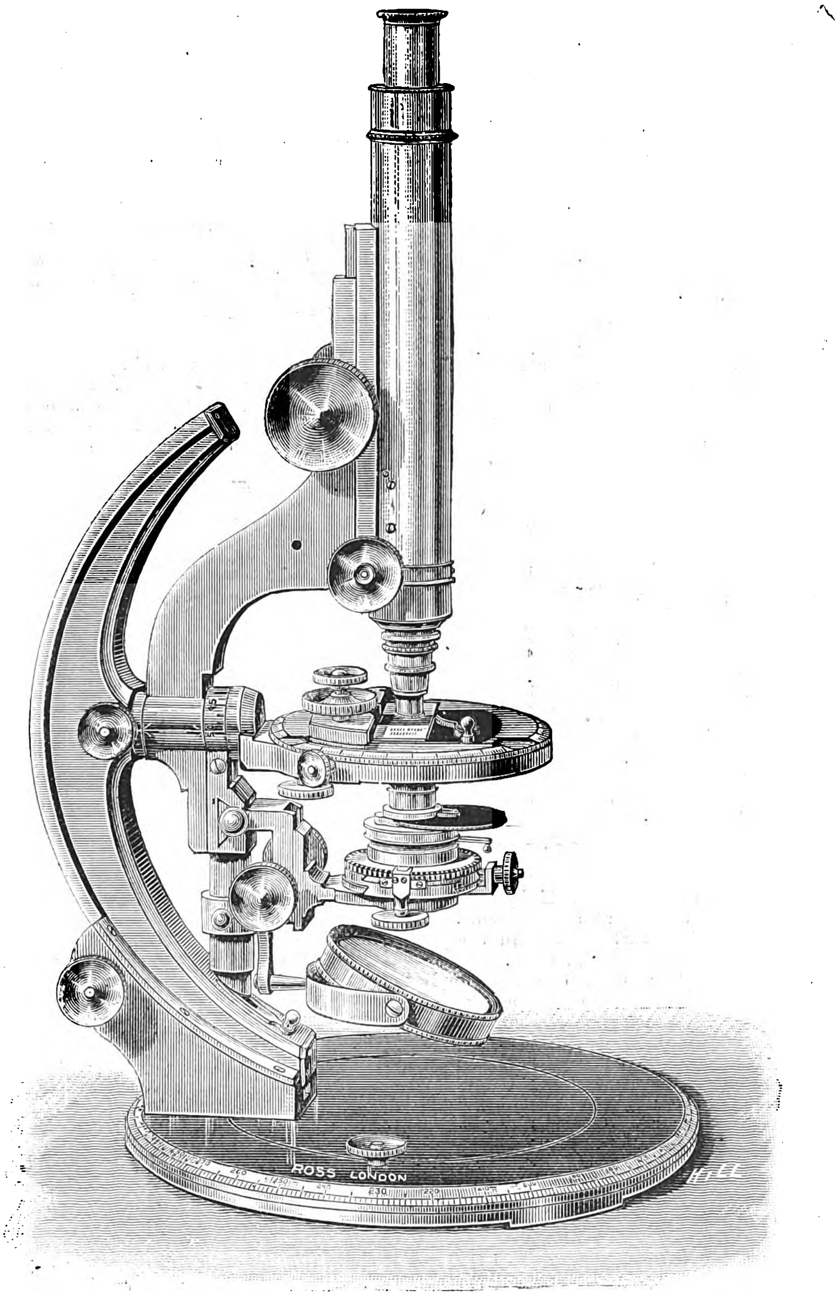
FIG. 187.

(To be continued).

WENHAM'S UNIVERSAL INCLINING AND ROTATING MICROSCOPE.

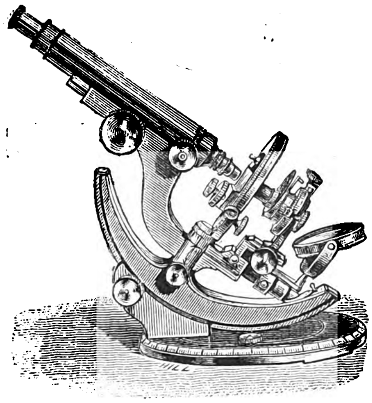
THIS new microscope (Fig. 1) has been devised by Mr. Wenham specially to obtain a large range of effects of oblique light both in altitude and azimuth. The principal movements are as follows:—(1) An inclination of the limb together with the body-tube, stage, substage, and mirror, in a sector sliding within jaws attached to the rotating base-plate. The centre of this inclining motion is (very approximately) the point where the plane of the object cuts the optic axis, *i.e.*, a point situated about the thick-

FIG. 1.



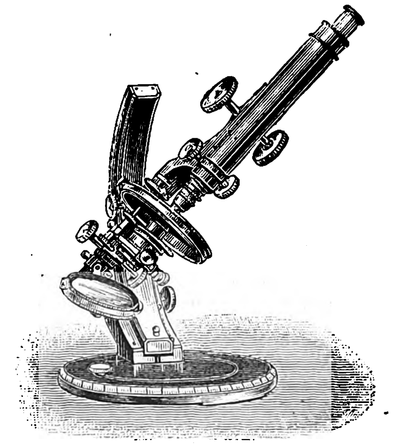
ness of an ordinary object slide above the centre of the surface of the stage. (2) An inclination of the limb to either side upon an axis attached to the centre of the sector. The centre line of this axis prolonged forwards also intersects the optic axis in the plane of the object on the stage. (3) A rotation of the instrument upon its circular base, the optic axis being the centre of motion.

FIG. 2.



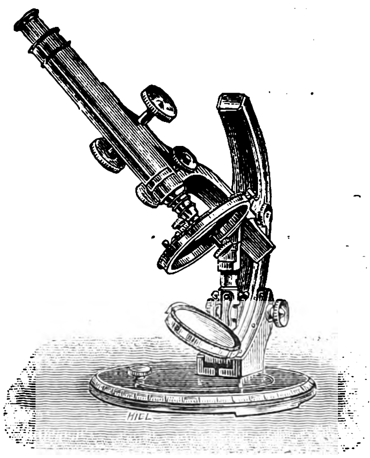
The leading principle followed in the construction of the stand is, that when it is inclined backwards (as in Fig. 2) or turned laterally (as in Figs. 3, 4, and 5), or rotated on the base-plate, a pencil of light from a fixed source will always reach the object, all the movements, whether separate or combined, radiating from the object (or the prolongations of its axes) as a centre.

FIG. 3.



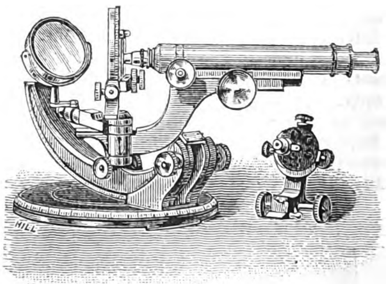
The mechanical stage rotates completely, and is a modification of that of Mr. Tolles (of Boston, U.S.A.), in which the rectangular motions are effected by milled heads acting on the surface and entirely within the circumference. In recent volumes of the ENGLISH MECHANIC we have several times referred to Mr. Tolles' stage, and in No. 866 we gave a Fig. and full description of his latest modifications in the construction; we therefore dispense with a detailed description of this stage, remarking that with the exception of the very ingenious flange devised by Mr. Tolles to which we directed special attention, all the essential points in the two stages are similar. Mr. Wenham's stage is mounted on the Zentmayer system: it can thus be easily removed, or replaced by a glass or metal friction-stage, &c. The rotating plate is graduated near the edge on the surface, and "finders" are engraved in convenient positions; the rotation can be effected by rack and pinion (milled head shown beneath the stage); two centering screws enable the exact rotation round the optic axis to be secured. A simple and effective plan has been adopted of applying the iris-diaphragm, hemispherical immersion illuminator, or Wenham's "half-disc" beneath the stage, where they are held in position by a small flange and a spring latchet.

FIG. 4.



The substage can be removed entirely from the lower part of the limb by means of a metal dove-tail slide, and it has the usual rectangular (centering) and rotating motions. The substage condenser has a centering cap, and a rotating plate of the usual series of slots, central stops, &c., is applied close to the lower surface of the optical combination; an iris-diaphragm beneath modifies the diameter of the illuminating pencil.

FIG. 5.

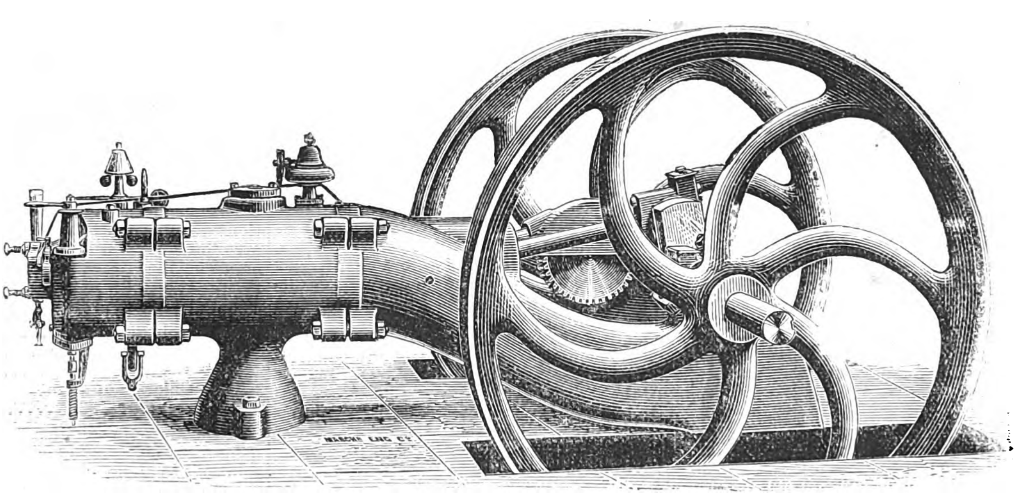


The coarse adjustment is of the "Jackson" form, with spiral pinion and diagonal rackwork. The fine adjustment acts directly upon a vertical slide carrying the objective only, and is controlled by vertical milled heads on both sides of the nose-piece.

In illustration of the variety of motions obtained with this microscope, Fig. 2 shows the sector inclined at about the usual position for working with central illumination. Fig. 3 shows the lateral inclination of the limb, &c., the sector being at its highest position. Fig. 4 shows the Zentmayer swinging tail-piece clamped to the sector (as suggested by Mr. J. Mayall, jun.), the limb being inclined laterally, and the substage removed: this lateral inclination of the limb (the tail-piece with mirror, &c., being fixed) causes the stage to revolve upon a central horizontal axis, so as to present the object to the illuminating pencil at all obliquities. Fig. 5 shows the sector at the lowest position, so that the microscope-body is horizontal, the tail-piece is clamped to the sector, the limb swung laterally about 45° to the right, and the substage removed: this position of the sector is that required for measuring angles of aperture by the graduations on the circular base. The axis of the lateral inclining motion is also graduated, so that either the degree of inclination of the limb or that of the swinging tail-piece can be registered. In all these positions, and, indeed, in every position in which the various movements enable it to be placed, the microscope is very steady.

The construction of the stand has been carried out by Messrs. Ross, under Mr. Wenham's instructions, and we understand that they purpose making such modifications as will permit a lamp to be carried by the swinging tail-piece, or placed at the lower end of the sector, and the mirror to be attached at pleasure to a rotating slide in the centre of the base: these alterations will add still more to the facilities for obtaining obliquely incident light.—*Journal, Royal Micr. Soc.* (with additions).

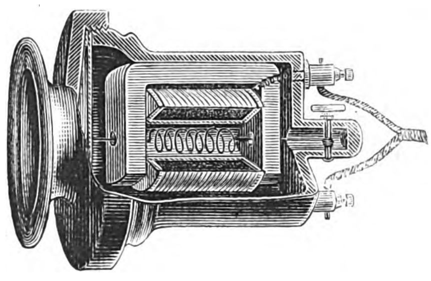
THE NEW "OTTO" GAS-ENGINE.



IN the engraving below we give a view of the new 16 horse-power Otto-Crossley gas-engine, which can be seen at work in the West Corridor at the Crystal Palace driving some of the dynamos. Messrs. Crossley exhibit altogether eight engines; but that shown in the engraving is the largest single-cylinder gas-engine ever made. So far as the framing is concerned, the engine is of novel design, and it has an improved governor, which renders the engine especially adapted for driving electric machines. Nominally of 16 horse-power, it indicates 40 horse-power, and a glance at the figure will show that it is simplicity itself in the matter of fixing. The numbers of gas-engines now in use would be enormously increased if the gas companies, taking advantage of their position, would but supply heating-gas by a separate service. By dispensing with the costly purifying processes, it is known that coal-gas could be sold at a profit for little more than one shilling per 1,000 cubic feet, and at that rate power-users could, by means of one of these engines, have 40 I.H.P. for 10d. an hour, or, at the rate of one farthing per horse-power per hour. No words are needed to explain what an important effect so cheap a motive-power would have on the industries of the country.

A NEW TELEPHONE RECEIVER.

WE illustrate a new telephone-receiver, the action of which is due to the contraction of a spiral magnet core under the influence of the current traversing the bobbin. The spiral core is attached at one end to the diaphragm, and is connected at the other end with an adjusting-screw. The spiral core is perfectly free to work in the helix, and the contraction or expansion of the spiral under the influence of the current from the transmitter acts on the diaphragm in much the same manner as though it was attracted by a magnet, the results being the same as in Bell's, Gray's, or Phelps' instruments. A permanent magnet placed outside the bobbin magnetises the "spiral core" by induction, so that the spiral is very sensitive, thereby making it sensitive to the influence of currents passing in the bobbin. The inventor expects to, partially at least, overcome the influence of induced currents in the receiver, and to obtain more distinct articulation. The construction of the telephone will be readily understood by reference to the engraving, in which a portion of the instrument is broken away to show the internal parts. The diaphragm is mounted on a mouthpiece of the usual description, and the permanent magnet and bobbin with the inclosed spiral is placed in a small casing attached to the mouthpiece. The instrument is provided with the usual binding posts and flexible connections. This receiver is the invention of H. S. Thornberry, of Winona, Minn., who may be addressed for further particulars. — *Scientific American.*



THE APPLICATIONS OF ELECTRICITY.[*]

(*Continued from page* 96.)

WE have here a piece of soft iron bent into the shape of a horseshoe, and surrounded by several turns of silk-covered copper wire. This piece of iron is altogether incapable of exercising any attraction on the small bar of iron, which stands at about half an inch from it. If, however, we send an electrical current through the wires, the soft iron is instantly converted into a powerful magnet; you see the piece of iron rushes upwards, and sticks to the electro-magnet thus formed, so that I cannot tear it off. I will attach several weights to the attracted piece of iron to show you that our small electro-magnet is strong enough to sustain them. Let us now interrupt the current; the instant it ceases to pass, the piece of iron ceases to be magnetic, and the weights fall down. This is a most important experiment, and capable of an endless number of applications; indeed, I may almost say that the principal part of nearly all our electrical instruments is an electro-magnet. Several telegraphs entirely depend upon this property of soft iron to become magnetic by the electric current. In Wheatstone's A B C dial telegraph the receiving instrument consists of a dial, around which are marked the letters of the alphabet. Every time the current is sent from the sending instrument an electro-magnet in the receiving instrument attracts a piece of soft iron or armature, which works an escapement and sends the needle on one letter. The message is thus easily spelt out. Wheatstone invented a very perfect A B C instrument, which needed no battery, but was worked by magneto-electric currents. This instrument is not employed in France, but is much in favour in England, especially on short lines between business houses.

In France the only A B C telegraph in use is Breguet's. In this telegraph clockwork is employed, and the escapement is worked by an ordinary electro-magnet. The hand can thus turn round the dial and indicate the message, letter by letter. You see that all these telegraphs leave no permanent record of the despatches; this is a grave defect in several cases. Morse's printing telegraph is admirably suited to meet this difficulty. The principal and active part of the apparatus is, of course, an electro-magnet; but here we do not use it to turn a hand round a dial, but to work a small lever carrying at its end a wheel wetted with printing-ink. Every time the current is sent from the sending-station the lever is worked and the inking-wheel is brought to bear against a long and thin strip of paper, which is moved uniformly by clockwork. You easily see that if I only close the current for an instant, I produce a dot on the paper; whereas, if I keep the current on for a longer space of time, the inking-wheel will trace a line or dash on the strip. A certain number of dots and dashes are attributed to each letter of the alphabet, just as a certain number of right and left deflections are attributed to each letter of the alphabet in Wheatstone's single-needle telegraph which I have already described. The Morse telegraph is in use in all countries. In order to make it more rapid, Wheatstone rendered it automatic and dispensed with the sending clerk. In this system the message is given to several clerks, who punch it out—that is to say, they perforate a strip of paper, so that when it is passed through the sending instrument, it will do exactly what a sending clerk would do. It will allow the current to pass at regular intervals to form the dots and dashes in the receiving instrument; it goes, however, much quicker, for the perforated strip can be passed very rapidly through the sending instrument. This system is much used where heavy work is required. In France we much like Hughes's printing telegraph, which prints the message in typographical characters ready to be sent to destination and readable by everybody. It is a very delicate and complicated piece of apparatus. The chief part of it is a type-wheel, on whose circumference are engraved the letters of the alphabet, moved by clockwork. The clockwork is let off or stopped by an electro-magnet, and it will easily be understood that the type-wheel may be brought with the desired letter opposite a strip of paper, on to which it will be impressed by movement of the latter. The sending instrument consists of a keyboard; the sending clerk presses the appropriate key in order to print the corresponding letter.

(*To be continued.*)

GALVANIC BATTERIES FROM ELEMENTS ALONE.

IT has been commonly supposed that the action of a galvanic combination requires that at least one constituent be a body that conducts electrolytically, a decomposable liquid. Combinations formed simply from elements would, it has been thought, be inactive. According to the chemical theory of the galvanic current, however, in every case where there is a reciprocal chemical action of two substances, with loss of potential energy, there is also electricity; it does not matter whether these substances are elementary or not. If they are capable of conducting electricity, and care is taken to conduct away continuously the electricity generated, a galvanic element is formed.

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[*] Lectures delivered by C. Detaille, at the Palais du Trocadéro, Paris.

With this view, the well-known Austrian physicist, Prof. Exner, lately sought to form galvanic batteries with elements alone. Of all combinations that present themselves, those of metals and bromine or iodine appear the most suitable, because bromine and iodine attack metals considerably, and as the heats of combination have been very exactly determined by Herr J. Thomsen, a quantitative comparison of experiment with theory is rendered possible.

The very first experiments made, with two metals and bromine, proved the correctness of the hypothesis. According to the metallic combination, galvanic elements more or less strong, and quite constant, are formed, and there is, of course, no polarisation.

On account of the very small conductivity of bromine and iodine, which generally pass for insulators, the measurements were made with a Branley quadrant electrometer (with mirror). The bromine was chemically pure, as used for quantitative analysis, and underwent no degradation of purity by an electrolyte; this was proved both by later measurements of conductivity, and by the fact that there was not the slightest trace of polarisation. The metal to be examined was, simultaneously with a carbon electrode, inserted in the bromine, and the latter connected with earth, the former with an electrometer. The electrometer, which a Daniell element deflected to the extent of 23·6 divisions, indicated the electromotive force of the combination. Separate portions of bromine were used for each experiment, which lasted only a few seconds. The metals tried were: magnesium, aluminium, zinc, lead, silver, copper, and platinum.

Similar experiments to those with bromine were made with iodine, and the average value of the electromotive force reduced to Daniells, and compared with those calculated from the heat of combination, are given in the following table:

Element.		Electromotive Force.	
		Observed.	Calculated.
		D	D
Mg	Br	2·36	—
Al	Br	1·60	1·61
Zn	Br	1·52	1·52
Pb	Br	1.29	1·29
Ag	Br	0·91	0 91
Cu	Br	0·51	0 65
Pt	Br	0·04	—
Mg	I	1·57	—
Zn	I	0·96	0·98
Al	I	0.77	0 93
Hg	I	0·55	0·68
Ag	I	0·56	0·55
Pt	I	0·313	—

There is, with some difference, a very satisfactory amount of agreement. The calculation was made on the assumption, that besides the reaction between the metal and bromine or iodine, no other circumstance participated in the formation of a current. Thus, it appears, that elementary substances, where they act chemically on each other, are capable of forming galvanic combinations. This was supported by the fact that none of the combinations showed a trace of polarisation, which must have occurred if their action had been caused by electrolytes.

The conductivity of iodine and bromine was also investigated by Prof. Exner, and found (unlike that of metals) to increase with the temperature. This fact (says the author) is perhaps of interest with regard to a theory of conduction, for it seems to indicate that the increased conductivity is connected with the liquid state. Mercury, whose conductivity, of course, decreases with the temperature, has a considerably less coefficient of temperature than all solid metals; it seems to me, therefore, not singular, that in the case of other substances, in which, perhaps, the influence of the liquid state preponderates over that of the metallic nature, the temperature-coefficient also changes sign.

NEW AND DELICATE TEST FOR AMMONIA.

A NEW and delicate test for ammonia in the gaseous form is described by G. Kroupa in the *Chemiker Zeitung*. When fuchsine is dissolved in water and dilute sulphuric acid added, its red colour will be changed to a yellowish brown (the mono acid becomes converted into the di or tri sulphate). If stripes of unsized paper be dipped in a not too dilute solution of rosaniline and dried, they will appear—similar to turmeric—of a beautiful yellowish colour. Paper prepared in the above-described manner is permanently coloured carmine by ammonia when it is in the form of a vapour. The action of the ammonia is to convert the poly-acid—rosaniline into a monacid fuchsine. This paper is of use for the detection of ammonium salts when they are present in small quantities. The substance to be tested is placed in a bottle and moistened with calcium hydrate. The bottle is closed with a piece of the test attached to the lower part of the stopper. It is best to employ the paper when it is in a dry state, because when it is moistened it becomes bluish and its change to red is not so readily perceptible. In order to hasten the decomposition of the ammonium salts, the bottle with its contents may be warmed, as the paper is not affected by steam. By this means a beautiful red colour may be produced with 0 0005 gramme ammonium chloride, and 0·0005 gramme ammonium carbonate in a very short while. When it is exposed to the air it is liable to be attacked by moisture, though only after some time; it is, therefore, best to preserve it in well closed vessels. It cannot, however, be kept indefinitely, as it is too fragile.

SUGGESTED ANALOGY BETWEEN "WATER-HAMMER" ACTION AND EARTHQUAKE AND VOLCANIC PHENOMENA.*

PROFESSOR PRESTWICH, in his paper in the January number of this Magazine on the "Causes of Volcanic Action," assumes the existance of hot reservoirs or cavities filled with molten rock, and cold reservoirs or cavities, nearer the surface, filled with water; and he supposes the shrinkage of the Earth to squeeze up the molten rock till it meets with the water, which then explodes, producing a volcano. I would suggest that the action which goes on in the fissures that connect the hot and cold cavities is similar to the "water-hammer" action, so well known to engineers. This assumption is necessary, it seems to me, to render the theory completely satisfactory. Water hammer action manifests itself where steam has to be conveyed to considerable distances from its source without any return communication or easy vent. It occurs in this way. The steam, on being turned into the cold pipes, is quickly condensed, and in a short time a quantity of water is formed. The steam condensing most quickly at the end furthest from the inlet, there is there formed a partial vacuum. The steam rushing forward in consequence, gathers up the water into a plug, which fills the sectional area of the pipe, and forms, indeed, a water-piston. This water-piston is dashed by the force of the steam against the end of the pipe, producing a severe shock, accompanied by a loud report; and then follows, by natural sequence, a rebound, which must be a rebound of a compound character, made up in part of the rebound of the steam, in part of the rebound of the water, and in part of the effort of the water to regain its level by gravity. The first two are probably of momentary existence, but the last takes time, and proceeds with a measured swing like a mighty pendulum. When the force of the return wave is spent, and the steam again gets the advantage, condensation having in the mean time been going on behind the return wave, this piston of water advances a second time, and is dashed with increased fury against the obstruction in the pipe. This action in a few strokes arrives at its maximum, and thence, if the pipe has been able to withstand the shocks, gradually diminishes and dies away. There are two operations at work affecting its destiny. The quantity of water set in motion is increasing, tending to increase the shock, and the temperature of the pipe is heightening, tending to diminish the shock by reducing the difference of pressure between the spaces before and behind the water-plug. The latter is by far the more potent agent, and quickly reduces the water-hammer action to nothing. Now the essentials to this kind of action are—1. A length of passage confined at its extremity. 2. A fluid. 3. A condensible vapour. 4. A difference of temperature at the two extremities of the passage. 5. The initial action, which is merely the introduction of the condensible vapour into the colder end of the passage from the hotter, so that it may be under conditions producing condensation, and thus commence the water-hammer action. That this kind of action, owing largely to the very low compressibility of water, is capable of producing very severe shocks, even when the essential factors are of comparatively low value, is seen from the fact that stout iron pipes of only a few inches in diameter are often burst into fragments by it, even when the difference of pressure developed cannot be more than about 50lb. per square inch, and where the length of pipe is not many yards. Given, therefore, subterranean reservoirs, as Professor Prestwich supposes, we have only to assume a communication formed between these two reservoirs by a fissure, and we shall have the conditions favourable for the water-hammer action on such a gigantic scale as appears competent to account for the phenomena of earthquakes and volcanoes. Immediately a fissure is formed connecting the reservoirs of water nearer the surface and at comparatively low temperature with the more deep-seated reservoirs of molten rock, steam is formed, which, passing along the fissure, becomes condensed, difference of pressure is set up, the water and molten rock form a fluid piston or plug, and shocks proportionate to the difference of pressure, the length and sectional area of the passage, and to the quantity of matter set in motion, are thence inevitable. If, when this action arrives at its maximum, the water cavity is incapable of sustaining the shock, and gives way, its broken walls are thrown out as dust and ash, the whole body of the water, which had become superheated, bursts into steam, and the molten rock is poured out as lava. There is another analogy indirectly connected with this matter, which appears to hold between the conditions beneath the crust of the earth and those in a steam-boiler, to which I shall only make a brief reference, as the question has been dealt with in well-known geological works. It bears upon the observed fact that mountain ranges occur mainly along lines of thick deposit. If a sediment (especially one of a loose or of a greasy character) be allowed to accumulate on the outside of the firetube of a boiler, the heat is prevented from getting through the iron plate sufficiently fast to prevent overheating. The contact of the plate with the water is broken, and the sediment is a bad conductor. The result is that the plate becomes overheated, and the external pressure on the firetube thrusts it out of shape, producing what is known as a "collapsed furnace." This seems to illustrate what takes place on a large scale in areas of great deposition. The thick, loose sediment forms a bad conductor, overheating takes place, and that first, of course, along the line of thickest deposit, and the pressure being internal instead of external, a ridge outside is the result, instead of a collapse.

GELATINO-CHLORIDE OF SILVER PICTURES BY DEVELOPMENT.*

I PROPOSE this evening to demonstrate the method of producing transparencies on gelatino-chloride plates, and to describe certain modifications in the development which I have found to give the best results. For the preparation of the emulsion the following simple formula is all that is required:—

Gelatine	300 grains.
Cold water............	4 ounces.
Nitrate of silver	240 grains.
Distilled water	2 ounces.
Chloride of ammonium..	100 grains.
Water	4 ounces.

Mix the above in three separate vessels, allow the gelatine to soak for ten minutes, and warm all the solutions to about 120° F. Now add the silver to the gelatine, and immediately afterwards add the chloride. Emulsify at the same temperature for about an hour; then allow the emulsion to set. Pass through canvas, and wash in running water for some hours in the usual way. When washed and dissolved by gentle heat the emulsion will be ready for coating the plates. The glass chosen should be as thin and flat as possible, to insure contact in printing from the negative. The dried film should appear pure white by reflected light, and of an orange tint by transmitted light. The latter colour is owing to the chloride of silver being held in an extremely fine state of division. With regard to the sensitiveness of these plates, I have found them at least a hundred times less sensitive than ordinary gelatino-bromide plates. The time of exposure will depend, to a great extent, upon the colour desired in the transparency and the strength of the developer. With a moderately-strong developer an exposure of two or three seconds to diffused light under an ordinary negative will give all the detail. The developer I use is a modification of Doctor Eder's formula and that of Captain Abney. A stock solution is made as follows:—

Citric acid	5 ounces.
Distilled water	20 ,,
Strong ammonia	2 ,,

The heat produced by the addition of the ammonia will cause the crystals of citric acid rapidly to dissolve. As soon as the mixture is sufficiently cooled the solution is ready and will keep a long time. When required for use, mix three parts of the above solution with one part of the ordinary ferrous oxalate developer freshly made, by adding one part of a saturated solution of sulphate of iron to three parts of a saturated solution of neutral oxalate of potash. Now add to each ounce of the mixture two or three drops of a twenty-grain solution of bromide of potassium.

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* By THOMAS MUDD, of Hartlepool, extracted from the *Geological Magazine*.

*Extracted from a paper by B. J. EDWARDS, read before the South London Photographic Society.

This will form a very powerful developer for the gelatino-chloride plates, and with a moderately-short exposure will give a rich purple tone to the transparency. For a pure black tone expose less time and use equal parts of the ferrous oxalate and citrate of ammonia solutions, with an extra drop or two of restrainer, if required. If much warmer tones are desired, six or eight parts of the citrate solution should be used to one part of the ferrous oxalate. Any shade of colour may be obtained, from jet black to bright ruby red; but with the weaker developer it will be necessary to increase the exposure considerably. For instance, to obtain the ruby colour two or three times the exposure will be required than for the black tones with the stronger developer. In this way a great variety of beautiful tones may be produced at will; but the great advantage of this method of development consists in the very great latitude allowed in the exposure. When working by daylight and with negatives of different degrees of density it is practically impossible to be sure of getting the correct exposure except by repeated trials, unless the developer can be regulated to suit the exposure given. By my method this is easily done. I make three or more portions of developer of different degrees of energy; that is, containing a greater or less proportion of the ferrous oxalate. Should the transparency appear under-exposed the developer is at once poured off and the development completed with a more energetic solution. In the case of over-exposure the operations are reversed. This power of correcting under or over-exposure in the development of pictures on chloride of silver has not hitherto been obtained by any known method; and I think I may venture to assert that, without the power of compensating for errors in exposure, the process of printing by development on chloride of silver, however beautiful in some of its results, would be practically useless. With regard to the keeping qualities of the developer, I find that after being mixed it gradually but slowly loses its energy, otherwise keeping in perfect condition for several weeks. It can, however, at any time be restored to any desired strength by adding the proper proportion of freshly-made ferrous oxalate developer, as in the first instance. With regard to the utility of this really beautiful process, I think few will question its superiority for the production of the most exquisite transparencies for lantern slides or for making enlarged negatives. There is, however, another application of the process which may eventually prove of far greater importance. I allude to the rapid production of silver prints on paper by development, instead of the present slow process of printing out under the negative. I have already made a few experiments in this direction, and from the results I have already obtained I should judge that it is not improbable that the process I have described to you to-night will prove in time the quick-printing process of the future.

USEFUL AND SCIENTIFIC NOTES.

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Lacquers.—The following have been given as lacquers for brass:—(1) Seed lac, dragon's blood, annatto, and gamboge, each 4oz.; saffron, 1oz.; wine spirit, 10 pints. (2) Turmeric, 1lb.; annatto, 2oz.; shellac and gum juniper, each 12oz.; wine spirit, 12oz. (3) Seed lac, 6oz.; dragon's blood, 40gr.; amber and copal triturated in a mortar, 2oz.; extract of red sanders, ½ drachm; Oriental saffron, 36gr.; coarsely-powdered glass, 4oz.; absolute alcohol, 40oz. (very fine). (4) Seed lac, 3oz.; amber and gamboge, each 2oz.; extract of red sanders, ½ drachm; dragon's blood, 1 drachm; saffron, ½ drachm; wine spirit, 2 pints 4oz. (5) Turmeric, 6 drachms; saffron, 15gr.; hot alcohol, 1 pint; draw the tincture and add: gamboge, 6 drachms; gum sandarac and gum elemi, each 2oz.; dragon's blood and seed lac, each 1oz. (6) Alcohol, 1 pint; turmeric, 1oz.; annatto and saffron, 2 drachms each. Agitate frequently for a week, filter into a clean bottle, and add seed lac, 3oz. Let stand, with occasional agitation, for about two weeks. (7) Gamboge, ½oz.; aloes, 1½oz.; shellac (fine), 8oz.; wine spirit, 1 gallon.

THE four-track line of the New York Central is now complete from Albany to Buffalo, 298 miles. The *Railroad Gazette* says there is nothing like this four-track road from Albany to Buffalo anywhere else in the world. There are short sections of four-track roads on several lines, and the London and North-Western expects to be compelled to have separate freight and passenger tracks for a considerable portion of its road, we believe; but nowhere else in the world can be found a continuous four-track line 300 miles long.

THERE does not appear to be any intention at present in Russia to raise the duty on bar, plate, or other iron, although most of the duties on other imports are being raised.

SCIENTIFIC SOCIETIES.

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ROYAL ASTRONOMICAL SOCIETY.

THE April meeting of the Society was held on the 14th inst., at Burlington House, Mr. E. J. Stone, president of the society, and director of the Radcliffe Observatory, Oxford, occupied the chair.

Mr. Robert T. Pett, of the Royal Observatory, Cape of Good Hope, was balloted for and duly elected a Fellow of the Society.

Among the presents which had been received by the Society, Mr. Knobel called attention to a number of the "Bulletin des Sciences Mathématiques et Astronomiques," in which was re-published a curious catalogue of Southern stars which had been observed by Frederic Houtman, in Sumatra, in the year 1600. It had been originally published at Amsterdam, but was extremely rare and little known.

Mr. Glaisher read two papers by Prof. Asaph Hall, "On the conjunctions of the interior satellites of Saturn," and "Observations of the companion of Sirius, made at the United States Naval Observatory, Washington.

Mr. Glaisher also read a paper by Prof. E. S. Holden, "On the inclination of the ring of Saturn to its orbit, deduced from the Washington observations made during 1877 to 1879 with the 26in. refractor. The observations seemed to indicate a diminution of the inclination.

A list of errata in the first Melbourne General Catalogue of Stars, by Mr. Ellery, was also read, in reference to which Mr. Downing remarked that a comparison of Lacaille's places with the places in Mr. Stone's catalogue gives nearly the same proper motions as the comparison with the Melbourne catalogue. It would appear from this, therefore, that Lacaille's places are useless for the determination of proper motions.

Mr. Glaisher read a paper by Mr. T. E. Espin, on the variable star β Ursæ Minoris.

Mr. Knobel read a paper by Professor Newcomb, entitled, "Remarks on the Instructions for Observing the Transit of Venus, Formulated by the Paris International Conference." The writer stated that he hesitated to suggest improvements upon the instructions drawn up by the eminent astronomers who took part in the Conference, but the subject was of great importance to Americans, as their observers would probably be as numerous as those of all the other countries who would send out expeditions to observe the Transit. With regard to the first three articles of the instructions, he would only suggest that the use of a silvered objective might in some cases diminish the light of the sun too much. Everything really depended upon the observers seeing the gradual approach of the cusps round Venus, and estimating the moment when the thread of light became visible. This would be best seen if the solar disc were as bright as the eye could bear with comfort.

Prof. Newcomb did not clearly understand some expressions in article four of the Instructions, and proceeded to make some general statements with regard to the phenomena of contact. The moment of true internal contact is when the points of the cusps begin to meet round the planet; the imperfections of definition, however, never allowed this moment to be fixed with perfect accuracy. The instructions endeavour to surmount this difficulty by explaining the phenomena to be expected, but these are not described with sufficient precision, and would probably lead to the time of ingress being noted too late, and of egress too early, as appears to have been the case with Mr. Tebbutt in his observations of the Transit of 1874. The instructions seem to indicate that there is a precise moment when a shade appears upon the line of light between the planet and the sun's limb, which is not the case, and also that the "shade" and the "black drop" are two distinct phenomena. The phenomena observed are, in fact, not always the same, but if sufficient precautions are taken there should be only two causes of difference—viz., different atmospheric conditions and differences of contrast between the brilliancy of the sun and of the sky. Observers should concentrate their attention upon the cusps, and endeavour to estimate the moment when they would meet round the planet if they were sharply defined instead of being indefinite. He was sorry that observations of exterior contacts should be neglected, and thought that in the Instructions the observer should have been warned against mistaking the line of light seen round the portion of the planet outside the Sun, for the solar limb. He strongly recommended practice with an artificial transit, and concluded with a few remarks upon the employment of photography.

The President said we should have been very glad if we had received this communication earlier, as the committee had been most desirous to obtain the views of the American astronomers before the Instructions were drawn up. Last October a provisional list was sent to America, but no suggestions were received by the committee. I believe most of Prof. Newcomb's objections are mere criticisms of verbiage, and that had he attended the conference, an agreement might easily have been arrived at. We have recommended observers to note at ingress the last moment of discontinuity of the limb, while Prof. Newcomb directs attention to the cusps, and to the instant when they would meet round the planet; but these are the same things described in different words. With regard to the line of light round Venus, we have been very desirous that observers should not mistake this for the limb of the Sun.

Mr. Christie said: I agree in the main with Mr. Stone, but there are difficulties with regard to some of the Colonial observations, in which different phases of contact are described, differing from one another by minutes. It is often very difficult to decide which phase the observer intends to describe, as they frequently do not express themselves definitely.

Mr. Rand Capron mentioned a photograph which he had taken of the last partial eclipse of the sun under unfavourable atmospheric conditions, but in which the solar limb was well defined, and asked if this might be due to the shortness of the exposure.

Capt. Abney said that it was a matter of chance whether the photograph would be well defined or not, but good definition was more likely to be obtained with extremely short exposures.

The Rev. S. J. Perry said that in M. André's experiments with an artificial transit, the difference between the time of *actual* contact and of the last appearance observed was from 1½ to between 3 or 4 minutes. He also found, at ingress, that the cusps invariably appeared flattened, and at egress rounded. The black drop could always be obtained by varying the illumination. Perhaps it might be possible, in actual observation, to destroy the black drop as it formed, by decreasing the illumination, so as to obtain true contact. The atmosphere of Venus will not be likely to mislead observers, if they do not use the double-image micrometer up to the last moment, as they will be able, with care, to discriminate between the line of light and the solar limb.

Mr. Green called attention to the remarkable drawing of Mars made by Professor Schiaparelli, in which the greater number of the fine lines represented in his former drawings were delineated as *doubled*. Fine lines upon the planet Mars have been described by Mr. Dawes and Mr. Banks, which do not appear on Signor Schiaparelli's drawing. Mr. Burton has drawn some delicate markings which cannot be reconciled with drawings made at another time. These lines should not be regarded as facts until they have been repeatedly seen by other observers.

Mr. Maunder said: I have observed fine lines on Mars, which appear to correspond with those on Schiaparelli's drawing; but not perfectly. One fine marking, in particular, I have repeatedly observed under favourable circumstances; have frequently seen what might be the commencement and the ending of canals which Schiaparelli has marked, but which I have not been able to trace in their entirety. In many cases I should consider the "canals" rather as the boundaries of delicate tints. I have, however, generally been able to make out the stronger markings that Schiaparelli has delineated.

Mr. Knobel said that in some drawings which he had made in 1879 there were some confirmations of Schiaparelli's markings. He had also distinct markings made on three different nights which were not on Mr. Green's map, and which had not been drawn by Schiaparelli.

The President read a paper on the results obtained from meridian observations of Mars made during the opposition of 1877 at the Cape, at Melbourne, at Leyden, and at Washington.

Mr. Downing thought that the different methods of observation which had been employed might have introduced systematic errors, and asked if Mr. Stone had discovered any difference in the observations made before and after opposition.

The President said that he saw no difference. He did not think that the different methods of observation had introduced any considerable systematic errors.

The following communications were also announced and partly read:—Lieut. W. U. Moore, "Alleged errors in the time-record of observations of the Transit of Venus, 1874, made at Hermitage, Rodriguez"; and D. Gill, "On the best mode of undertaking a discussion of the observations of contact to be made at the approaching Transit of Venus."

ROYAL MICROSCOPICAL SOCIETY.

THE seventh meeting of the session of the above Society was held on the 12th inst. at King's College, Strand, the President (Prof. P. Martin Duncan, F.R.S.) in the chair.

The minutes of the previous meeting were read and confirmed, and the list of donations was submitted, and the thanks of the Society given to the donors.

Mr. M. M. Hartog (of Owens College) described some specimens which he exhibited under microscopes. One of these was Apus cancriformis, the largest of the water-fleas. It had not, to his knowledge, been hitherto recorded in England, the specimen shown having been obtained this spring from some mud received from Germany. The other exhibits were a series of sections of Entomostraca, which had been prepared for histological study. The specimens were killed by adding a few drops of osmic acid to the water in which they were placed, and as soon as they fell to the bottom they were removed to spirit direct. This plan had its advantage inasmuch as any mutilation was thereby avoided; but, on the other hand, by opening them in the osmic acid, a certain amount of maceration was unavoidable, which might sometimes prove to be detrimental to the histology. They were at first transferred to spirit of 30 per cent., and then to 50 per cent., after which they were placed in cochineal solution, and were then washed repeatedly in 70 per cent. alcohol, until they yielded no more colour to it, and afterwards they were placed in 90 per cent., and then in absolute alcohol. They were next treated with a greasy medium, and for this purpose, whilst they were in the absolute alcohol, a small quantity of oil of cloves was poured in; this sank to the bottom of the tube, and the entomostraca would then lie, not at the bottom, but just between the alcohol and the oil of cloves. In this way he had, with specimens which had been unopened, obtained preparations in which there had been absolutely no shrinkage of the protoplasm. Most of the oil of cloves was then poured away, and the specimens having been embedded in a mixture of spermaceti and castor-oil, the sections were cut in the usual way. It would be noticed that the sections were arranged in series on the slide; to do this some benzole was poured on the glass and left to evaporate, and this was sufficient to cement them to it. By this means of preparation he had been able to make out some very important points. The specimens exhibited the entire organs of the body; the nervous cord could be well seen, as could also the gullet with its muscles. A rough sketch made to illustrate the chief points of interest was also exhibited.

Mr. Beck thought the remarks of Mr. Hartog were exceedingly interesting, for if they were ever really to understand these structures, it must be by means of taking sections. He was glad to have heard the very practical remarks which had been made, and hoped they would be the means of inducing others to practise the process, feeling sure that such a study would elucidate many points which were now involved in mystery.

Mr. Stewart said he should like to ask whether, in cutting these sections, a microtome was used, or whether they were cut by hand with a razor. It also occurred to him that this process might also be very useful in the preparation of sections of many of the soft-bodied creatures, such as the mites or the arachnida, for it was very difficult to make out many parts of their anatomy by any process of dissection.

Mr. Hartog, in reply, said that as in all cases where sections had to be cut in series, a microtome was used, in order to insure perfect regularity of thickness; in this case, Zeiss' microtome was employed, using oil to moisten the razor. He agreed that the process would be very useful in the case of mites and spiders; but he thought it well to remark that picric acid—so much in favour with some persons—should be avoided, as it penetrated too freely.

Mr. Crisp called attention to two microscopes which he had brought for exhibition. One of these—which it had been proposed to call the "Jumbo" microscope—stood about 4ft. 6in. high, and weighed about 1¼cwt. It must have been made about fifty years ago. The other, the "Midget"—shown by way of contrast—was completely finished for use, its entire height being only 4in., and its weight a few ounces. Six of such microscopes could be inclosed in the eyepiece of the larger one.

Mr. Beck examined the "Jumbo" instrument, and made some remarks as to the peculiarity of its construction.

Mr. Crisp read a note received from Dr. Loew as to the chemical difference between living and dead protoplasm, and exhibited a photograph illustrating Loew and Bokormy's statement as to the different reaction of dead and living protoplasm on silver salts.

Mr. A. W. Bennett said that the photograph represented two filaments of *Spirogyra nitida*. One of these (*b*) had been subjected in a living condition to the silver reagent; the reducing effect of the living protoplasm had converted the cell-contents into a black opaque mass. The other filament (*a*) had been killed by a 1 per cent. solution of citric acid before treatment with the silver solution. In this case no reduction and consequent blackening is exhibited, the spiral arrangement of the chlorophyll-bands being still perfectly distinct.

Mr. Stewart said he did not see that they had any actual proof that the protoplasm in the one case was dead and in the other living, especially when it was borne in mind that the way in which it was killed was by means of citric acid, a small residual quantity of which he thought might have some effect upon the result.

Mr. Bennett said it was clear that they wanted more particulars before coming to a definite conclusion, though it was naturally to be supposed that all acid had been removed before the tests were applied.

Mr. Hartog referred to the silver-staining processes recently described in the *Journal*.

Mr. Stewart said if they wanted to make silver-staining a test in the case of the tissues of living animals, it would not always be found an easy thing to do. In cases of operations they could probably get living tissues, but there were many parts which it would be very desirable to test with, which could not be obtained until after 24 hours from the time of death, and yet he thought that in such cases the outlines of a cell were as perfectly rendered as if they were living. He was afraid that unless the citric acid were entirely eliminated, it would probably exercise an important influence on the results.

Dr. Matthews felt sure that such would be the case, for it was well known that in photography the developing fluids had been acidified, and this especially by citric acid, for the purpose of retarding the reduction of the silver salt, so that the results where acid had been concerned would be very suspicious. The use of alkaline instead of acid preparations was the secret of the modern rapid processes of photographic development.

Mr. J. E. Ingpen read a paper on the use of diaphragms, illustrating his remarks by drawings upon the black-board. He said the principle governing the application of diaphragms was that they should cut down the cone of rays reflected from the mirror, illustrating the case by drawing on the black-board a cone, having the object on the stage for its apex, and the active diameter of the mirror as its base. That was the cone to be acted upon by any system of diaphragms. He showed that the ordinary wheel of diaphragms in very general use was effective to a certain extent; but he gave the preference very decidedly to the sliding cylinder-diaphragm so largely adopted on the Continent, and stated that the most perfect form of it that he had seen was devised many years ago by M. Varley, in which a double cylinder was used—one working within the other,—the outer one with moderate-sized opening sliding up in the substage, or in the ring provided for the purpose beneath the stage, until in contact with the slide. This cylinder was lined with cloth, to facilitate the sliding-in of the second cylinder, having a similar opening in the cap. By the proper use of this double cylinder the cone of light could be modified in the most perfect manner,—in fact, it left nothing to be desired. Mr. Ingpen further said that diaphragms had been recently brought forward in which the essential principle of action to which he had just directed attention had been entirely ignored. As an example, he referred to a plate of diaphragms devised by Dr. Anthony, consisting of a series of apertures punched in a strip of vellum, to be slid immediately beneath the slide upon the stage, the action of which he described as "merely cutting off stray light." This device did not appear to him effective as a diaphragm on the illuminating cone, inasmuch as at the position in which Dr. Anthony placed it the cone of rays was far too small to be affected by the size of apertures adopted, passing, in fact, completely within the apertures. He might apply the same remarks to the action of the *calotte* diaphragms, which he equally regarded as based on a wrong conception of the action of diaphragms. Mr. Ingpen also said he could not commend the use of the Iris diaphragm, on the ground that it required a special fitting, and could rarely be used near enough to the slide.

The President said he should be glad to hear remarks upon Mr. Ingpen's communication, as he was sure there were many Fellows present who had made a special study of the use of diaphragms.

Mr. J. Mayall, jun., said he thought Mr. Ingpen had misapprehended the purpose of the diaphragm proposed lately by Dr. Anthony. On the supposition that the sole purpose of diaphragms was to reduce the entire cone of the illuminating pencil, Mr. Ingpen had no difficulty in showing that the aperture in Dr. Anthony's diaphragm was too large to be effective in the position in which he placed it—that is, immediately beneath the slide. But there was another purpose in the application of diaphragms—a purpose not touched upon in Mr. Ingpen's remarks, namely, the cutting off different portions of the illuminating pencil, which all workers with high powers on diaphanous structure had felt the need of, and for which innumerable contrivances had been devised.

The mere cutting down the diameter of the illuminating beam was, of course, the main object of the wheel of apertures in common use, and of the cylinder diaphragms referred to by Mr. Ingpen. But Dr. Anthony's diaphragm was intended to supplement the action of the strictly central aperture by a series of apertures that could be easily applied to cut off more or less of the beam after all had been done that was possible in modifying the light with the central apertures—in fact, to use a phrase of Dr. Anthony's, "to give the finishing touch to the illumination."

Mr. Ingpen's statement that this diaphragm served no other purpose than to "stop off stray light" was thus shown to be an error. Regarding the *calotte* diaphragm, Mr. Mayall said he could not agree with Mr. Ingpen's general condemnation. He might remind Mr. Ingpen that the recent application of the *calotte*—used as a diaphragm alone — immediately beneath the slide, was due to Mr. Zeiss, of Jena, who was hardly likely to have adopted it with his portable microscope unless he had found it effective. The still more recent application of the *calotte* *above* the achromatic condenser must be regarded as a step in advance. Mr. Bullock, of Chicago, appeared to be one of the earliest in the field to see that the system of dirphragms supplied *beneath* the optical combination in Gillett's condenser, might be advantageously applied *above* the lenses, where, obviously, the cone of rays is so short and of such great angular extension that every variation in size or shape in the apertures of the *calotte* would be effective. He might also mention that Mr. Swift had adopted the *calotte* in connection with the achromatic condenser. As to the use of the Iris diaphragm, Mr. Mayall thought it was effective for low powers, especially when mounted to fit in the stage itself, as adopted by Messrs Ross; but, so far as his own observations went, he had not been satisfied with it in connection with the achromatic condenser. He believed there were difficulties in the construction which rendered it almost impossible to close the aperture with sufficiently accurate centring to be of real service with the condenser. In conclusion, Mr. Mayall said that the great number of devices that had been brought forward in recent years to cut off portions of the illuminating pencil independently of the mere reduction of the cone by strictly central apertures, proved conclusively that a need was felt in that direction.

Mr. Beck said he could hardly understand what was meant by saying that with the Zeiss diaphragm they could not cut off any portion of the cone of rays, because if it was properly made they could cut off all the rays entirely. Though there might be differences of opinion as to what was the most valuable kind, he thought no one would dispute the great importance of a good diaphragm, which was of extreme value in rendering visible portions of an object which otherwise could not be seen.

Mr. Ingpen said that his remarks were merely taking things as they stood, and did not, of course, apply to the use of the *calotte* diaphragm with the achromatic condenser. The *calotte* diaphragm, as drawn by Mr. Mayall, was very effective, but almost every effect could be obtained by a very small number of stops with tolerably small apertures. Professor Abbe had satisfied himself of this entirely.

The President read a note on the histology of Temnopleuridæ ("Sea Urchins") which he illustrated by drawings upon the blackboard.

Mr. Stewart called attention to a curious change which took place under certain circumstances in the reticulated network. Where there was any friction going on it was found that the interstices became filled up with carbonate of lime, and this seemed to be a case of precisely the same kind as what went on in bone tissues under similar circumstances. Besides the spicules in the hard tissues, there was found a remarkable exception in the structure of the teeth, which more closely resembled silicious rather than calcareous spicules.

Mr. Hartog said that in studying the structure of these organisms it was important to study the soft parts in connection with the hard ones. To do this the specimen should be first stained and then saturated with liquid Canada balsam, which should then be evaporated down to a resin; sections could then be cut through the shell and the soft parts at the same time, showing them together *in situ*, and stained so far as they could be. This was, he said, Koch's method.

Mr. Stewart said that in Koch's method it was solid copal varnish which was used instead of solid Canada balsam, the latter being too brittle to enable good sections to be cut. He had seen sections which had been made by this method, and they certainly showed the structure remarkably well in the corals, &c.

The President said that Koch's method was a most excellent one as applied to corals, but it did not answer so well for Echinoderms. He had found it a very good plan to dissolve out the calcareous portions with weak acid. With regard to the fossil forms, they all knew that the reticulated structure was entirely lost during fossilisation when it seemed entirely filled up by calcite.

Mr. Stewart remarked that this complex network showed under the polariscope a common axis of tension passing through the entire body.

The President announced the second conversazione of the session for the 26th April; he then adjourned the meeting to May 12th.

SCIENTIFIC NEWS.

◆◆◆

THE installation of the Edison electric lighting system on the Holborn Viaduct has been the most interesting event of the past week, and we have now an application of the new light to the wants of everyday life. The incandescent lamps are employed for illuminating a chapel, the front of a railway station, a hotel, a restaurant, and sundry shops, warehouses, and offices. Besides those instances, there are a number of street-lamps, and as Siemens's regenerative gas-burners are in use from the Viaduct to Holborn Bars, a capital opportunity is afforded for direct comparison of the rival systems. The dynamo is the large machine exhibited at Paris, which is driven by a Porter-Allen engine fixed on the same base-plate. The armature makes 350 revolutions a minute, and the current produced is over 1,000 ampères, sufficient to supply about 1,000 lamps of 16 candle-power. The lamps being all arranged in what is known as multiple arc, the E.M.F. of the machine is very low, and the whole current can be passed through the body without injury.

Mr. J. R. Hind writes that, from observations at Harvard, Vienna, and Rome, he has determined the following orbit for comet Wells:—T. June 9·9697; π 54° 25′ 17″, ☊ 204° 37′ 42″, i 73° 35 39″, log q 8·748238. According to this orbit, the theoretical intensity of the comet's light at noon, June 10, will be 3,600 times greater than on March 19. The comet will be a naked-eye object in the latter part of May, and be visible in powerful telescopes in broad daylight. It will be always above the horizon of these latitudes until the beginning of June. The R.A. on April 22 will be 0h. 25m. 49s., N.D., 59° 31′ Greenwich midnight.

The English observers of the eclipse of the 17th May are busy preparing for their departure. Captain Abney will, we believe, not be able to go, but Dr. A. Schuster will take his place. Mr. Ranyard has made elaborate arrangements for securing photographs of the eclipse in all its stages.

The French commission, for the observation of the Transit of Venus, have completed their arrangements, and the astronomers selected for the work are already practising with the instruments. Three kinds of observations will be made—viz., photographic, direct contact, and by means of refracting prisms and micrometrical distances. The stations selected are Gaudaloupe or Martinique, under M. Tisserand, Cuba, M. d'Abadie; Florida, Colonel Perrier; Mexico, M. Bouquet de la Grye; Patagonia, M. Perrotin; Santa Cruz, Captain Fleuriais. Ingress and egress will be observed at all stations.

Mr. W. Peck has published (Archibald and Peck, Edinburgh) charts and diagrams of the transit, with explanations, showing at a glance all the places that are favourably situated for observation, and the times of beginning and ending, over the globe.

Mr. Stretton's pamphlet on railway accidents, the new edition of which we referred to last week, has been issued. It will be found interesting by all who are in any way concerned with railways, whether as shareholders, operators, or travellers. It is published by Spencer Bros. and Russell, Leicester.

Edison's electric railway at Menlo Park is making rapid progress, several miles being now complete and in working order. The line has several curves and gradients, one of 1 in 176. The current is conveyed by two wires of large section, one connected to each rail, which is insulated.

The *Alaska*, probably owing to the prevalence of easterly winds, has beaten her own record on the Transatlantic passage. On her last voyage she completed the run from Queenstown to New York in 7 days, 4 hours, 24 minutes, two hours and twenty minutes less than the voyage from New York to Queenstown. She has thus established her reputation as the fastest vessel following the shortest track across the Atlantic. The Cunarders go further south and make a longer distance of the voyage.

The rumours of new steamers being built in the United States are not with foundation, and we can wait with patience for their promised performances. The following is the description which has been published, and which has not been contradicted. "The vessel is built of wood, has a turtle-back deck, no masts, and nothing on deck except a pilot-house, ventilators, and the smoke pipe. The length is 151½ft., the breadth of beam is 22ft., the depth of the hold 16½ft., the draught forward is 5½ft., and aft 10½ft. The capacity is 512 tons. She will have three screws; the main one of four blades and of such pitch as to be capable of a speed of 30 knots an hour. The others will be fitted in the stern, behind the plates, and will be used in case of accident, when the plates will be used to steer with. The engines are of new design, and the ship is to be named the *Meteor*." Messrs. Biven and Lorillard are the active agents in the new scheme, which, judging by the above, has some peculiar features.

The Viceroy of India recently laid the foundation stone of the new buildings at Calcutta of the Indian Association for the Cultivation of Science. The object of the institution is to afford students the opportunity of pursuing their studies after they have left college.

Mr. Jennings, of Baltimore, U.S., patents a method of utilising the volatile matters given off by coffee-beans when roasting. The fumes are first passed through hot water, then through cold to separate the constituents, which are subsequently mixed with a mucilaginous vehicle, and used to coat the roasted beans.

Mr. Banks, of Birmingham, has hit upon a method of combining the pickling of metal plates with the production of electricity, and has obtained a patent. It is No. 3,771, of 1881.

An interesting simplification of dynamo-electric machines has been recently described to the Belgian Academy by Capt. Plucker, of Antwerp. It consists in substitution of a solenoid for the electro-magnet, whose branches (in the Gramme machine) embrace the cylindrical surface of the rotating coil. The arrangement is that of a movable coil, rotated within a fixed coil. The inducing current traverses the solenoid, and develops, in the movable coil, induced currents which are employed as in the Gramme. The induction is strengthened by means of iron armatures placed near. Captain Plucker put electro-magnets in place of the solenoid, and obtained the same effect. He claims for his system the advantage of smaller weight and volume.

In a recent memoir on landslips, Professor Heim distinguishes two principal categories of these: descent of movable ground, and that of rocks in position. Among the former cases he distinguishes first those which are characterised by slipping: this has been frequent in the history of the Swiss Alps, and a good example is the village of Fetan, in the Engadine, the position of which becomes increasingly critical, through the ground about it gradually sliding down. Then there are the cases of descent of rolling materials; *e.g.* at Bilten in the canton of Glaris (29 April, 1868). As to descent of rocks in position, one may again distinguish cases of slipping, such as that of the Rossberg, which buried Goldau on 2nd Sept., 1806; and falls of rocks, or fragments of mountain more or less considerable. It is to this last category that most of the cases in Switzerland must be referred. Professor Heim gives a catalogue of the chief landslips, from that of 13th June, 1486, which destroyed Zarera, in the valley of Poschiavo, to that of Elm. A large number are of combined types, and some cases (currents of mud, subsidence) do not find a place in the above classification. As a rule, the outline of mountains is but little affected by the loss of those portions which descend from them.

An important industry (we learn from *La Nature*) has sprung up within the last few years in the French department of Landes, through the enterprise of M. Charavil. It consists in extraction and applications of oils from pine. These oils are of two sorts: the heavy (pinoleum), obtained by distilling the resinous wood at a low temperature, and used for painting and wood-preserving; and the light oil for illumination, got by distilling in special apparatus, and purified with chemical agents. This light oil has the same chemical composition as oil of turpentine ($C_{20}H_{16}$), and distils at the same temperature (150° to 160°), but has the advantage of not resinifying. It contains neither pinic nor sylvic acid. As it does not emit vapours except at a high temperature, its use for lighting purposes is quite safe. Its luminous intensity is greater than that of petroleum; it contains 88 per cent. of carbon, while petroleum has 82 per cent. Two similar burners showed the pine oil to have an advantage of 33 per cent. in luminous intensity; the consumption was also less. In the department of Landes, roots and old stumps of pine, formerly unutilised, are now made to render considerable quantities of oil.

It is now recognised that a plant does not draw its food from a nutritive solution fully prepared, but prepares it itself by direct and intimate contact of its cells (which have always a slightly acid reaction) with the earth particles, in which nutritive elements have been fixed by way of physical absorption or chemical precipitation. The analytical chemist has to use strong mineral acids to redissolve these fixed matters, and there is the inconvenience that the acids also dissolve elements in combination by which a plant could not directly benefit. Hence imperfect information as to the degree of fertility of soils. M. Petermann is now seeking to develop a new method of analysis—viz., by dialysis of arable soil. In a preliminary paper to the Belgian Academy he finds that (1) arable soil yields to distilled water, from which it is separated by a vegetal membrane, the following nutritive substances: lime, magnesia, oxide of iron, potash, soda, chlorine, sulphuric acid, silicic acid, phosphoric acid, and nitric acid. (2) Arable soil contains organic matters which pass easily by diffusion through a vegetal membrane.

The American silk industry, according to Mr. Blodget (in a recent paper to the Franklin Institute), is the third of the textile class in the country; it amounts to nearly 50 million dollars in value of actual manufactures, as compared with 250 million for cotton, and 300 million for woollen and woollen-mixed goods. Silk goods are imported to the extent of 35 millions. Most of the raw material is, of course, imported from Japan and China (about 4 million pounds of raw silk, 3 million of reeled, and one million of spun and waste silk). Philadelphia has several new machines and combinations for silk manufacture, greatly superior to those used in Europe. There are several hundred compound looms there, each doing the work of ten to sixteen hand-loom weavers. Mr. Blodget denies the alleged inferiority of silk grown in America, and urges an extended culture of it. It has been the object of the "Women's Silk Culture Association of the United States," since 1880, to promote this culture, and there is a great demand all over the country for the instruction they supply.

A new incandescence-lamp has been recently invented by Dr. Regnard, and is suitable for projections, where the electricity or the lime-light cannot be had, as well as for other purposes. In it a mixture of air and petroleum vapour is burnt on a piece of platinum net, which is thus raised to a white heat. The lamp consists of a Bunsen burner, the mouth of which is closed by a small cage of platinum wire. The burner is connected below by means of caoutchouc tubing with a stoppered jar holding petroleum; the stopper supports a longer and a shorter glass tube, the former dipping in the liquid and being connected with bellows, or other blowing apparatus; the other connected with the lamp. With a continuous air-current, several of the lamps may be kept in action at once, to light halls, &c., and the aspect resembles that of a Swan lamp. (The lamp is illustrated in *La Nature*, April 8).

A recent inquiry by Herr Wollny into the influence of colour of ground on its heating, yields the following results. (1) The colour of arable land of approximately the same nature, affects its heating to a comparatively great depth. This influence is different according to the season, time of day, and amount of cloudiness. In the warm season, at the time of daily maximum of ground-temperature, and with unhindered radiation, the ground is hotter the darker the colour. The differences of temperature between bright and dark-coloured ground disappear more or less in the cold season, at the time of the daily minimum of temperature, with diminished insolation, and at great depths. (2) The daily variations of temperature are greater with dark coloration than with bright. They are generally greater, the greater the differences in the mean temperature, and conversely. (3

The influence of colour indicated in (1) decreases in proportion as the water-content increases, and the other factors which determine the heating of arable land (especially heat, heat-conduction, absorption of heat through evaporation, &c)., gain the preponderance. With great differences in physical properties, chiefly caused by a larger amount of humus, and water capacity, the influence of colour may be wholly set aside.

The value of sulphurous anhydride as a disinfectant has been well demonstrated of late by M. Fatio. A great difficulty, however, presented itself in the imperfection of the instruments for decanting and distributing the gas liquefied under strong pressure. M. Fatio has devised suitable apparatus for the purpose, and describes it in detail in the *Archives des Sciences*, under the name of *siphonoid* apparatus, and a special *transvaseur*, which admits of charging quickly and without danger his flagons for application of the substance, or the vessels in which the Industrial Company for R. Pictet's processes delivers anhydrous sulphurous acid.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

A REMARKABLE SUNSPOT — THE MOTION OF SIRIUS IN SPACE—SCIENTIFIC RESEARCH AND THE ROYAL SOCIETY—OCCULTATION OF A STAR—LENGTH OF A DEGREE OF LONGITUDE—ο LEONIS, &c.

[19935.]—I am curious to know if any of my brother-readers noticed a very remarkable spot—or group of Spots—just to the North of the Sun's Equator, and somewhat to the East of his central Meridian, on the 11th inst.? It consisted of one normally shaped spot, equably surrounded by its penumbra; but connected with this by a line of small ones was another, having the form of a *line* of irregular thickness, suggesting the idea of a black "rill." Of course, everyone who has ever looked at the Sun at all, is familiar with the effect of foreshortening on Spots, in virtue of which they present a linear effect when close to the Solar limb; but in this case the Spot was not so very far from the Sun's centre. I invite attention to this, because it seems difficult to account for the existence of a ditch-shaped orifice in the extremely mobile envelope of the Sun, upon any recognised dynamical principles. By the bye, there is a remarkably fine and singularly complicated group of spots just coming on to the Sun's following limb this (Friday) morning.

There are half a dozen lines on p. 234 of the current number of the R.A.S. *Monthly Notices* which, while in all probability they will be passed over cursorily by two-thirds of its readers, contain the record of a fact of the very highest physical interest. All who have followed the masterly researches of the head of British Spectroscopy, Dr. Huggins, and the almost equally valuable work performed at Greenwich by Messrs. Christie and Maunder, must be familiar with the fact that Sirius has been for some years travelling away from the Earth at a rate which, at the time Dr. Huggins first detected its recession, amounted to 29½ miles per second. Since then this has been a gradually diminishing quantity, and for a time last year Sirius appeared to be stationary. Now the measures which, as I have intimated above, are recorded in the *Monthly Notices* for March, show that the sign of the star's motion in the line of sight has changed, and that Sirius is approaching us again. Here, then, is a most remarkable confirmation of the hypothesis that the Dog-star is describing a stupendous orbit round some invisible centre.

Mr. Bruce Allen (letter 19920, p. 127) may rest assured that the excellent suggestion contained in his concluding paragraph will never be carried out, so long as the present ring of wire-pullers at Brompton are suffered to influence the scientific advisers to the Government. To divide the sum now annually voted for (so-called) "scientific research," and to commit its administration to the societies specially qualified to deal with it advantageously to the sciences they were respectively established to promote, would be to inflict a death-blow upon jobbery, which is now rampant. Depend upon it, that an annual grant to the Royal Astronomical Society would be expended in a way which would do ten times more towards the advance of astronomy than five times the amount would if distributed by the Royal Society; and, *mutato nomine*, the same thing may be definitely predicated of Government contributions intrusted to the Geological, Chemical, Linnæan, or other Societies. But this would cut at the root of a system in virtue of which the quacks, humbugs, and self-advertisers of science at present get the lion's share of whatever is going in the shape of Government grants and appointments, and would seriously diminish the receipts of some of the disinterested scientific advisers of the Ministry.

I regret my inability to clear up the difficulty of "W.S." (query 46622, p. 138); but I can, at all events, assure him that π Leonis was not the star which he saw occulted on the 30th ult. The Moon passed considerably to the south of π, as seen from Greenwich, and, *à fortiori*, must have gone further south of it still, as observed at Sheffield. "W.S.'s" object may possibly have been an unnamed 6th mag. star N. of 9 Sextantis, shown on Map 6 of Proctor's large "Star Atlas."

I must ask Mr. Atkinson (query 46645, p. 139) to forgive me for pointing out that he is slightly confusing two different things: linear and angular measure. Every parallel of latitude on the Earth's surface, from the equator to the Poles, is supposed to be divided, indifferently, into 360° or 24 hours; and consequently 15″ of arc are as much equivalent to 1sec. of time in Spitzbergen as they are on the Gaboon. But the actual length of a degree *in miles* differs widely at any two places so far separated as these in latitude. At the equator we may take such length to be 69·1634 miles; and, assuming for our present purpose that the earth is a sphere, we have only to multiply this quantity by the cosine of the latitude of any given station to determine the length of a degree there. Performing this operation for the latitude of Greenwich, 51° 30′, we find that a degree must there measure 43·0552 miles. Bear in mind, though, that these 43·0552 miles take 4 minutes to travel through 1-360th of the circumference of the celestial vault, just as do the 69·1634 miles at the Equator. My querist will find a very extensive table of the "Length of a Degree of Longitude and Latitude, &c.," at the end of Loomis's "Practical Astronomy." This is accurately calculated from the ascertained data of the Earth's spheroidal form.

In reply to query 46647 (p. 139), I know nothing of ο Leonis as a double star, beyond the fact that it is so marked in Proctor's large "Star Atlas." I would add that stars 100″ apart are not nowadays regarded as "double" at all—but as two separate ones. Doubtless "J. A." has not found anything new. I cannot answer his question as to the present magnitude of R Leonis, as this letter must be posted in daylight on the day that his query appears.

A Fellow of the Royal Astronomical Society.

COMET "A," 1882—DOUBLE STARS IN "GEMINI," "COMA BERENICES," AND BOÖTES.

[19936.] – Comet A, 1882 (Wells), was observed here last night (April 15) with 4in. Cooke Equatorial.

It was found close to the position assigned to it in Lord Crawford's circular No. 49.

Apparent position at 10h. G.M.T., R.A. 18h. 53·3m., N.D. 52° 32′. Position angle of tail estimated ± 260°.

With low-power positive eyepiece, the tail could be traced a considerable distance, and it was observed to be straight, and without any considerable expansion at its farther end. "Coma" bright, and bore magnifying well. Even with a power of 225, its cometary character was still quite apparent.

This comet is now within the reach of small apertures. A 2¾in. will suffice to pick it up. I found it still plainly visible with a stop of this aperture and powers 36 and 60.

Will Mr. Webb or "F.R.A.S." examine ΟΣ 266 (Coma Berenices)? The latest measures I am aware of give P = 336·1°, D 1·22″ (see Crossley's Handbook). I observed this object on 15th April, and I am of opinion that the distance is now at least 1·5″. The distance seems not to have changed appreciably up to 1877, since measured by ΟΣ in 1846. It would, therefore, seem strange that so considerable an increase of distance should have taken place since 1877. If this star be compared with Σ 1699, in the same constellation, the distance of which is given ("Celestial Objects") as 1·5″, it will be found that the latter is now the closer of the two. They were both perfectly easy objects with 4in. Cooke achromatic, power 225.

μ′ Boötis.—In examining this star on 15th April I was struck by the faintness of the 8th mag. companion. It seems to me to be more like 10 than 8 at present. The night was clear and suitable for faint objects, as I had no difficulty in seeing the small *comes*, *n f.* η Coronæ, spoken of by Smyth as being a glimpse star with 5·9in. aperture.

κ and δ Geminorum.—Mr. Webb, in "Celestial Objects" (4th edition) says the *comes* of κ suspected variable (8·5 – 14). It is now certainly much fainter than the companion of δ, which is rated as 9th mag. by Smyth, and called 8·2 by ΟΣ. I have noted on March 11, 1882, "the small *comes*" of κ is not now brighter than the 14th mag. *comes* of δ seen by Sadler.

David Simms.

Limavady, Co. Derry, April 16.

OBSERVATIONS OF KNOWN DOUBLE STARS—THE VARIABLE STARS 19 PISCIUM, AND IOTA ANDROMEDÆ.

[19937.]—The following objects form the first of a series of observations we hope to give from time to time. We hope to survey the chief objects of interest known in the sky visible in England, and also to find and publish others hitherto unknown, through the pages of the English Mechanic. In order to prevent any observations clashing, we have each taken certain parts of the sky, which will be indicated by the following limits:—

Section I. Mr. Gage's, 0°—40° declination North.
,, II. Mr. Read's, 40°—80° declination North.
,, III. Mr. Espin's, 80°—90° N., and all S of the equator.

But for the convenience of each observer, the original plan has been slightly modified. Some of the constellations in section I. being given to Mr. Read, and *vice versâ*. The telescopes employed are:—

Section I. Mr. Gage, 6¼in. refractor.
,, II. Mr. Read, 4¼ ,,
,, III. Mr. Espin, 5 ,,

Section I.—Mr. Gage's Observations.

ε Arietis, January 9th, 1882.—Easily split with one of Browning's achromatics, power 200.

ι Cancri.—Orange and blue. Is large star double?

ρ Cancri.—Seen triple with 8½ Calver reflector.

ε Hydræ.—January 28th. *Comes* blue.

α Leonis (Regulus).—Saw *comes* double on February 1st, also on March 4th and 14th, with 8½ Calver reflector. Colour of Regulus is bluish-white, and of *comes* deep yellow.

6 Leonis.—I think there is one very faint *comes*, *s p.* 12″ ±, and perhaps another, *s f.* at same distance. P = 180° ±.

88 Leonis.—Yellow and lilac. Close *n.p.* is a wide pair of very minute stars, 13—14 mag. P = 225° ± D, = 20″ ±.

30 Tauri—Easy. Colours white and lilac. Is comes so low as 10 mag.?

Section II.—Mr. Read's Observations.

19 Piscium.—This star is certainly variable. Flammarion ("Les Etoiles, p. 266) remarks:—"L' ètoile 19 Piscium notée de 6e, grandeur par tous les observateurs du siècle dernier et de celui-ci surpasse aujourd'hui les étoiles de la cinquième." He makes it 4·9 mag.; Gould, who suspects it of variation, makes it 4·9; Birmingham makes it 6·2; Espin gives the limits of variation as 4·9 and 6·5. From several observations made Dec., 1881, it was found to be 5·3, or perhaps slightly fainter than this. This star is Birm. 648; in Dec. 1881 it appeared of a fine reddish orange colour. I feel certain, however, that the red tint is not so decided as when I observed it in Dec., 1879; it may possibly vary in colour also. 30 Piscium, marked by Gould as red, I only observed to be golden, with a slight tinge of red. 33 Piscium, 22 Piscium seemed pale golden and pale orange: these are also marked red by Gould—all these stars are, however, well worth looking at. μ, γ, δ, ο Piscium are also fine objects, all of a fine golden colour.

ρ Piscium.—A, pale yellow; B, bluish. This star is variable (vide Webb). Gould gives its magnitude as 4·8. It has, however, brightened slightly of late.

ι Andromedæ.—Gore suspects this star of variation, and thinks the period is probably short (R.A.S. *Notices*, Vol. XXXIX., p. 199). It has been watched on several occasions during November and December, 1881; but no appreciable variation was ever detected in its light. At the same time, if the estimates of it by previous observers are to be at all relied on, it must have varied considerably at different times, and should certainly be watched.

20 Geminorum.—A, col. dull yellow; B, dusky white. B was found slightly fainter and duskier than A; but there was little difference in colour or magnitude. The two stars probably vary in colour and magnitude.

μ and η Geminorum are two very fine objects, very similar in colour, both deep golden. The field round η with a very low power is fine.

Section III.—Mr. Espin's Observations.

19 Piscium.—The following are my estimates of magnitude:—

1880.	September	2	4·8
,,	,,	4	4·8
1881.	August	3	5·7
,,	September	30	6 0
,,	October	1	6·2 or less
,,	,,	15	5·5
,,	,,	17	5·5
,,	December		5·3—5·4 Mr. Read's observations.

The star thus appears to have passed through a maximum and a minimum, and we shall have for comparison with future observations:—

Maximum, 1880, Sept. 3.
Minimum, 1881, Oct. 1.

If this be considered to represent a period and a half (which seems not improbable), we should thus have as an approximate period

$$P = 260 \text{ days,}$$

and a maximum should have taken place about Feb. 11th last.

27 Hydræ.—A wide but fine pair not in "Celestial Objects." The colours were noted on March 15 as yellow and blue.

Σ 1357 Hydræ.—This star will be found 1¼° south of α Hydræ. It is the following star of two bright 7 mag. stars forming a wide pair, and in the same low-powered field is another wide 7 mag. or 8 mag. pair further to the south. The companion of this double star was rated 10·5 by Σ., and as it is only 7″ distant it is not a very easy object. It was rated as 12 mag. of Herschel's scale. When once seen, however, it is not difficult to hold steadily. It was picked up by accident when sweeping over this region a few years ago. The field is fine. The large star is of a deep yellow, while the companion is bluish by contrast, Σ 1367 lies 4min. following it, and about a degree to the South.

ι Leporis.—Here we have another of Σ. stars rated at 10·5 mag. It was rated 12 mag. by Smyth. On one night in January the star was accidentally swept over, and the companion at once seen, and rated about 10½ of Herschel's scale.

Nebula 3900 Virginis.—A pretty object, somewhat circular, and which appeared on March 11 as a sparkling nebulosity. A star 8 mag. lies *s f.* quite close to the nebula. The star is orange. The field is well worth looking at. The nebula can easily be picked up by sweeping between ι and μ Virginis, and it will be found about half-way between the two, and hence to the N. of 106 Virginis.

In our next paper we hope to give the approximate place and positions of some new pairs lately found.

T. E. Espin.
W. H. Gage.
T. Read.

ASTRONOMICAL—ζ CANCRI—R LEONIS—DOUBLE STAR.

[19938.]—I AM much obliged to M. Gaudibert for his courteous anticipation (19888) of my reply to Mr. Mills respecting ζ Cancri. The inquiry had not been forgotten; but, owing to absence and various hindrances, I had for a long time had no opportunity of examining the object. When I attempted it a few nights ago the discs were mere balls of wool in a great haze; but last night being unusually favourable, with only a little unsteadiness, I found, with my beautiful 9⅓in. With mirror, the close pair too hard for a power probably under 200; with a Browning E ocular, about 375, it was distinctly split; and with 450 there was a strong black division, which in better air would probably have more than equalled the half of either disc. M. Gaudibert's telescope (I believe by the same accomplished artist) must be a very fine one. The Washington mean of six not very accordant observations in 1878 was 0·813″. From a communication with which I have been favoured by Mr. Perry, it is now closer still, and forms a severe test for any but first-class instruments.

In reply to "J. A." (46647); he will easily find R Leonis by taking his largest field and putting Regulus boldly out of it to the north, the difference of declination being 34′; a sweep some distance westward will then bring in R, which is now very conspicuous, about 7 mag., and of a splendid red colour. This direction, though intended for an equatorial mounting, will of course apply equally to an altazimuth if the objects are on or near the meridian. Not having previously refreshed my memory from the ENGLISH MECHANIC, I am sorry to say that it did not occur to me to look for the companion to Omicron.

I swept across a pair about 8 and 10 mags., some 29m. E., 25′ S. from Regulus; the place is *very* rough, but sufficient to find it, as it is insulated. Though very wide, the contrast of colour makes it a pretty object.

T. W. Webb.

Hardwick Vicarage, April 15.

TELESCOPES BY THE "OLD MASTERS."

[19939.]—WILL you kindly permit me, in thanking those who have sent information on this subject, to supplement my former letter by stating that to render the proposed tabular arrangement of more interest than a mere list of telescopes, I should be glad to receive particulars of foci as well as apertures of object-glasses and mirrors; experiments to determine their dividing power, details of the powers employed, more especially the results of any experiments with specially high powers, such as were formerly employed in certain cases, and so forth? These results would be only given *generally* in the tabular statements, so as to avoid any appearance of invidious comparisons between the telescopes of different owners; while at the same time they would enable a comparison to be (to a certain extent) made with modern instruments. Comparative light-tests between different specula would also be valuable. I think, in conclusion, I may venture to quote the following from a letter received from our well-known contributor, Mr. P. Vallance—"I hope you will succeed in tracing the fine instruments of Dollond and Tulley, and others of the old makers, as I believe the readers of the ENGLISH MECHANIC would be obliged for a report on them." L. L. L.

DOUBLE OBJECT-GLASSES.

[19940.]—PERHAPS if "E. Y. J." showed his concave to some optician other than the maker, he might learn whether his lens was (in reasonable probability) made of the kind of glass he ordered. It most likely *is* flint-glass, for it is not, I think, usual to grind concaves of crown-glass; but opticians seem not always to be able to supply what they profess. Out of about two dozen, I have three which are not to order or to invoice; but it is something of a favour to supply a lens of an unusual description, and I am afraid a dissatisfied customer for small lenses would not fare particularly well.

I hope "E. Y. J." remembered my caution that his eyepiece, if used with the concave, would very possibly magnify too much. I thought it quite enough as it stood for most nights, and the addition of the concave to *that* power eyepiece would not, I apprehend, improve the definition—probably the reverse.

Webb (page 7) thinks 50 to the inch more than sufficient, generally, upon the *planets* or *moon*; if this be so with well-made expensive achromatics, how can the confessedly inferior construction of the dialyte, or the old refractor, be expected (especially when made by an amateur), to stand it?

"E. Y. J.'s" remarks as to construction of a telescope agree with my experience. I, however, used a *square* tube of thin poplar, and prefer at least 8ft. to 10ft. focus. Arthur Hinde.

THE TELECTROSCOPE, OR "SEEING BY ELECTRICITY."

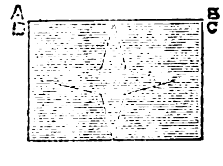
[19941.]—I HAVE lately been giving a good deal of thought to this subject, of which the following apparatus is the result. As, however, there are several points in it about which I am somewhat doubtful, I should be glad if any correspondents would give me their opinions, and the benefit of any knowledge which they have bearing upon the subject.

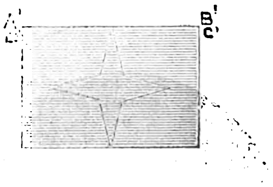
In all previous efforts in this direction, I believe, the image of the object to be transmitted is projected either upon a single selenium cell, which, by itself moving, receives upon it the successive portions of the image, as in Bidwell's apparatus (see Vol. XXXIII., page 180), or upon a plate containing a great number of tiny selenium cells, which is stationary, each cell in turn transmitting a current corresponding to the portion of the image which impinges on it, as in Senlecq's apparatus (see Vol. XXXII., page 534). In both of these instruments, however, no actual image is formed at the receiving end, but merely a printed representation. Now, in the following apparatus, provided I have made no invalid assumption, and that the somewhat numerous practical difficulties can be overcome—an image in light and shade will be formed upon a screen at the receiving end, an exact counterpart of that at the transmitting end; and, more than this, every change in the image in the transmitter will be faithfully depicted upon the screen of the receiver.

Either of the above forms of transmitter may be used. We will suppose, however, that we use one similar to Bidwell's, in which a single selenium cell, by moving in parallel lines very close together, receives upon it, in succession, every portion of the image of the object projected upon it by a powerful lens. We will now turn our attention to the receiver, which is, I believe, quite novel. It consists essentially of an ordinary lantern to project a strong beam of light through a pair of Nicols prisms, and also of a pair of ordinary achromatic prisms, one placed vertically and the other horizontally in front of these, each capable of turning about its axis, and beyond these is placed a screen.

Suppose the Nicol's prisms to be so placed with regard to each other that the maximum amount of light passes through them, then a beam of light from the lantern passes through the two Nicols, next through the vertical prism, then through the horizontal one, and finally forms a small spot of light upon the screen; and it is evident that, by slightly turning the vertical prism about its axis, the spot of light can be moved in a horizontal direction along the screen, and that by turning the horizontal prism it can be moved in a vertical direction. Hence, by combining the motions of these two prisms, the spot of light can be brought into any position whatever upon the screen. Moreover, if one of the Nicols be rotated, the brightness of the spot will gradually diminish, and, finally, when it has been turned through an angle of 90°, altogether disappears. Hence, by this arrangement, we can vary the position of the spot of light upon the screen, and augment or diminish its brightness at will.

Let us suppose that the selenium cell is at a point A, and is moving along the line A B; also that the spot of light is at the point A′ on the screen, and that the vertical prism is turned in such a manner that the spot moves along A′ B′ in the same time that the selenium cell moves along A B.





Next, let the selenium cell move along C D, and let the horizontal prism be so turned that the spot of light is at C′ when the cell is at C, and let the vertical one be turned as before so that the spot travels along C′ D′ in the same time that the cell does along C D, and so on, until the cell has passed over the whole of the image; when this has been accomplished, the cell starting again at A and the spot at A′.

The selenium cell forms part of a circuit which passes round an electro-magnet at the distant receiving station; this, by suitable mechanism, turns one of the Nicols through a greater or less angle—in no case, however, greater than 90°—according as the current passing round the magnet is greater or less, that is, according as a greater or less bright portion of the image impinges on the cell.

Suppose now that the cell is in absolute darkness, and that in this case the Nicols are placed so that no light passes through them; then no spot appears upon the receiving screen, and all is dark. Let the cell be now set in motion, then, as it moves into the light, a stronger current passes, the Nicols are turned by the magnet, and the spot of light flashes on the screen, moving synchronously, as above described, with the selenium cell. Moreover, as the cell moves into brighter portions of the image, the Nicol is turned through a larger angle, and the spot becomes correspondingly brighter, and *vice versâ*; so that the spot not only moves synchronously with the selenium cell, but its brightness also varies as the brightness of the portion of the image which the cell receives upon it.

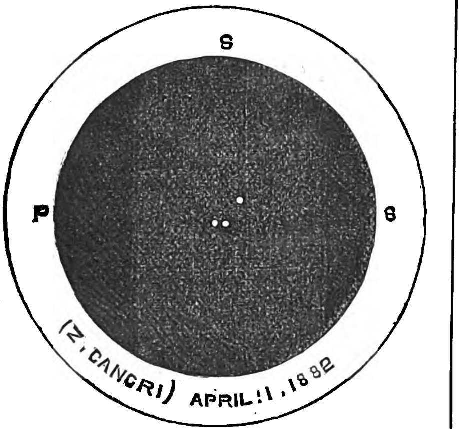
If now the selenium cell moves over the whole image, and again reaches its first position within the time of visual impression, the spot of light on the screen will also move over the whole screen within the time of visual impression, so that the impression of the spot at the first point will not have faded away until the whole screen has been traversed and the first point has again been reached. In this way an image will be apparently produced upon the screen in the same way as a whirling brand produces the impression of a continuous ring of light, and by continuing the motion of the apparatus the image will not merely be momentary, but may be retained for any required length of me.

This completes the description of the outlines of the apparatus. I have confined myself merely to its principles, and have not touched upon the mechanism by which the various motions of the cell and prisms will be produced, for the simple reason that I have not, as yet, fully worked them out. The motions required are somewhat involved, and the fact that they must be synchronous and have a high speed still further complicates the mechanism by which they must be produced; but here I do not think that any insurmountable difficulties will be encountered. There are, however, two points in the principles, both of vital importance, with regard to which I should be particularly glad to have the opinions of others. Firstly, the selenium cell must move at a very rapid rate. Do the changes in the resistance of the cell take place with sufficient rapidity to admit of this? Secondly: Supposing this to be the case, are these changes in the resistance great enough to produce such a change in the current as to produce a corresponding change in the position of the Nicol's prism? That is to say, is the difference in the strengths of the currents when the cell is in absolute darkness, and when it is illuminated by the maximum amount of light, great enough to rotate the Nicols through 90°, mechanism being used to effect this which magnifies as much as possible the movements of the armature of the electro-magnet? The first difficulty could, I think, be overcome by using a transmitter of a form somewhat similar to M. Senlecq's, which has been mentioned above. The description of this, however, I must, I think, defer to another letter, as I fear I shall be trespassing too much on valuable space. **W. L.**

ζ CANCRI.

[19942.]—Thanks to Mr. C. Gaudibert for his interesting observations on ζ Cancri (letter 19888).

On the 1st of April last, when testing a 12¼in. mirror, ground and figured for me by Marsden, I turned it on this star, and with full aperture and powers of 400, divided as in my diagram. I was struck by the position angle of A B. Webb, in his new edition of "Celestial Objects," gives it 108° in 1877; and so also do Crossley and Gledhill. Judging from the appearance of the group, I would be inclined to say the angle must be now about 80° or less Of late years it has been decreasing, and it would be interesting to know at what rate, as the periodic time is variously given by different observers. Will Mr. Gaudibert kindly look again at this star, and note the position angle of its components and say also what power he uses in dividing it with 5½in. aperture?

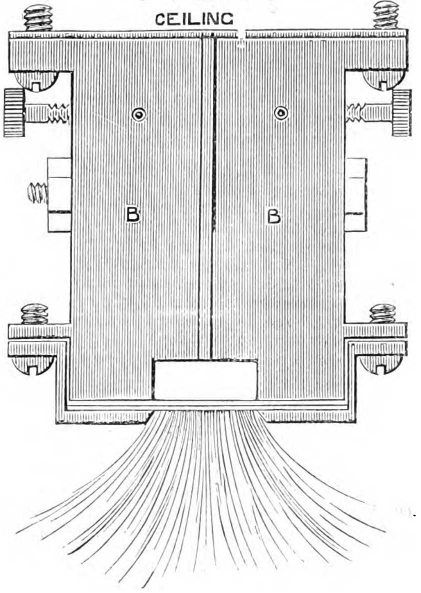


Droylsden Rectory, April 8th. **S. Mills.**

PLATINUM ELECTRIC LIGHT.

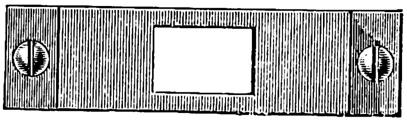
[19943.]—Amongst the many ideas which are now occupying the public attention on the new light, I have ventured to forward mine. We are now told that carbon gives out in a short time. Platinum is everything which could be desired, but melts if the current becomes excessive. To obviate this difficulty, I propose to use talc as a medium of protection, which (if I mistake not) resists a great heat, where glass would be inadmissible. Fig. 1, B B, represents two brass castings separated by an insulating material, as is also the ceiling. The binding screws are seen just below the screws which fasten to the ceiling. A bolt passes (insulated) right through the middle to unite the castings. The recess below is to be filled with calcined magnesia, or lime compressed well together, making all a flat surface. A thin piece of platinum, same size, is laid on this surface, and over that a piece of talc, same size, and then the cap, Fig. 2, is put on and screwed up tight, means, of course, being applied for insulation and making airtight. The cap is shown in section in Fig. 1, in order that the layers of platinum and talc may be seen. The terminals are put in the holes above B B, and screwed up. Then all is ready for the current.

FIG. 1.



Here, if the platinum happens to melt, it does not matter, and its resistance to oxygen being also very great, its durability may be expected to be everlasting; and again, no space being left for air or other gases, there is no need for the troublesome exhausting process. Should the talc not be very lasting, it may easily be replaced by pieces of the size kept ready for use (cheaply). As the figures are only given to furnish the method of carrying out the idea, possibly better details might be contrived, which may be left to the experienced electrician, as also the size and thickness of the platinum, the insulation, and other details of dimensions, &c.

FIG. 2.



Barry-road, S.E. **J. H. Huxley.**

DYNAMO MACHINES.

[19944.]—In letter 19882 "Conrad" describes a new dynamo-electric machine of his own design, and though perhaps in some ways ingenious, it would, I fear, in practice turn out very ineffective. I do not say it would produce no current, for certainly it would; but for the same weight of machine and speed of revolution it could never approach the Gramme or Brush. In the first place, "Conrad" falls into a mistake with regard to the use of the iron in the armatures of both Gramme and Brush. Instead of its being of little use in these machines, they would, without the iron, produce practically no current at all, and for the following reasons. The general rule governing the induction of currents by magnets is as follows: When any change is made in the number of lines of (magnetic) force cutting the area inclosed by a closed circuit, a current will be induced in the circuit, and the electromotive force producing such current is in direct ratio to the number of lines added or subtracted in unit time. Lines of force must, therefore, pass through the centre of the coils. Suppose, in the Gramme machine, there were no iron in the core of the coils, the lines of force would nearly all pass straight from one pole to the other, as shown (Fig. 1), and would cut but few coils; with iron the magnetic field is spread out, and the lines of force are led round through the coils something as shown (Fig. 2). Thus nearly all the lines of force are utilised, whilst without iron very few are of use.

FIG. 1.

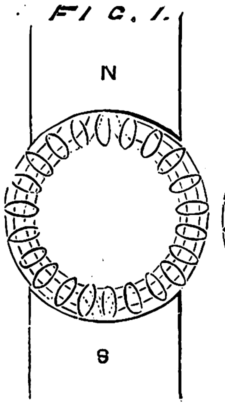
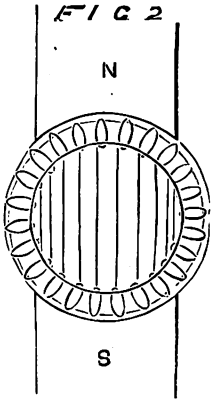


FIG 2



Similarly, in the Brush machine the lines go round the armature from one pole to the other; without iron they would go straight across through the axle of machine. When the bobbins of the Brush machine are directly between the poles, no lines of force cut them; as they pass on, lines are added, till when at the highest or lowest point of the machine they are at a maximum. Then they decrease, the change being accompanied by reversal of current.

Now, in "Conrad's" machine the iron is, indeed, of little value, for in any case the lines would go direct across from the north to the south pole, and the iron does little to concentrate or lead them through the bobbins.

Again, since the electromotive force is proportional to the number of lines added or subtracted in unit time, our aim should be to add or subtract as many per revolution as is possible. In "Conrad's" machine, in every position of the armature a certain number of lines are passing through the coils. These are added to until the coils pass the strongest part of the field; they are then subtracted, and so on. Since adding lines coming from a north pole is the same as subtracting lines coming from a south pole, we should, had a reversal taken place, have added and subtracted just twice as many lines of force in a revolution, and have had twice as much electromotive force, which would have given twice as much current. Since, in "Conrad's" machine, the number of lines cutting the coils is never zero, some part of the magnetic field is never utilised—namely, those lines cutting the coils in the weakest part.

"Conrad" had much better remove the cores from the bobbins, and have reversals of magnetic polarity, than keep the cores and have no such reversal.

In conclusion, I hope "Conrad" will not think this letter written to pick him to pieces; my only wish is to point out his error. **Ll. B. A.**

HARMONIUM BLOWING—VELOCIPEDES.

[19945.]—The object of accompanying drawings, together with explanations, is to make plain and clear the proper method of blowing, and also to describe the method of constructing a simple apparatus, which being practised upon by a student, is so contrived that it *must* work in the way described, as the proper method, which he will thus be taught, as it were, in spite of himself.

I remember, 30 years' since, practising for a whole day, and succeeded in attaining to the proper method, and it has ever since been quite easy to me. I was lately looking into an instruction book issued by a good firm, but found that the directions were not as clear as desirable for beginners, though rather lengthy. I think it would have been better, merely to have said that one foot should begin pressure before the other had done, and that in order to allow time for this, each foot in its turn should be *quickly* lifted up, and commence *gradually* again.

I will now give my version of the proper method, introductory to the description of the apparatus, Figs. 4, and 5, which is based on this principle.

The travel of the footboards is divided into three parts for explanatory purposes. In Fig. 1, one of the footboards, A C, is pressed down, two-thirds ready for the start. Fig. 2 shows, then, that boards A B and A C have each travelled a third part. Fig. 3 shows that A B has further travelled the middle third, while in the *same* time A C has (by quickly lifting the foot), travelled back the whole distance ready for another start; and observe, now, the boards in Fig. 3 agree in position with Fig. 1. Hence repetition is all that is required.

FIG. 1.

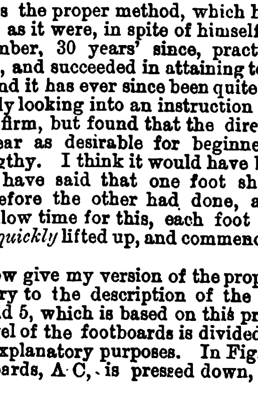


Fig. 5 and 4 is the apparatus referred to. Fig. 5 shows, in section, two circular plates, into which is firmly keyed a short axle, rotating on an upright standard, passing up between the plates, and fastened down upon the middle of the foundation board, which is 12in. square. The pins, D E, are diametrically opposite, and carry the connecting rods (not shown here), the other ends of which are at the side of the end of footboards. The fronts of the footboards are hinged to the foundation board.

FIG. 2.

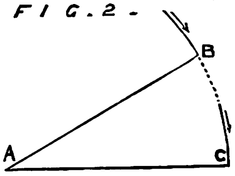
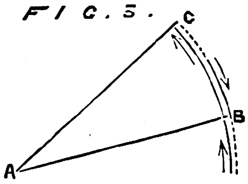


FIG. 3.



In Fig. 4, the pins project from the dotted circle. The boards and connecting rods are each shown in 2 positions. Thus, A B D is in its lowest position, and at the dead point, but observe A C E (the other board) is in a good position for work to carry point E round to E′, during which time A B will have been carried right up. as at A B′; but here, particular attention is required to the position of its connecting-rod B′ D′, which is not seen, being in a line with its footboard. But here, again, is the other dead point; and observe, again, the position of A C′ E′, which also has a good purchase and arrives at its lowest position, and we proceed as before.

FIG. 4.

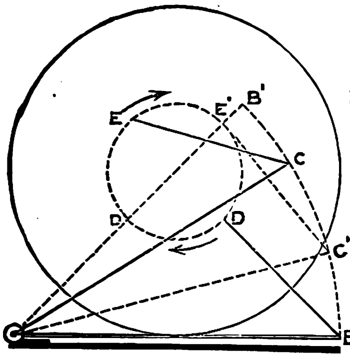
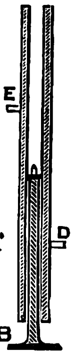


FIG. 5



The plates spoken of are used instead of cranks, in order. by their weight, to get a momentum.

It having been here shown that, by the adoption of this principle, no hindrances arise from dead points, its applicability to many other cases is evident. But I now call attention to the advantage which may be derived from its adaptation to velocipedes. On level roads, the momentum is sufficient to make the cranks pass the dead points; but on a rise, this is generally not so, and the rider has to dismount, and (like "the old man and his ass") become the steed. But, adapting the principle of this invention, we have seen that one crank would always be in a position for work, and so, to dismount would be unnecessary.

I omitted to say, that space should be left between the footboards, for Fig. 5 and connecting-rods, which would then admit of the boards being about 4½in. wide, and these should be helped to rise by a spiral spring underneath (to prevent lagging), as is done with the ordinary feed-bellows. In all adaptations this help (modified to suit), should be applied. Fig. 4 is represented by lines only, in order that the measurements may be better understood, and the scale is 1-6th, or 2in. to the foot.

Barry-road, S.E. **J. H. Huxley.**

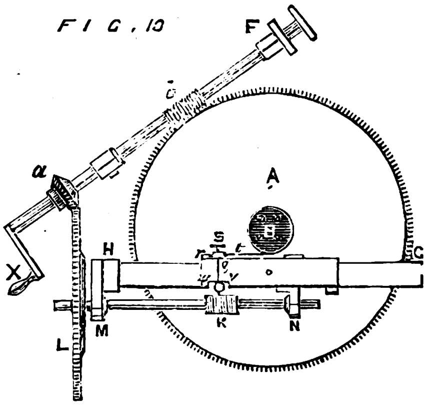
RAMSDEN'S DIVIDING MACHINES.—

Part III.

Ramsden's Engine for Dividing Straight Lines.

[19946.]—IN this machine a screw is used to give motion to a rectangular plate, which has one of its edges cut into teeth, whose distance apart is the same as that of the threads upon the screw. In order that the plate may receive equal and uniform motion, the pitch of the screw must be invariable throughout its length, since the whole number of threads is engaged at once. Fig. 10 represents a plan of the apparatus for cutting a screw of invariable pitch. A is a strong circular plate of brass, having its edge ratched as described in the account of the circular dividing engine; on its centre is firmly fixed the pulley B by four screws, having a groove turned in its cylindrical part perfectly concentric with the plate A. E represents an endless screw which gives motion to the plate A. F is a circular divided small plate, or micrometer head, which may be turned with or without the endless screw; and on the other end of this screw arbor is a large pinion a, with bevelled teeth on its edge, together with a winch X to turn it by. G is a triangular bar of steel, which passes over the circular plate A, and is firmly fixed to the frame of the engine at H and I; K is a piece of steel forming the arbor of the screw intended to be cut, having a wheel L on one end, acting with the pinion a. M and N are two strong pieces of brass, in which the arbor turns, and are firmly fixed to the bar G. O is a piece of brass that slides on G, the two extremities of which are made to fit the bar. Near one end of O is an angular groove q, that holds the tool, by which the threads are cut, and is pointed with diamond, in order to cut the steel after it is hardened and tempered; the cock w serves to fasten the tool, which may be set to take proper hold on the steel by turning the finger-screw s, and is fixed there by the screw v.

FIG. 10



To make a perfect screw, it is only required to give the point that cuts the threads a uniform motion parallel to itself, and also to the axis of the intended screw; and that this motion may be proportioned to the revolutions of the intended screw, as the number of threads may require. To effect this, a piece of tempered steel t, exactly of the same thickness throughout, is fastened to the slide O at r, the other end of the spring being fastened to the pulley B in the groove; now while the circle A with the pulley is turned round its centre, by turning the endless screw to the right the spring t draws the slider O with the attached cutter q along the triangular bar; at the same time the steel arbor K of the screw to be cut revolves by means of the communication of its wheel L with the revolving pinion a.

The screw E of the circular plate has 20 threads per inch; therefore, if the number of teeth on the pinion a be to the number in the wheel L as the number of teeth on the circular plate A is to the number of 20ths of an inch round the circumference of B, allowing for part of the thickness of the spring, the spaces between each of the threads of the screw to be cut will be also 20ths of an inch. The size of the pulley B was determined thus: the endless screw E being disengaged from the plate A, the slider O was drawn back till the end of it came nearly to the piece M; the endless screw was again engaged in the plate A; then, having two very small dots on the slide O, set off parallel to one side, at exactly 5in. apart, the slider was moved by turning E till one of its dots was bisected by a small silver wire, fixed across a hole made in a thin piece of brass, fast to the piece N; then, O on the micrometer head F being put to the index without moving the screw, the pulley was tried and reduced, till just 600 revolutions of the screw E brought the second dot to be exactly bisected by the fixed wire. These bisections were examined by a lens of ½in. focus, that was fixed perpendicularly over the wire."

It is unnecessary to give a full account of the machine for cutting divisions on straight lines. It consists essentially of a rectangular brass plate, moving easily, but without shake, on the top of a rigid iron frame. The teeth on the edge of the plate, and the threads on the screw, are each 1-20in. pitch; on the screw arbor is a micrometer head, divided into 50 parts, each of which is subdivided by a vernier in five parts, so that the motion of the screw, equal to 1-5000in., may be read. A tracing or cutting-frame is arranged in a manner similar to that on the circular engine; but as the cuts are not always required to be square to the edge of the plate, it is made to turn on a centre, so that the lines may be traced at any desired angle.

"When lines are to be divided by divisions not commensurable with English inches, which constitute the scale, the line to be divided may be laid down, not parallel to the plate, but obliquely, so as to make any angle with it, or become the hypotenuse of a right-angled triangle; which line shall, by calculation, be to the base as the denomination of measure, when longer, is to the English inch—that is, as the secant to the radius, provided the lines are traced square to the side of the plate; but if square to the line to be divided, then the divisions on that line will be shorter than they would be on a parallel line of the plate, in the proportion of the cosine of the angle of inclination to the radius. In order to adjust the inclination of the ruler, two sectoral portions of a circle are laid down at one end of the movable plate; the outer one divided into degrees, numbered from 1 to 9, and subdivided to 10 minutes, and the inner in the proportion of cosines to radius 10,000; and its divisions numbered 10, 20, and to 140. The use of this contrivance will be best understood by an example; for instance, if a line of 9 999·1000 were to be divided in the same number of divisions, and in the same manner, as if it were 10in. long; put the ruler to the cutting frame, and move the apparatus till the edge of the ruler cuts the central point and first division 0 of the inner sector; then screw the ruler fast to the plate, and when it has moved 10in. in its own direction the whole length of the divisions on the line divided, will be only 9 999-1000in., but the divided spaces will be respectively equal among themselves."

The contrivance for regulating the angular motion of the screw is worthy of notice.

"Besides the micrometer head already named, the arbor of the dividing screws, which has its thread similar to those of the notched ratching screw, has at its opposite end two sets of ratched wheels: one set for turning the screw, and the other set for stopping it at the proper times. These sets are each composed of three wheels, of which one has 32 teeth, the second 48, and the third 50, which afford the means of subdividing the inch into spaces of different denominations; those wheels used in stopping the screw are ratched with teeth pointing in a contrary direction to those for putting it in motion. I (Fig. 11) represents a cylinder of brass, having on one end two steel rings a and b, with their contiguous edges cut into ratched teeth in contrary directions, so as to fit each other; on one of these rings is an index, and the other has its teeth numbered 10, 20 and to 50; the other end of the cylinder is made hollow, and contains one of the sets of ratched-wheels already named. There are two slits opposite each other, pierced through the hollow part of the cylinder W, in each of which is a click, turning on an axis, and pressed into the teeth of the ratched-wheels by a small spring; these clicks may be moved along their axis so as to catch in any one of the three ratched wheels, and may be fastened by a small tightening screw, s. The cylinder I, with the clicks, turns on a steel axis attached to the piece K, in a line with the axis of the endless screw. Motion is given to the cylinder by a piece of catgut, one end of which is fastened to the ring b, and the other, after passing four or five times round the cylinder, is fastened to a treadle. On the treadle being depressed, the clicks s catch

FIG. 11.

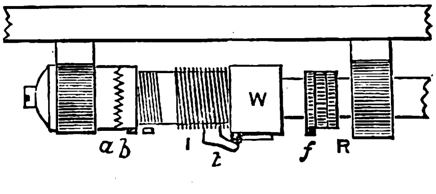
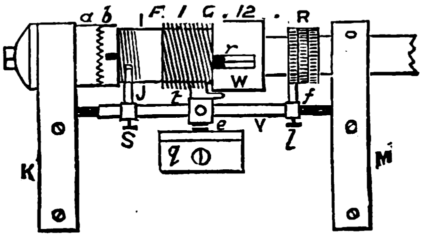


FIG. 12.



in the teeth of one of the ratchet-wheels, and turn the screw, and at the same time a spiral spring is compressed which, on releasing the treadle, turns back the cylinder i, and raises the treadle to its former position. V is a small, square, steel bar, with cylirdrical extremities, which work in steel bushes in D and K. This bar carries three different pieces: the middle one, t, lies in the interval between the threads of the screws, and passes nearly half-round it; it is kept in the threads by a spring e pressing on the piece q, attached to the frame, this piece t being fastened to the bar V by a screw. The motion of the cylinder I moves V in a longitudinal direction. The upper end of f is formed into a hook, which may be set to catch in the teeth of any of the ratchet-wheels, and then fastened to V by a screw, i. Near the other end of the bar is a stop piece, j, which may be set in any position by the screw s. When the engine is used, the treadle is pressed down and the catgut turns the cylinder I. In the mean time the piece t moves along the thread, till a stud r on the cylinder, striking on the top of the curved piece t, bends the spring e, until that piece rests on q. By bending this spring, the square bar is turned a little on its axis, and pulls the hook f into the teeth on the rachet R; then, the treadle being released, the spiral spring turns back the cylinder, till the piece j is brought under the stop on the ratchet ring b. The parts of a revolution are regulated by setting the number required on the ratchet ring b to the index on the fixed ring a. Each of the teeth answers to the motion of 1-1000th of an inch in the plate, and the number of revolutions, each of which moves the plate 1-20th of an inch, is regulated by setting the piece j on the bar.

Orderic Vital.

HUXLEY'S CALCULATING MACHINE.

[19947.]—I notice Mr. Buttershaw's observations (19909) on the calculating machine (19834), which for ordinary use has a scale not greatly differing in the size of its divisions; but observe the slide-rule with its last division about one seventieth the size of its first division (taking the scale as 100); here it is evident that, in order to invert all the subdivisions, the scale must be considerably lengthened: hence the new machine, which has also this advantage, that the angle made by the arms serves as a pointer for reading the answer.

J. H. H.

MEDICAL REPLIES.

[19948.]—Rheumatism (46610).—"Querist" is probably not suffering from common rheumatism; but she may safely try 10 grain doses of salicylic acid (in place of salicylate of soda) three times a day for a time. Vegetarianism also will be a safe experiment, but not to the extent of avoiding milk, unless she be corpulent. The Turkish, or vapour, or warm bath may safely be pushed and fully tried; but avoid catching cold afterwards. Probably the patient needs more accurate diagnosis as to whether any nervous or blood affection is present, and if so, properly adapted constitutional treatment may be required. Wear flannel, avoid damp houses, and damp climates and night air, especially after hot, badly ventilated rooms.

James Edmunds, M D.
Grafton-street, Bond-street.

HIBERNATION OF ANIMALS.

[19949.]—The author of the article on "Hibernation," reprinted in the English Mechanic of 7th inst., does not mention any instance of hibernation of birds; but as one such instance has come to my knowledge, it may interest your readers to hear of it.

In Chili, and especially in the forests in the south, where the climate is very moist, and many species of the trees flower very abundantly, there is found at least one species of humming-bird which, in the earliest spring, may be seen hovering about the flowers almost as high up the mountain sides as the snow, and one of our surveyors who observed them supposed they migrated from warmer regions, though their powers of flight seemed not equal to the distance.

Having been several years on the coast of Chili, and often made inquiries as to the migration of these little birds, I was told by a friend at Port Montt that he had frequently seen them in the winter in hollow trees hibernating; that if brought into the house they revived, but again became cold and stiff.

The fact of their passing the winters in this condition was spoken of by others as well known, and even at Valparaiso, where there is very little cold, another of my friends told me his servant had found one in that state on the branch of a tree and had brought it in to him.

The information which thus came to my knowledge convinced me that the humming-birds in that country do not migrate, but hibernate, and that they might, with very little difficulty, be brought to England if kept in a cool place.

In the event of anyone making the attempt, I doubt if honey alone would prove a proper food on their revival, as in Chili, and in the tropics, the majority of humming-birds, whose skins I preserved, had insects in their stomachs.

The Chilian species would certainly acclimatise in Madeira, or possibly even in Jersey.

April 13th. **R.**

UNIVERSAL CUTTER.

[19950.]—Noticing the description of universal cutter by "F. W. G.," letter 19908, I trust the author will allow me to say a few words relative to it. In the first place, I can only say that it is a very good instrument; but at the same time it is important that it should at times be capable of being set to any angle, simply because, when being used for cutting spirals, the tool should be set to the pitch of the spiral being cut. I can see no reason why this instrument cannot be made to do so. With regard to the geometric staircase, our correspondent will find that the pattern he describes is totally different from that cut with the eccentric chuck, March 3rd, and that cut by "F. W. G." is what is called the basket pattern, and the result of the variation in division will, as stated, give a spiral appearance to the work.

J. H. Evans.

LATHES AND LATHE-MAKING.

[19951.]—In a letter (19819) under this head on page 35, "Scorpio" says he would like to know how screws were produced in the earlier period of mechanical engineering.

In "Holtzapffel's Turning and Mechanical Manipulation," Vol. II., chap. 26, he will find a good deal of information on the originating of screws, and in the footnotes there are references to several works on the subject.

"Orderic Vital," in a letter (19818) on same page, makes a very practical remark in saying that Mr. Evans would add very much to the value of his papers if he would give such data as would enable a workman or amateur to construct the various apparatus he describes so well, and to make the various parts of proper dimensions.

Of course these appliances will vary in size very much according to the lathe for which they are intended: but if the various apparatus, chucks, cutters, &c., were described for some particular size of lathe, say one of 5in. centre, amateurs could then construct the tools lighter or heavier in proportion to their requirements. When drawings are given might they not be made to scale? This alone would be a great assistance, and would be a guide by which to proportion the different parts of any apparatus. There is nothing more unsatisfactory than to waste time and material in making a tool and to find that it is too heavy and clumsy or too light and inclined to vibrate and make bad work.

The proper proportioning of various parts is a thing that amateurs can hardly be expected to know a great deal about.

On page 11, "F. W. G." describes a very simple and apparently efficient eccentric cutter and drilling instrument; but if he had given us the result of his experience as to the most suitable dimensions for the different parts of the cutter, it would have been a great help to amateurs wishing to make one for themselves.

The same remarks apply to his letter on the combined eccentric and ellipse chuck on page 55. The description and illustrations show very clearly what an ellipse-chuck is like, but it would be difficult to form an idea of the relative sizes of the various parts unless one had some knowledge of the style of chuck.

If "F. W. G." had given the dimensions of the body or face-plate of the chuck, and also all particulars of the ring and the bolts that work the slide, it would have been a great assistance to many amateurs.

He describes a simple and excellent form of "fly-cutter" on page 108, and here he has marked some of the sizes.

The wheel-cutting frame described on page 127 is a very simple and most useful tool.

With reference to the plan for cutting worm wheels, I have tried the following method with some success, and though it is not a very mechanical way of doing work it requires no apparatus, and can be tried by any one having a slide-rest:—

The wheel must be turned with a semicircular groove. In the tool-holder of the slide-rest fix a piece of iron about 6in. long, and ¾in. by ½in. or so thick. The end next the lathe-centre must have a hole to take a vertical stud, which must be turned a working fit for the bore of the wheel to be cut.

On this stud place the wheel, the centre of the groove being exactly the height of lathe-centre. Fix a carrier to a common plug-tap, of a diameter to suit the thickness of the wheel, and run this between the centres. With the top-slide of the rest the wheel may be brought in contact with the revolving tap, and the latter will cut the teeth and carry the wheel round. The wheel can be examined to see whether the number of teeth suit the diameter; but I have never had much trouble on this point.

The wheel must be secured on the stud by a nut and washer above. I have not seen this plan tried anywhere, and would like to have "F. W. G.'s" opinion on it.

No doubt a hub such as he describes for his wheel-cutting frame would be much better than a tap to run in the lathe. The only advantage of my plan is its simplicity. **Tinker.**

ORNAMENTAL SLIDE-REST.

[19952.]—In reply to the objections raised by "M. A." (19230) to my ornamental slide-rest, he says he does not think the tool-box so well adapted to eccentric cutters and drills as to ordinary turning tools. If he looks back to an article of mine on a combined eccentric cutter and drill, he will see that the instrument I use and recommend is perfectly adapted to the tool-box, the driving pulley being in front, and it is set true in the rest by the edge of stem being placed exactly along the margin of upper slide. (The engraver, in illustration, has not made the clamping-screws of tool-box to project apparently far enough towards margin of slide.) "M. A." objects to my plan of taking up back-lash between nut and screw, and like many critics, opposes theory to actual practice. He evidently quotes from Mr. Evans's article on the ornamental rest, and is undoubtedly right in his method of taking up back-lash in square threads, but I adopted my method from its superior handiness of adjustment without having to take the rest asunder. When describing my rest, I probably did not enter sufficiently into the minutiæ of the process of the construction as Mr. Evans in his articles does; as, in the first place, it is very difficult to make oneself intelligible so as to be of any use to a tyro; and, secondly, I take it for granted that anyone who would attempt to make any of the apparatus I describe would be already pretty dexterous at turning and fitting. When making the nuts and screws for my rest, the lathe being a screw-cutting one, they being ½in diameter, are cut 11 threads to the inch, instead of 12, Whitworth gauge; though if anyone wants to fit spiral apparatus 10 threads would be handier; but as I have another self-acting slide-rest, it did not matter to me. The threads in both leading-screws and tap for nuts should be cut deep and sharp, and afterwards the top of threads of leading-screws rounded off, and a reamer passed through the nut, after being tapped, sufficiently large just to take off the top of the threads of nut also. Thus, when the lugs of the nut are drawn together by the little binding-screw, the threads of both nut and screw wedge into each other. Of course, when the nut gets very much worn, you must get a new one, which is easily done. I have my rest in use now for several years for ornamental work only, and have never yet had to put in new nuts. I think it does not matter whether you have the pillar O fastened to the lever or fixed in the hole P, provided it is made a good fit: but it must be capable of being taken out when using the stop arrangement with the leading screw. Next, with respect to the rival merits of the screw ferrule or washers for raising the rest. I have only one washer on mine, as making all my ornamental cutting frames myself, I can fit them exactly to suit the height of lathe centres; but for those who buy their apparatus, perhaps at different times, and of various sizes, I admit that the screw ferrule might be better, provided they do not mind the extra trouble or expense. Lastly, with regard to what "M. A." says about my combined oval and eccentric chuck. He must think that mine is made with the slide and guide-bars, double chamfered at each side, like Mr. Evans' pattern. It is not so; they are made with single chamfers, and the opposing surfaces of under side of slide and bed-plate are true planes, the former being first planed with my planing attachment, which I have already described, and afterwards scraped and tested by a surface-plate, and the latter accurately turned and also tested on the surface-plate, and then ground together with oilstone powder; and they come as close together as a film of oil will allow, so that no clamping screws could possibly bend them. Certainly, if the chuck was made like Mr. Evans' pattern, with double chamfers at each side, his objection would apply, if there were a sufficient space left between the surfaces to admit sheet-brass, however thin. In conclusion, to show how a little inadvertence in a description may expose one to adverse criticism, may I ask "M. A." how, if the four holes for the screws in the corners of his square-threaded nut be drilled and *tapped* before the nut is sawn in half, the binding screws are to draw the halves together—they presumably being screwed firmly into both halves?

F. W. G.

TO "FELLOW-WORKMAN."

[19953.]—When speaking of making the hole to fit pivot, you were not sufficiently explicit for anyone to gather your idea, as you simply said "make the pivots fit jewel-holes; with brass holes, *vice versâ*." As you have in some degree explained yourself here, perhaps my criticism may prove beneficial to the many readers of this valuable paper; if so, I shall be glad to have added my mite towards instructing the ambitious amateur, who would like, I have no doubt, frequently to see such criticisms, for it is through criticising each other that we gain much knowledge.

I quite agree with you about using too much space; but, in some respects, we might not be thoroughly understood with a given space; in such cases we had better beg an extra inch or two than spoil the article for want of it. As I have for some considerable time contributed horological lessons to one of the leading trade journals, I am well aware of the value of space, and therefore always try to be as brief and explicit as possible; but, at the same time, try to give every minute particular regarding the different parts of a watch.

Tempus.

LEGAL REPLIES.

[19954.]—Legal (46565).—As a general rule, one trustee is not liable for the receipts, acts, or defaults of his co-trustee. A clause to this effect is generally inserted in all well-drawn deeds of trust, and is now implied under Lord St. Leonards' Act. But if the co-trustee be guilty of any fraud or negligence, or be at all aware that the money is insecurely invested, or the like, then he would be liable, so that much must depend upon the facts of each case. Lord St. Leonards' handbook on the Law of Real Property is the best I know of; but the doctrine of trusts and the duties of trustees are now subjects so vast that they cannot be dealt with in any little book for laymen.

(46573.)—There is no fine for not proving a will sooner; but if there be a delay of more than three years, this delay must be explained to the satisfaction of the Registrar. In the case put, the widow must prove the will before she can do anything, and by way of explaining the delay, she should make an affidavit as to the property being mortgaged, and that she now desires to divide it under the will. Upon this she will probably be allowed to prove, and then she can carry out the testator's wishes, as she ought to have done twelve years ago. She may, of course, be held liable to render an account of the estate so received by her and paid away.

Legal (46584).—A user of 16 years is not long enough to give a right of way by prescription. There must be a twenty years' enjoyment to do this. In the case put, I think, therefore, that the gates can be hung up again, and the mere fact that they have been down for 16 years will not give anyone a right to remove them as obstructions.

A Ruinous Wife (46586).—The best thing the husband can do in this case is to apply to the magistrate for an order upon the pawnbroker to give up the property pawned by his wife without authority. Such an order should be made, as the pawnbroker would have no legal answer to the case. A husband is not liable to repay money borrowed by his wife without his authority, even though under false pretences.

Legal (46590).—An assignment is necessary to enable a purchaser of any debt legally to recover it, and this assignment is not valid until written notice thereof has been given to the debtor. The assignee of a debt, after notice, may now sue for it in his own name, or if the original creditor allow him so to do, in the name of that creditor. In taking an assignment of a county court debt, by which I mean one already sued for, leave to use this creditor's name should be inserted. The best books are Pitt-Lewis, price 2 guineas, and Heywood's, one guinea, and several shilling books of little value.

Deed of Gift (46592).—As against the father, the deed of gift is, of course, good, whether the houses are freehold or leasehold. But being merely a voluntary conveyance, it would not affect either a purchaser or a mortgagee of the property for valuable consideration in good faith, and without notice of the deed of gift. In other words, the sons could not upset the title of the purchaser or mortgagee at all, if freehold, nor if leasehold, unless they could show that he had notice of the existence of the settlement in their favour, or of facts that amounted to such a notice, because in law the sons would be only volunteers.

Legal (46600).—As far as I can understand this question without further particulars, the legacy rests in the nephews and nieces, from the date of the will, and therefore, each would be able to leave his or her share by will. But in these cases it is necessary to see the will itself, before being certain.

Wife's Liability (46625).—The husband could not be liable, but the wife certainly would, and she should be sued for the debt, and her goods taken in execution if it be not paid. But in the present muddle of the law, it would be safer to join the husband with her in the action, though only asking for an order of judgment against the wife's separate property.

Fred. Wetherfield.

2, Gresham-buildings, Guildhall, E.C.

TOLMAN'S BATTERY — GRATIS ADVERTISEMENTS — MR. BENNETT'S BATTERY.

[19955.]—Your correspondent (19902, page 107) states that my *form* of battery has been known to electricians for 15 or 16 years. He evidently means principle, not my particular form, or shape. He then gives us the theoretical action of the manganese cell, of which nearly every word for word we have read before, and winds up with a protest against the exclusion of manganese. His letter would have looked better if he had merely signed his name, and not have used the pages of "ours" to post the name of his *firm* before the readers gratis. As far as manganese is concerned, I made up cells with and without 16 years ago, and they are as good now as the day they were set up, and I defy anyone by tests to select the ones containing manganese. After 10 years' use I have examined manganese: it is not the slightest reduced or discoloured. So satisfied am I with my cell, that I am making up 36 of them for one job alone.

I do not consider that either "W. W. H. G." or Mr. J. H. Anderson has made any improvement on the caustic-soda cell. For the benefit of readers, I may state that I purchased in 1874 a caustic-soda battery—I think the name was Highton; it was identical in form with the old Leclanché, without manganese—that is, the porous cell had a plate of carbon in it, and was packed with broken carbon; a solution of the soda in the outer cell, in which was placed the zinc. In a few weeks, it followed the fate of the Grenet—not the slightest current could be obtained from them.

George Tolman.

MR. BENNETT'S NEW CELL.

[19956.]—The modification I mentioned in letter 19901 is simple and very readily constructed, and will yield a current of 22 hours' duration without rest, so that for those who cannot easily obtain "tins and borings," the following will answer:—An old pot or jar, 4½in. diam., 5in. deep; broken hard coke, previously saturated in a solution of common salt, and well drained, packed around a porous cell inside of jar, and a zinc plate in porous cell. (See page 5.) A lead plate in place of zinc will produce a current slightly weaker than the zinc yields for nine hours without rest. The positive plate may be muffled with cotton rag, and saturated with the caustic soda solution, in lieu of porous cell, for experiments. I may mention that the words "my plan" were only used for a distinction.

J. H. Anderson.

A NEW FORM OF CHEAP BATTERY.

[19957.]—The following particulars of a cheap battery will, doubtless, be of some interest to many of your readers who are interested in the development of the electric light for domestic purposes:—The outer cell is an ordinary quart battery-jar, and contains a small porous pot, which is closely packed round with a mixture of iron boring with peroxide of manganese; the porous jar contains a strip of platinised silver about 1in. wide, with a wooden plug to fit the porous jar closely. To charge the battery, fill the outer space with the ordinary bichromate solution, and the inner cell with one part of nitric acid to ten of water. Six cells of this description gave a good light from a Swan lamp for over eight days without renewing, except making up for evaporation.

Hy. E. Hawkins.

Birmingham, April 14th.

GELATINE EMULSION.

[19958.]—Several queries having lately appeared concerning above, I venture to give a method which gives results equal to the most rapid plates to be bought:—

Coignet's best gelatine....	4gr.
Bromide potassium	30gr.
Distilled water	4dr.

Silver nitrate	42gr.
Distillled water	2dr.

Warm bath: Add silver solution gradually, shaking after each addition; now wrap bottle containing emulsion in piece of cloth; then put them in tight-fitting tin canister, and place in ordinary oven; the temperature reaching emulsion will be about 120° Fahr. Emulsify about 4 hours, or until a warm purple by transmitted daylight, which must be ascertained by removing canister from oven to dark room, after second hour removing stopper and touching piece of clean glass for after examination. Examined by transmitted daylight, the changes which the emulsion undergoes are:—Yellowish orange, when first mixed, then a dirty brownish colour to warm purple. By reflected light the emulsion changes from white to greenish cream colour. If the emulsification is carried much further, coarseness of the image without increased sensitiveness results.

During the emulsification place to soak, water 6 drachms, Coignet's gelatine 70 grains. When emulsion is cooked, add the strong gelatine solution which must be previously dissolved (it requires a good heat), shaking frequently and violently for about a quarter of an hour, during which time it must be kept hot. Pour out to set, squeeze through coarse canvas into water, let it stand half an hour, squeeze through again into fresh water, let stand a little longer, then pour water containing emulsion into calico bag (made of a large piece of calico, elastic band, and wooden rim of sieve), and wash by pouring gradually about 2 gallons tap-water over. Slip off elastic band, gather end of cloth, wring rather dry, dab the ball of emulsion in bag on blotting-paper, untwist, scrape into bottle, dissolve, filter, and coat.

N.B.—1. When emulsion is first mixed, make very hot before putting in stopper; otherwise heat of oven might raise it.

2. For very hot weather, 1 drachm alcohol added to above quantity entirely prevents frilling.

3. Small opaque spots in the film are caused by insufficient shaking, after adding thick gelatine solution.

4. Red or green fog is caused by insufficiently washing the emulsion after setting, and generally shows when development is forced.

I have already occupied too much space, or would describe easily-made rapid drying-box; but should anyone be interested will write again.

Gelatino-Bromide.

EVOLUTION—THEORY AND PRACTICE.

[19959.]—Mr. J. H. Huxley and others interested in the subject will gain much instruction by reading the article "Evolution" (by the late Prof. De Morgan) in the "Penny Cyclopædia," wherein he lucidly expounds the rationale of Horner's method of extracting roots and of solving equations.

W. J. R.

Chelsea, April 8th.

SCREW PROPULSION.

[19960.]—With reference to Mr. Thos. Moy's remarks (19879), I repeat, after looking up the laws regulating the motion of solids in fluids, that it does not appear practicable to go astern with sculls projecting from the stern. I understand the Chinese are adepts at sculling from the side of a boat. I have seen a Collin sailor boy scull from the side. The Fijians scull from the platform connecting their double canoes; they stand up, press the loom of the paddle forward, astride the paddle. "If you want to propel with the greatest efficiency, you must do so by pressing or striking the water back in the opposite direction in which you wish to proceed." I suppose it is a truism that it was hardly worth while to state here. I repeat, Mr. Hooley's, as far as the theory of it is concerned, is the most efficient propeller I have seen; it acts in a direct line, no twist or beating the water in a circular form. Water moves in right lines opposite to the pressure.

Twickenham. **J. C. Curtis, Capt. R.N.**

THE CONTINUOUS BRAKES RETURN.

[19961.]—The table given upon page 109 shows the amount of rolling-stock fitted with brakes which appear to fulfil the conditions of the Board of Trade.

The following list gives—

The total number of engines and vehicles fitted with each system during the half-year ending December 31st, 1881.

Name of Brake.	Engines.	Vehicles.
Westinghouse Automatic....	150	1,431
Sanders—Bolitho Automatic Vacuum..................	155*	691
Smith's Automatic Vacuum..	14	79
Clark, Clark and Webb, Chain	—	320
Smith's Vacuum	75	305
Fay, Fay and Newall	—	41
W. Parker-Smith's	—	3
Total........	394	2,870

The 155 engines fitted with the Sanders brake have steam brakes.

It is certainly to be regretted that the companies should have provided 75 engines and 669 carriages with brakes which do not even appear to fulfil the "conditions."

With reference to the letter of your correspondent "J.," page 130, the table which I published upon page 109, and in my pamphlet, was compiled from the last Brakes Return. "J." considers the Parker-Smith brake fulfils all the "conditions," but the Liskeard and Caradon Railway Company's Return (page 9) states that it can be applied *by guard only*.

It also appears that the company had the brake applied to four vehicles, but not to any engines.

It will be of advantage if "J.," or the inventor, will furnish further details to the English Mechanic to enable the readers to consider its merits and defects, and to see for themselves whether it fulfils the Board of Trade conditions or not.

Clement E. Stretton.

Saxe-Coburg-street, Leicester, April 15.

CONTINUOUS BRAKES — UNIVERSAL COUPLINGS—TO "CENTAUR."

[19962.]—At the Euston Conference very much was heard of "Universal Couplings," and one which can only be used with vacuum brakes was adopted. The Westinghouse coupling possesses very great advantages, as it is perfectly air-tight when used either with vacuum or air pressure. The Westinghouse automatic *vacuum* brake, by the use of a triple valve requires a main pipe of the same size as the automatic air brake; hence it follows that by the use of the universal coupling, carriages having the one system of brake may be introduced into trains fitted with the other, in the same way that vehicles having through pipes only are used to prevent the brake power being cut off by an unfitted carriage.

This coupling, which appears very likely to become the much-desired *universal coupling*, has a tap at the end of each vehicle.

The ordinary Westinghouse pump serves to produce either air-pressure or vacuum, or both at once if required. To obtain and maintain a vacuum by means of *ejectors* necessitates the expenditure of a far larger quantity of steam than when the same work is performed by a pump.

A very important correspondence has recently taken place in the *Engineer* and *Railway Review*, in which it has been repeatedly stated by several of the writers that the use of a small ejector always "blowing" to maintain a vacuum, not only uses a quantity of steam but seriously detracts from the "steaming powers" of the engines, so much so, that drivers state that they have had to shut off the small ejector, and work the train without a continuous brake.

This inconvenience would be entirely avoided by the use of a pump, and this latter would possess the very great advantage of being capable of producing either compressed air or vacuum, and, therefore, supplying the power for either of the two great brake systems.

Clement E. Stretton.

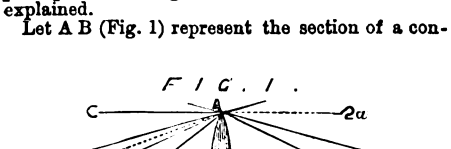
RULES FOR FINDING THE FOCI OF LENSES.—Part II.

Conjugate Foci.

[19963.]—In my previous letter on this subject, I gave rules for finding the principal focus of a lens of any given form. When we wish to compare the powers of any two lenses, the principal or solar focus of each must always be found, either experimentally or by calculation. Rays of the sun are parallel—that is, the circular beam of light falling on the lens has no tendency either to close up or to widen: thus a standard is obtained by which we can estimate the effect of any lens. But supposing we place a candle in front of a convex-lens, we know that, generally, an inverted image of the flame is formed at some point behind the lens; if we know one of these distances, how can we find the other? The place occupied by the light is called the radiant point, that in which the image is formed, the focus; and both these are termed conjugate foci, because they are, as it were, linked together, and are interchangeable; that is, if the light be placed in the back position, the image will occupy the front one. Their distances from the lens have a definite relation to the principal focal length; what this is will now be explained.

Let A B (Fig. 1) represent the section of a convex-lens; and C A, a solar parallel ray, be bent in the direction A D, cutting the axial or unchanged ray in D. Then D E is the principal focal length. Let us bend a piece of wire to follow the path C A, A D; then by moving it about A as a centre, it will show the advancing and receding positions of the conjugate foci. For instance, let the left branch be lowered till it cuts the axis in (1), then the right branch will have receded so as to cut it in (1*a*); and as (1) approaches the front, (1*a*) recedes behind, until we come to position (2), which is the same distance in front as the principal focus is behind. The second branch is then in a line with C A, showing that the emergent rays are parallel. Passing (2) towards (3), the direction of rays coming out of the lens is inclined so as to cut the axis in some point (3*a*) on the same side as the radiant point—that is, the rays diverge on emergence. When we know the principal focal length and one of the conjugate focal distances, we can find the other by a very simple rule. Let F, as before, be the principal focus D E; D the radiant distance from point (1) to the lens, *d* the conjugate or back focus from (1*a*) to the lens; then, to find the value of *d*, multiply F and D together, and divide by their difference. Let D be greater than F; the rays will come to a real focus at (1*a*) behind the lens; but if F be greater than D—that is, if the radiant is behind position (2)—there will be no real focus, and *d* will represent a distance of some point (3*a*) in front of the lens.

FIG. 1.



This rule gives the second congugate focus for diverging rays falling on a convex-lens. Now, if the first rays had tended towards a point, or had been converging, the sum, instead of the difference, would have been the divisor. Thus we obtain the following two rules for a convex-lens:—

1.—Diverging rays, $d = F \,.\, D / (D - F)$.

2.—Converging rays, $d = F \,.\, D / (D + F)$.

For a concave lens, the imaginary focus is on the same side as the incident light, and diverging rays are made still more divergent; hence, rule (1 becomes—

1.—Diverging rays, $d = - F \,.\, D / (D + F)$.

And the second one—

2.—Converging rays, $d = F \,.\, D / (F - D)$.

From this latter rule it appears that D must be less than F, in order that a real image may be formed.

I will illustrate these rules by a few examples:—

Ex. (1).—A candle is placed 12in. in front of a lens of 8in. focus; where will the conjugate image be formed?

By rule (1) for a convex, $d = (12 \times 8) \div (12 - 8) = 24$in. behind the lens.

Ex. (2).—A convex lens of 20in. focus is placed 12in. in front of another convex of 6in. focus; if the sun's rays pass into the combination, where will the conjugate image be formed?

Since the lenses are 12in. a part, the rays from the first really form a converging beam, tending to a point 8in. behind the second lens. Hence employing rule (2) for a convex, $d = (8 \times 6) \div (8 + 6) =$ 3 3-7in. behind the second lens.

If in the first example the lens were concave of the same negative focus, we should have by rule (1) for a concave:—$d = (12 \times 8) \div (12 + 8) =$ 4 4-5in. in front of the lens.

And similarly in the second example:—$d = (8 \times 6) \div (6 - 8) = 24$in. in front of the lens.

It is usual to express the above rules in reciprocal values, which is much more concise. Thus the first two are $1/d = 1/F \mp 1/D$. And for the second pair, the sign of F must be negative, which is all the alteration required.

When two or more lenses are in contact, the reciprocal of the compound focus is equal to the sum of their reciprocals (or difference, if one or more are concave).

There is one property of the conjugate foci, which is useful in finding the principal focus of a small lens. When the radiant point is twice the principal focus distant from the lens, the back focus is at the same distance on the other side. Hence, if we so adjust the conjugate foci that they are equally distant from the lens, its principal focus is one fourth of the distance they are apart.

Orderic Vital.

LENSES AND THEIR FOCI. — TO "ORDERIC VITAL."

[19964.]—In reply to "Orderic Vital," may it not be that the "mistiness" is not only in my brain, but, to a certain extent, in the textbooks themselves? At all events, though I am pretty well supplied with the latter, I have, hitherto, failed to find the information in the simple and convenient form in which "O. V." is himself supplying it in the pages of the English Mechanic. I am, therefore, glad my letters have had such a satisfactory result. The fact is, the textbooks aforesaid assume the reader to want one thing when he may want the very reverse; for instance, when the radii of curvature of the lenses are known, it is easy to roughly obtain the foci by geometrical construction in the way shown by the diagrams, or by the rules given in illustration; but when one wishes to determine the radii (which radii are perhaps desired to bear a certain ratio to each other) in order to obtain a required focus, then the textbooks do not help one.

Again, supposing one has a convex mirror, and it is desired to find the focus, it is not much use to have a formula founded on a diagram in which the radius of curvature is assumed to be known. The method of doing this I came across by chance; but it was not in a book on optics. Or, once again, the textbooks show you how to find the focus of a concave mirror, and give diagrams of the reflecting telescopes; but I have not yet come across a rule to find the equivalent focus produced by the combination of the two mirrors in Gregorians and Cassegrains, or how to fix their distance apart so that the image may be reflected by the small mirror to the right point behind the large mirror. The former I happen to know (no thanks to any textbook); the latter I can only indirectly obtain by trial diagrams. There is also very little information to be found on proportioning curves and lenses for making eyepieces of telescopes and microscopes of any required focus, though one finds diagrams which show very prettily the paths of the rays when they are made.

As to size of "light-spot," I am aware that as a matter of abstract theory this is independent of the size of object-glass or mirror; but as a matter of practice the light-spot seems to be somewhat smaller and of more definite outline when small lenses are employed, or perhaps more strictly when the centre part only of a lens is employed, and this, too, even in the case of lenses which are supposed to be free from spherical aberration. Let me then repeat my query, and ask what will be the diameter of the light-spot produced by a lens or mirror of given focus and aperture. In connection with this I may remind "O. V." that Sir W. Herschel found the apparent magnitudes of the star discs to vary according as he used the central rays, the outer rays, or the whole body of them, though the mirror must have been accurately parabolic. He of course knows that in a large telescope the effect is produced of giving an apparently larger diameter to, say, Saturn than when it is viewed in a smaller instrument. Theory and textbooks don't tell us anything about these peculiarities of practical optics. May I also call "O. V.'s" attention to my query as to photometric measurement of light reflected from mirrors of different foci.

Lens.

Errata.—Evolution (19898).—Page 196, line 19, for "$a^3 \times$ &c.." read "$a^3 +$ &c."; line 6 from bottom, for "83," read "13"; mid. col., line 12, for "by ×," read "by +"; and line 4 above the end, for "$10a^3x^2$," read "$10a^2x^2$."—J. H. H.

REPLIES TO QUERIES

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[45869.]—**To Mr. Dresser.**—As a rule I tune every stop from the principal, but it is a rule with exceptions. I tune every 8ft. stop and also every 2ft. stop from the principal, and any mutation stop between those pitches. If there is a 16ft., I tune that from one of the diapasons, either opened or stopped, according to the 16ft. The reeds *should* be tuned from the principal; but much depends on the power of the stops, and the open diapason or principal may be used, as may be found most convenient; but whichever method is adopted, if the organ is properly winded and the tuning correctly done, there should not be any beat. The answer to the question commencing "Why I ask, &c.," is that if such occurs, the tuning is badly done. Again, you say "Then I am told you tune the twelfth, &c." I should say, Who told you so? as it is not generally so done. The gambas, &c., are tuned from the principal. I shall include tuning in my papers on "The Organ."—J. Dresser.

[45959.] — **Bourdon Pipes.** — The Bourdon should not be slow of speech, but if the mouth is only ⅜in. high for a CCC pipe and very little wind admitted, it must be slow. Cut the mouth 1½in. high, and give as much wind as it will take without sounding any harmonic.—J. Dresser.

[45995.]—**Embossing and Gilding on Glass** (U.Q.)—There are two ways of embossing glass: by means of hydrofluoric acid and by the sand-blast. The second method being rather beyond the power of amateurs, I shall not describe it here. In the hydrofluoric acid process, the glass is first coated with some protecting substance, and upon this the design is drawn with a sharp instrument, so as to expose the glass below. The acid is then applied, when the exposed portion of the glass becomes corroded. The wax can be afterwards removed. In practice, the glass should be warmed and coated with molten beeswax (not paraffin, which is too brittle). Superfluous wax should be drained off, so as to leave as thin a coating as possible. Or a composition may be used, formed by melting together 2 parts of beeswax, 2 of asphalte, 1 of black pitch, and 1 of Burgundy pitch, and heating them together until a drop placed upon a cool surface gets hard and tough. Whatever the protecting substance used, it should be permitted to set, and the design should then be traced with some pointed instrument, care being taken to cut right down to the glass. If the design is complicated, it will be found better to trace it first on paper, and then to go over the lines with a pricker. The paper can then be placed upon the wax, and some dark-coloured powder dusted over the holes. On removing the paper, the outline of the design will be found marked on the surface of the wax. It will then be easy to cut away the wax at the desired places. A shallow tray of guttapercha or of sheet-lead must then be taken, and into it be placed about half an inch of the dilute hydrofluoric acid of commerce. The glass must then be placed wax-side down over the tray, and left exposed to the vapour of the acid for some time. On removing it, washing with water, and cleaning off the wax, the design will be found etched in opaque lines upon a bright ground. If required bright upon an opaque ground, the waxed glass, instead of being exposed to the vapour of the acid, should be dipped into the acid itself. After the removal of the wax, the surface of the glass should be ground with very fine emery. Another way is to draw the design on the glass with a pencil and Brunswick black, using as a guide a sketch on paper placed beneath the glass. On exposure to the acid vapour, the whole background will be rendered opaque. The Brunswick black can be cleaned off with turpentine, leaving the design in clear glass. Instead of Brunswick black an ink may be used, made by dissolving asphalte in turpentine, and thickening with beeswax and resin. Where it is desired to produce an artistic effect by the introduction of shading, recourse may be had to Gruene's patent process, wherein the wax or Brunswick black is replaced by substances not altogether impervious to the action of the acid. The design is drawn with oil-varnishes, greasy printing inks, or some such substances (using a good protector for the high lights, a bad protector for the deep shades, and so on), and is then dusted over with finely-powdered metal, copal, &c. When dry, the glass is dipped into hydrofluoric acid and allowed to remain in for a few seconds, and is afterwards washed. If care is taken in the selection of the protecting materials, it is possible for an artistic workman to obtain very striking results. *Gilding.*—Gilding may be done either with bronze powder or with gold-leaf. If the powder is to be used, the design should be traced on the wrong side of the glass with Japan gold-size thinly laid on, which is afterwards dusted over with bronze powder. When dry, a coat of varnish is laid on. In tracing the design, it must not be forgotten that the wrong side of the glass is being worked at, and that when viewed from the front everything will appear twisted round—the right being to the left, and the left to the right. To gild with leaf the glass must be carefully cleaned and laid upon the design. Then a solution of isinglass is put on by aid of a flat camel-hair brush. While still wet, gold leaf is laid on with a gilder's tip (for the sake of economy adhering to the design as nearly as possible). When quite dry, the design, the outline of which has been pricked out as before described, is taken and placed upon the gold. Dark-coloured powder is then sprinkled on as before. The paper is next removed and the outline carefully gone over with Brunswick black. The superfluous gold is cleaned off by the aid of a sharp narrow chisel. The size is made by dissolving ¼oz. of isinglass in a sufficiency of water, adding a quarter of a pint of rectified spirits, and making up to half a pint with water. Note.—If hydrofluoric acid is dropped upon the fingers it is desirable to wash it off without unnecessary delay; but let no one be deterred from using the acid by the dreadful things the textbooks say of it. They don't apply to the diluted acid sold at the shops.—Alfred W. Soward.

[46221.] — **Calculating Watch and Clock Trains.**—I am afraid it would take too much space to reply fully to your query. I would, therefore, recommend you to read a book recently published by Spon, 48, Charing-cross, written by Rev. H. L. Nelthropp. In this work you will find many valuable calculations, which are really copied from Reid's book on "Watch-Work." The book will cost you 6s. 6d. Should you not care to speculate in this, I will try and let you see mine, if you will advertise your address. I can then also recommend other works which would be very useful to you for calculating watch and clock trains.—Father Time.

[46260.]—**Railway Brake Formula.**—To "A Driver."—The resistance due to a brake is the same, deduced from the "distance" run in making the stop, or from the "time," if the brake-power commences to act with full force when the time begins to run, and that it continues to act to the end of the stop. The deviation between the results shows that time elapsed before the brakes came into full operation. Therefore the nearer the results approach equality the more perfect is the action of the brake. The forces acting upon a train are usually expressed in percentages of the weight, or in pounds per ton, while velocities are more conveniently expressed in miles per hour than in feet per second. To find the resistance due to a brake in pounds per ton deduced from distance run, the following formula is used—$R = 74{\cdot}78 \times V^2 / D$; where

R = Resistance in lb per ton.
V = Speed of train in miles per hour.
D = Distance run in feet.

If the resistance is to be deduced from the *time* occupied in making a stop, the calculation is equally simple. By the laws of falling bodies a force equal to the weight of a body acting upon it for a period of one second, will produce a velocity of 32·2ft. per second, and this velocity will vary directly as the force applied and as the period of application. Therefore, to impart in one second a velocity of one mile per hour, or 1·466ft. per second, to a body weighing one ton, would require the application of a force of $2240 \times 1{\cdot}466 / 32{\cdot}2 = 102{\cdot}02$lb. Thus, if we let T = the time in seconds during which the accelerating or retarding force is applied, while R and V are, as before, the amount of the force in pounds per ton, and speed in miles per hour, the following formula is obtained:—$R = 102 \times V/T$. In cases of emergency, a brake is required to bring a train to rest in the shortest possible *distance*, the time being of no practical value. Therefore, it is essential that all calculations should be deduced from the distance run in making a stop.—Clement E. Stretton.

[46295.]—**Turkish Bath for Home Use**—A simple form of hot-air or steam-bath may be made as follows:—To the back of an ordinary wooden or cane-bottom chair fix an upright piece of wood, and to this at the height at which the neck of the sitter on the chair will be fix a hoop of cane or other material sufficiently wide to keep the cloth to hang from the hoop free from the shoulders of the sitter. Place beneath the chair a gas or oil lamp or two, if one does not give sufficient heat. If, now, a cloth be fixed round the ring sufficiently ample to reach the ground and close all round the sitter, a tent will be formed from the top of which the head of the sitter will project. Let the cloth overlap the ring freely, so as to permit of being pulled close to the sitter's neck. Whilst taking this hot-air bath, the feet must be kept in a basin of warm water. If there is danger of a headache, a cold wet cloth on the head will prevent it. If a vapour bath is preferred, place a pan of water over the lamp, so that the water may boil.—Volvox.

[46296.]—**Harmonium or Organ.**—I have been waiting to see if any of our correspondents would notice an objection in the sketch furnished by "Joiner," on page 66 of our present volume, in reference to the above query; but, as no one seems to notice it, I hope "Joiner" will pardon me if I explain what that objection is. In the sketch at B, the tubes or cells are represented in the opposite direction to what they are generally placed. This increases the difficulty of extracting the reeds for tuning, &c., 50 per cent. to that of the general method. Any person at all acquainted with the interior construction of the American organ is aware that the front and back sets of reeds are the easiest to get at for tuning and cleaning. They are also aware that there is always some difficulty to remove or extract the reeds of the intermediate sets, such as the diapason set in large instruments; but the plan suggested by "Joiner" (of having the outer ends of the tubes, where the reeds slide in, inwards) increases the difficulty of removing the vibrator to a considerable extent. I am quite at a loss to conceive how the vibrators at B are to be extracted with a reed-hook. At any rate, in my opinion, it is quite an impossibility to remove them in the usual manner. Had the outer portion of the tubes been represented towards the back of the instrument (in the sketch), the matter of removing the reeds would have presented no difficulty whatever. For the benefit of interested readers, I trust that "Joiner" will clearly explain this, and let us know how he removes the reeds situated in the tubes at B, in the sketch.—G. Fryer.

[46305.]—**Blowing Engines.**—These engines are certainly "suitable," but would they not be rather costly as compared with a fan for each hearth worked from shafting? A smith's fire requires a blast having a density of only about a quarter of a pound on the square inch, whereas iron furnaces require a blast with a density of from 2½ to 3lb. per sq. in. You will find some information on the subject in Spon's "Dictionary of Engineering," but it is a special branch, and notes and formulæ are not published in the usual textbooks.—Nun. Dor.

[46331.]—**Flageolets.**—In all probability you have spoilt the instrument; better take it to a maker and see if he can repair. Doubtful whether any-one can suggest a remedy without seeing the instrument.—T. P.

[46340.]—**Painting on Silk and Satin.**—Did you form a ground with size first of all? I believe that is the secret of painting on silk.—M. P.

[46341.]—**Nickel Plating.**—Is the querist sure he obtained pure materials, and, above all, did he clean the work thoroughly? Make the solution by dissolving double sulphate of nickel and ammonia in hot water, one pound to each gallon, and have a bath large enough to hold about a fifth more solution than is needed. Battery power depends on quantity of solution, but always have plenty and couple up for intensity at the start, changing to quantity when a film has been deposited. The surface of anode should be largely in excess of the surface to be covered—in fact, surround the article with plates of nickel. Beyond thorough cleaning it is advisable to copper steel before placing in nickel bath.—E. C.

[46345.]—**Continuous Brake**—The Henderson system is hydraulic, I believe. A disc-shaped vessel contains a diaphragm, on one side of which is the water in the brake-pipes, on the other steam from the engine. I doubt whether many of them are at work.—T. P.

[46359.]—**Gilding Watch-Plates.**—Frosting is done with the scratch-brush held so as just to touch the metal. It requires a deal of practice. You will find several replies in back numbers; both mechanical and boiling processes. It is not clear which you mean.—Perth.

[46366.]—**Leather for Bellows.**—Ask for best strained sheepskin.—Sabbas.

[46368.]—**Clock**—In the American "Nutmeg" clock, which appears to be the kind alluded to by "Anxious Amateur," the back is secured by two pins, which enter into bayonet-catches at the top and bottom, in the edge of the back. Remove the three screws at the front of the clock which secure the works in the frame: then, using the winder and hand-setter as levers, turn the back to the left as far as the pins will allow, and then pull out the back and works together. To separate them, the winding-handle, which is secured on by a left-handed thread, must be turned to the right (not to the left, as suggested by "Calne"), and the hand-setter pulled off, when the back will be free.—G. C. C.

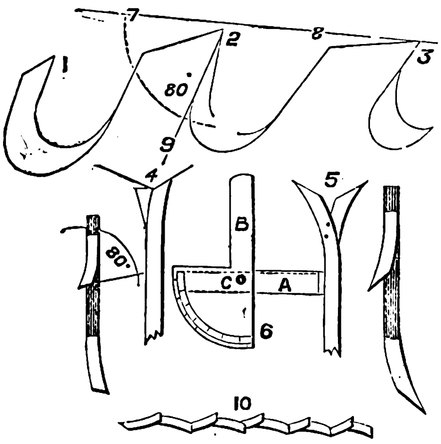
[46381.]—**Three-Legged Gravity Escapement.**—I cannot allow "Alfojoe's" reply to pass without comment. The gravity escapement was invented for the sole purpose of preventing errors of train getting at the pendulum. Now Benson, according to "Alfojoe," says, that "the great advantages possessed by this escapement over all other gravity-escapements are as follows" (paragraph 14): "The angle of the detent-planes can be set so as not only to offer no resistance to the unlocking, but to give an actual impulse." In other words, one of the advantages of this escapement is, that it can be so constructed that errors of train can be applied to the pendulum. One might just as well state that the great advantage of the zinc and steel compensation for pendulums was that it could be so made that the pendulum was not compensated. My reason for only criticising paragraph 14 is, that I saw at the exhibition of scientific instruments, South Kensington, a clock made and exhibited by Cooke, of York. The detents were rounded; so practically it was an impulse-escapement of a very indifferent kind. The erroneous reasoning in the other paragraphs will be obvious to any reader. I believe that the gravity escapement is not suitable for regulators. I understand that it is not used at Greenwich, which is a stronger argument against it than anything I could say. The double three-legged is an undoubtedly good one for turret clocks; at the same time it is equalled, if not surpassed, by a pin-wheel and remontoire.—Edward M. Nelson.

[46396.]—**To "Aldebaran."**—I wish "Aldebaran" would explain how the rays in a terrestrial eyepiece are, as he says, "still divergent" after passing through the second lens, B. In all the eyepieces I have seen, the distance C D is much less than the sum of the focal lengths of C and D, so that in them the rays must have been convergent after passing B. The position of the diaphragm between C and D is wrong; it should be at the point where the rays cross, where the image is formed. Nowhere else can it be clearly seen, and the edges of the field be sharp.—Paugul.

[46402.]—**Cement.**—You will find nothing like a few small silver rivets, which will make your china fit for use.—China Rivet.

[46422.]—**To Mr. Dresser.**—I intend to describe a number of couplers in my articles, both unison and octave.—J. Dresser.

[46424.]—**Circular Saw.**—Your saw should be dished—i.e., tight upon the circumference, to work well, and the hollow part next the fence, for in working, if not sharpened properly, will become hot, and the consequence will be a wobbling saw; but a 64th of an inch would be quite enough; if yours is too much, it may be altered by placing it upon a smooth anvil, and slightly hammering it around the outer edge, and testing it with a straight-edge; your saw, I suppose, from the size given, is the ordinary peg-tooth. There are some who profess to sharpen saws, but can never sharpen one to work without getting hot. A slight sketch will give you a little insight, and perhaps be useful. Fig. 1 is what is called the gullet-tooth, and is how I have seen them filed—1st to an angle forming a needle-point; the 2nd with a very slight angle, and with gullet right; the 3rd square at top, and too much chamfer in the gullet. Now from the face of saw the point of tooth-angle should never exceed 80° for soft wood, and for hard, square the chamfer in gullet about one and a half thickness of plate, and the set not more than two-thirds thickness of plate, the rake of tooth as shown by lines 7, 8, 9, from point of teeth 80°, and clearance from heel to point not more than one-eighth to an inch; the set



should be as shown at 4, not as at 5. Be careful in setting your saw; do not set it down to the root of tooth, or you will buckle it. The same rule applies to hand-saws for wood, that is including tenon saws, panel saws, hand saws, half-rip and dovetail saws (see 10); 6 is a gauge that is easily made; A, a piece of steel or iron hoop, ⅛in. thick, 1in. wide, 4in. long; B, a piece of sheet-iron a sixteenth thick, a quadrant at one end with a tail at the other, and a rivet at C. This is adjustable to apply as shown at lines 7, 8, and 9, and very useful until your eye gets accustomed to the form or work.—Jack of All Trades.

[46456.]. — **To J. C. King, or any Wheelwright.**—To put a new hub or nave to a timber-gig wheel without taking it to pieces. First, take the sizes of the front and back hoops of old hub, and have the new nave turned to suit them, and to the full diameter of the spoke shoulders (if by a rare chance such a wheel has shouldered spokes). Number the spokes from 1 to 14 (the common number of spokes of such a wheel). Take notice for heavy wheels that the spokes are nearly always ¼in. thinner edgeways at the back edge of the tenon than at the front; by neglecting to notice this you may spoil your job. Begin at No. 1 spoke and reverse the width of the tenon, making it a shade narrower by bevelling the tenon towards the front; serve the opposite face of No. 2 spoke in the same manner—this will produce a slightly tapering opening from the front between the spokes. The space between the next two spokes may remain untouched, as they will already be found to taper from the back; thus every alternate opening between the spokes will taper either from the back or front. The purpose of this will be obvious from the illustration Fig. 1, marked M 1, M 2, &c., which is an outspread plan of the spokes of the wheel at the nave. Measure the size of each spoke set out on the nave for mortising, which is done in the usual way, the mortises being duly bevelled to correspond to the "disch" of the wheel. The nave centre is now cut out for the "box" or "bush." I may here explain that the wood left between the mortices in the nave is technically called the "meash." It is round this meash saw-cuts are made to divide the nave into two halves, back and front. These cuts are made with a strong key-hole saw, alternately at the back and front edges of the "meash," as shown by the dotted lines A B C at the front edges of the back half of the nave, and D E at the back edges of the front half of the nave. This is shown by the plan M, 1, M, 2, &c., which by the closing together of the two halves lock into each other, and tightly wedge every spoke in its place. To hold two halves together six bolts are used, reaching from back to front, the same as in the common mail-coach axle-tree. Fig. 2 shows a plan of part of the back of the nave with a rabbet to receive the bolt-heads, so that they may not project, as shown by 1, 2, 3. A front and back face-plate to the nave is necessary for the bolts to go through to prevent them drawing into the nave; the edge of such back plate is shown by the dotted lines H H. Of course, the back and front hoops must be shrunk on the nave before the mortising is begun. A mixture of red-lead and linseed oil is the best cement for the mortise-joints. This is an easy job for an ordinary wheeler.—J. Charles King.

FIG. 2

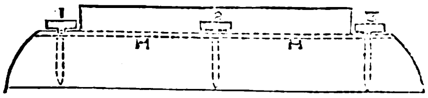
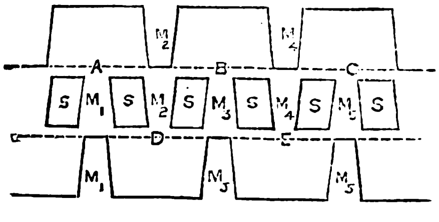


FIG. 1.



[46489.]—**Bicycle-Making.**—I note that you have bought the forgings in the rough only, therefore, let me help you as best may be. Now, what I should do would be to do the work properly, even at the outlay of time and a little money to make the needful tools, and the most necessary of all would be a drilling spindle. If the holes for the spokes are not drilled properly, so that the spokes, when fitted, stand straight and true, the wheel will be weak, and will be always a trouble with loose and broken spokes. What you need is a drilling spindle. This you can make yourself for a few pence and your own time, and if you will tell me what class of lathe you have, whether it is a single-gear one or with back-gear or not, and if also it has a slide-rest or not, I will then send you a sketch of the drilling-frame and spindle. Without some form of it, you would never be able to drill the hubs properly. In the mean time, you may occupy spare time in getting the hubs turned up to size, and the holes for the spokes pitched off. I need hardly tell you that the holes should break-joint—or, in other words, that alternate spokes should lead to alternate sides of the hub. Get all nearly centred up, as you will have to carry the hub between the lathe-centres when drilling the holes. With a drilling-spindle the spoke-holes are bound to come true. As to the neck and backbone not coming in quite right, as you have fitted it so far, you must rely on the brazing. See my remarks previously. In your case a small pin, drilled through and riveted over, would be an advantage. But get the joint well filled with spelter inside, so that it forms one solid mass. Not only this: but I should, if the fit is very loose, put in a piece of sheet-iron, to take up the slack, and so further solidify the joint. Let me know as to your lathe, and I will put you right on that or any other point, with pleasure.—Sunlight.

[46497.]—**Fortified English Cities.**—To fully answer "Antiquary's" query would no doubt occupy too much space, yet I expected there would have been more interesting information evoked by it than has been. What the query called for was dates, and they have not been forthcoming. Several correspondents refer to Chester as "unique," and "as perhaps the most perfect example remaining in Europe" of ancient walls. Ireland is still supposed to belong to the continent of Europe, and we have yet to hear of a separatist sufficiently rabid to dream of it being otherwise. In it have we not got *the* most perfect specimen of ancient fortifications—to wit, Londonderry? Perhaps the word ancient hardly applies, for the walls only date from the beginning of the 16th century. However, they saw service on more than one occasion, and most people have heard of the last time, when they so successfully answered the end of their being. Since then they have been preserved with the most jealous care. The city has much outgrown them, and to accommodate the increasing traffic, several new gates have been pierced in them; but they have been altered as little as possible. All visitors to the city make it a matter of duty to walk around them. They are a pleasant promenade of about a mile in length. On certain high days they are manned by those who consider themselves the representatives of the ancient garrison; and the thunder of cannon make the surrounding hills re-echo, and call up in loyal bosoms the memory of the good old days when the men of Derry fought and died for true liberty. Are not the walls of Chester much encroached upon by buildings, and when one is walking upon them are they not walking upon the tops of inhabited houses? And are they not quite overbuilt in some places? Are there any relics of the walls of Limerick remaining, or of any other Irish city?—Shan Sholus

[46498.]—**Cement for Glass.**—Isinglass dissolved in common (not glacial) acetic acid, with the aid of a little heat, makes a strong transparent cement for glass. The glass should be slightly warmed by dipping in hot water, after which it must be wiped dry and clean before the cement is applied.—T. A. C.

[46510.]—**Photography.**—Thanks to "W. T. B." and "W. H. S. W." for their replies to above. Will "W. T. B." kindly say what "black varnish" is the most suitable to cover tin developing-dishes with? The plan described for changing plates is just the kind of thing I have been looking for, and will do admirably. I shall be exceedingly obliged to "W. H. S. W." if he will give me full particulars, dimensions, &c., for making a bag as he suggests. The only black stuff I have been able to obtain is not sufficiently opaque without having about four thicknesses. Is black calico the name by which I shall obtain the best opaque stuff sold? Please give explicit instructions for fitting in the arms and elastic. I think that I can feel to do all that is required without the sights, though perhaps these may be an advantage at times.—F. C.

[46512.]—**Boring Horizontal** Bar.—See answer to 46513; but, instead of a drill-point file a three-square point the same as centre-bit, and give it one turn instead of a third.—Jack of All Trades.

[46513.]—**Drill.**—Get a bar of cast-steel, ½in. by ¼in., and make it into a pin-drill about 5-16in. and ½in. long; twist the end about one-third of a turn,

FIG. 3.

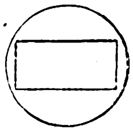
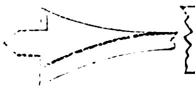
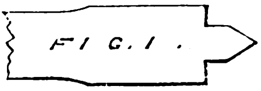


FIG. 2





and sharpen the square ends, giving about a 64th clearance from cutting-edge to heel, and harden and temper to a dark brown.—Jack of All Trades.

[46531.]—**Yacht-Deck.**—In my opinion, "Working Tom" does not give sufficient thickness to the deck planking, unless the boat be a very small one. 1¼in. would be less likely to give trouble by leakage; also it would be very injudicious to leave only ½in. of timber for the spike nails to be driven into, as he recommends.—J. J. A., Liverpool.

[46536.]—**Shaft.**—I have fixed shafting the same as you speak of, and have had very little trouble to get them to work properly. If you were in my locality I could show you one at work that I fixed five years ago.—Stratheden.

[46553.]—**Riveting Copper Boiler.**—Apparently it is only reasonable to presume that it is an externally-fired boiler you have in view. If so, and you want to reset the other end in, the only way is to flange up the end plate, and recess it into the shell, which will leave the rivets in view, as sketched in Fig. 1. Or another way is to flange out the shell-plates and rivet a flat end on as at Fig. 2. In either case, I should well sweat the joint with solder, to insure its being steam-tight.—Sunlight.

FIG. 1.

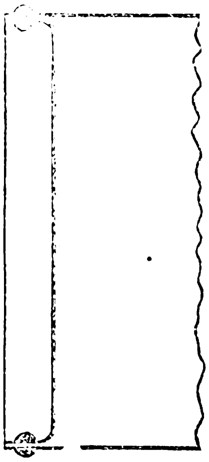
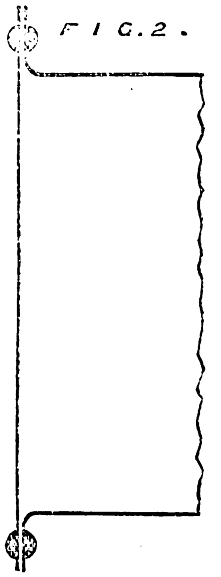


FIG. 2.



[46556.]—**Skin Disease.**—I was afflicted with a similar disease for 15 years without relief, until I was recommended to try the following by a retired surgeon from the East India Company's service, which completely cured me in six weeks. His prescription was five grains of corrosive sublimate to 1oz. spermaceti ointment, scented with bergamot. I rubbed a small quantity on the part affected two or three times a day, and increased the quantity every day. It made it apparently worse for a few days; but I persevered, and it cured me, and I have not had it since. I have recommended it to many, and never known it to fail. —Jas. Lewis, brushmaker, Swansea.

[46557.]—**Spun Wire.**—No drawings of machine have appeared in this paper since Vol. XVII., page 481, when I sent a plan and description of one I made for my own use. Just previous, a well-known correspondent, the late "H. B.," sent a plan of the method he advocated, but it required the assistance of a self-acting lathe or similar machine. A cotton or silk-covering machine will not do for covering with wire, for in this case it is absolutely necessary that a very great strain should be put upon the covering-wire while it is being wrapped round the under wire, and the principle of covering is different. You can buy covered strings singly or in sets, pretty cheaply, either of Mr. Davies, or elsewhere. In the olden plan, the wire is strained in a framing, carrying a toothed wheel at each end, and these wheels revolve equally by means of a shaft carrying suitable gearing. In the other plan the wire is placed within a tube, having a disc on one end carrying the covering wire; the tube revolving in bearings. —J. C. L.

[46557.]—**Spun Wire.**—The strings should first be prepared for covering by drawing them between two coarse files. This roughens the surface, and by giving the copper wire a hold, prevents its springing loose and rattling. The process of covering is a very simple one, and consists of fastening the steel string between two revolving hooks—properly, they ought both to receive the same motion by means of cog-wheels connected by a long rod; but for covering with copper wire up to about No. 20 B.W.G., it will be sufficient if one only does the work, while the other revolves freely with the string. The copper wire should be fastened to one of the hooks and held, in a piece of slit wood, at about the position the covering is intended to begin; the string will then wind up the wire as it revolves, and at the same time push the holder along. When the covering has gone far enough, a little pressure by the fingers on the copper wire underneath the holder will cause is to break off close to the string. The spare wire at the other end may then be cut off by reversing the movement of the lathe and nipping the copper wire with a pair of cutting pliers, which, to prevent injury to the steel, should previously have been softened. If Mr. G. Fryer will send me his address, I will forward him a holder. For this, though easy enough to make, is not so easy to describe without an illustration.—W. H. Davies.

[46559.]—**Sharpening Carpenter's Saws.**—See answer to query 46424, and for pitch of teeth, fine dove-tail saw, 24 to 32 to the inch; tenon, 12 to 16; panel, ⅛ to 5-32; hand, 3-16 to ¼; half rip, 5-16. Files there are great differences in: the first two a 3in. file will do; the next two, a 4in.; and the last, 5in. or 6in.; but for the first, any 3in. file will not do, as they are not fine enough upon the angles, but with Stubbs', I have cut 40 and 50 to the inch, the while with others that are called tenon-saw files I have had the greatest difficulty to get a tooth within the ordinary tenon-saws or meat-saws for butcher.—Jack of All Trades.

[46560.]—**Tuning Piano.**—To Mr. W. H. Davies.—I should hardly like to advise "R. H." to raise the pitch of his piano two whole tones without knowing something more about it, for I am afraid the tuner must have had some good reason for saying that, if raised, "it would be down the following day," as this would certainly not be the case unless something had given way, although it would be quite true that one tuning would not be sufficient to make up for such neglect, even in the best of instruments. I may, however, tell "R. H.," for his comfort, that the difficulty is quite as likely to have originated in the unwillingness of the tuner to undertake such a job as from any defect in the piano. For if there is one thing more than another a country tuner dreads, it is just such a task sprung upon him when he has very likely parcelled out his work barely to time a certain train, and it must be admitted that, under these circumstances, there is "good reason" enough to warm up the most prosaic of mortals into eloquence on the possible perils of such a proceeding; and it would be easier to blame him for this than to act differently in a similar situation, especially when it is taken into consideration that a very large proportion of these cases is due to simple neglect and to a foolish habit of boasting how much longer one particular piano will stand in tune than any other—pitch and tune being, of course, with such people quite distinct qualifications. "R. H." must not think I include him amongst this class; but the tuner would be almost certain to do so, and would make him suffer for the faults of his neighbours. The fact that the pitch seems to have gone down equally throughout, points to a defect in the wrestplank, if anywhere, and is, taking it altogether, rather an advantage than otherwise; but before venturing to tighten the strings I should remove the backing and notice if the plank shows any signs of pulling away from the bracings. If so, a few good strong screws would be of service, though I have noticed it is peculiar to such pianos that the tuning-pins are placed too near the top of the plank for screws to be put in above them, and it may therefore be necessary to put them underneath, though in this position they will have to contend against the increased leverage. In raising the pitch it will be at first only necessary to rough it up. For an amateur the easiest way of doing this will be to raise each note to unison with the ½-note next above, and proceed upward until finished. It should then be left to settle for a short time, and notice should be taken if there are any signs of giving way, such as loud noises, &c. The proceeding may then be repeated half a note at a time until the strings are all up to pitch. To fine tune it, will, of course, require a considerable amount of practice; but, with care, a passable job may be made with the assistance of a set of 12 harmonium or concertina reeds tuned to consecutive half-notes, —if fixed in a concertina so much the better—when the octaves and unisons may be tuned from the groundwork so laid. To remedy the squeaking, a touch of blacklead on the hoppers is all that is necessary; but the difficulty, in a check action, will be to get at them; perhaps the best way would be to lay the action, face downward, on a kitchen dresser and to scrape a little dry blacklead on to the butts of the hammers and to rub it into the grain of the leather with a camel-hair brush. The escape-buttons at the back of the hopper may also require a similar treatment; but with such difficulties a little careful and intelligent planning will do more good than a whole page of instructions, which must necessarily be mixed up with a great deal of advice given at random.—W. H. Davies.

[46561.]—**Water-Supply.**—"A." can, if he thinks fit, disconnect all pipes passing through his house—that is, if the house is his own property. All information he requires he can get from the water-works of his district.—P. Mooney, Plumber.

[46574.]—**Photo.-Bath.**—I was for some time troubled with these stains like marbling. In my case they were caused by a habit I had of moving the plate in and out of the bath by way of helping the ether and water to mix. A gentle motion within the bath may be useful; but if any part of the plate be withdrawn before decomposition is complete, the ether runs into greasy patches, which are sure to show on developing.—W. A. S.

[46574.]—**Photo-Bath.**—Insert pieces of blotting or filtering paper at the corners of the carriers; upon these let the plate rest. The bibulous paper will carry off the drip, and if plates are kept but a reasonable time before developing, the "oyster-shells" should not appear. An inferior quality of silver sometimes causes these marks; organic matter in the bath sometimes produces them, but glue (or other matter in the wrong place) at the corners of the carriers is very often the cause. Never use glue for carriers; shellac is safe. A prolonged and agonising experience makes me suggest glue as the possible cause.—W. T. Bashford.

[46579.]—**Continuous Brakes.**—The G.N.R. company use Smith's vacuum brake generally, and in some cases the Westinghouse automatic, on their Scotch expresses. The M R. use the Westinghouse automatic on their Scotch expresses, and the Sanders and Clayton modified automatic vacuum brake on the ordinary expresses. The L. and N.W.R. use the "Emergency" chain-brake on their Scotch expresses, which only acts on the train, and is not used except in cases of emergency, when it can be applied by driver, fireman, guards, and passengers (by pulling communication cord). The S.E R. use Smith's vacuum on their Continental, tidal, and other expresses.—Brake-block.

[46582.]—**Pressure on Wheels of Railway Carriages.**—The rule needed seems to be the ordinary one: Multiply the power (in pressure) by its distance from the fulcrum, and divide by the distance of the weight from the fulcrum, and the quotient will be the weight or resistance—in this case, the pressure on the wheels.—Paugul.

[46586.]—**A Ruinous Wife.**—I was for eighteen years labouring under the same misfortune, and found that nothing short of a thorough exposure and separation would cure the disease. If "An Unfortunate Husband" will advertise a name and address (post-office will do, but must not be initials), I will give him the benefit of my unhappy experience, and do my best to assist him.—X. Y. Z.

[46588.]—**Telescope Lenses.**—As a week has passed, and this has not been answered, I suppose it may now be considered open. Apologising, in any case, to the correspondent to whom it was primarily addressed, I may tell "J. L." that what was meant was rather the positions of the lenses themselves than of their tubes. What is essential is that the central ray of the eyepiece shall pass through the centre of the o.g.; whether it reaches it perpendicularly or not does not so much matter. Incline any *one* of the lenses of your eyepiece, and you will see.—Paugul.

[46588.]—**Telescope Lenses.**—To "Aldebaran."—By moving the eye-tube of a three-draw telescope sidewise, it is the centres only that are thrown out of line. This is of very little importance in any but very short-focus lenses, such as are occasionally used in celestial eyepieces for delicate double-star work. For ordinary use it would not have any appreciable effect, and, indeed, in nine eyepieces out of ten, is not thought worth the trouble of attending to at all. But to interfere with the squareness of the lenses to their axes is a very different thing, and would render clear definition impossible. As an illustration of how small an error of this description is sufficient to blurr the definition, I may mention that I have now in my possession an astronomical telescope of 3in. diameter, whose performance was, for years, extremely unsatisfactory. This was attributed all along to a want of achromatism in the object-glass, and perhaps the more naturally, that any bright star appeared surrounded by a blaze of all the colours of the spectrum. I was one day trying to focus the sun on a piece of white paper, and found it impossible to get a clear-cut image at all. This put me on the right tack, and I loosened the three screws that held the cell-cap to the body-tube, intending to adjust the lens to a proper focus, when I found, to my surprise, that it was already done, and that the definition was exceedingly good. I dare say "J. L." has at some time amused himself by reflecting sunlight with a piece of looking-glass. If so, he must have noticed that the slightest turn of the glass in his hand was sufficient to cause the reflection to pass across an immense area, while if he merely moved it bodily it had very little effect. These two motions fairly represent the difference between the truth of the planes and that of the centres of lenses in a telescope.—Aldebaran.

[46597.]—**Toning.**—Any good toning-bath with an alkaline reaction will, in course of time, assume a dark tint. This is due to a gradual reduction of the chloride to the metallic state. I find my bath, which has been in use for years, and toned many reams of paper, is slightly tinted, and I prefer it so; the deposit is once or twice a year collected and saved for reducing again to the chloride. If it is desired to prevent this precipitate, filter the bath immediately after use, and add just sufficient of a weak solution of aqua-regia to indicate acidity, but the bath must then be made distinctly alkaline prior to again using. Again, by adding a faintly acid solution of gold to the filtered bath immediately after using (sufficient for the next toning) will generally prevent the deposit, and the interval that elapses suffices to ripen the bath. Your formula is good, but your acetate of soda may be alkaline, and thus cause a wasteful deposit. A few drops of chlorine water, or of a solution of chloride of calcium—sufficient to make the bath smell of chlorine, will prevent the deposit, but changes the tone from purple to black.—W. T. Bashford.

[46597.]—**Gelatine Emulsion.**—I have had no experience with gum as a substitute for gelatine; and except for special purposes, I have for some time past bought the plates of one maker; they are so thoroughly satisfactory in every way, and so very cheap, that I would rather buy these than go to the trouble of coating the plates, though the emulsion cost me nothing. A few days ago one of the most successful amateurs I know asked me to test some plates he had prepared for a tour in Normandy. They were delightfully sensitive, clean, and easy to develop; the following was the simple plan he adopted—certainly the quickest and simplest I know:—1. Gelatine, 300 grains; ammonium bromide, 300 grains; water, 5oz.; dissolve by heat. 2. Silver nitrate, 400 grains; water, 5oz. To this solution add liquor ammonia drop by drop until the brown precipitate first formed is dissolved and the solution is clear. Make this solution of ammonio-nitrate of silver warm, the same as 1, and add the two solutions together, gradually stirring briskly all the time. Now set aside this emulsion where it can cool very slowly (the slower the better). The next day add 300 grains of gelatine to this emulsion, again set aside to cool very thoroughly, and wash in any way thought best. On remelting the emulsion, if it has not taken up enough water to make the total measure 20oz., add water to make that bulk. Or add water to make 20oz. before washing the emulsion, and coat the plates at once, washing them in running water after the coated plates are well set (personally I prefer the latter plan, and if there is convenience for this rather cumbrous method it has several advantages). Dry the plates thoroughly, and they are ready. There is a special make of gelatine peculiarly suited to this formula by Ch. W. Heinrichs, Höchst-on-Main, but probably equal parts of Nelson's No. 1 and No. 2 will answer almost as well. It is extremely important in all manipulations with this emulsion that very special care be taken to use the dimmest and most non-actinic light, both in mixing, washing, coating and developing. —W. T. Bashford.

[46598.]—**Problem in Plumbing.**—You can stop the water passing through the supply-pipe, by putting in the end a good cork. The cork must be in a few minutes before it will thoroughly stop it, as it will swell with the water. Care must be taken when drawing the cork or it will break. I would advise, if possible, an entirely new pipe, as the old one is dangerous.—P. Mooney.

[46606.] — **Back-Geared Headstock.** — To "Sunlight."—Many thanks for your reply. I beg to state that I have a single-geared headstock, but it is not my intention to alter it. I want to make a new back-geared headstock for the same lathe, with a mandrel running in gunmetal bearing, and kept true by a back-centre; and for this purpose solicit your instructions. I shall be most thankful for your help, and trust you will furnish dimensions, with a rough sketch of parts, &c.—Progression.

[46607.]—**Fuller's Battery.**—The Fuller is a carbon-zinc cell. In carbon division put a saturated solution of potassium bichromate, mixed with 1-12th its volume of strong sulphuric acid, with zinc, one of acid to 20 of water. A good modification is chloride of zinc inner cell, and muriatic acid with the bichromate in the outer cell. He may also refer to Vol. XXIX, pp. 298, 374,416.—Kappa.

[46607.]—**Fuller's Battery.**—This battery is a modified form of bichromate. An outer stoneware cell contains a solution made by dissolving three ounces of bichromate of potash in a pint of hot water to which, when cold, 2 fluid ounces of sulphuric acid is added. An inner porous vessel contains dilute sulphuric acid (1 of acid to from 6 to 20 of water, according to the use to which the battery is to be put). The negative element is a carbon plate, and dips into the bichromate solution. The positive is a zinc block, and dips into the liquid in the porous cell, at the bottom of which and in contact with the zinc is a layer of mercury. This block in the batteries sold by the makers is of a rather peculiar shape—resembling a pillar standing upon a broad flange-like base; but there would seem no reason why an ordinary plate or rod should not be used. The copper connecting wire attached to the zinc should be soldered thereto, and the joint coated with some protecting substance such as guttapercha. This may easily be done by rubbing some warmed guttapercha over the joint while the latter is still hot. This form of battery is more constant than the ordinary bichromate, and the zinc plates being, owing to the presence of the mercury, kept constantly amalgamated, local action is abolished, and a great saving of zinc is effected. The battery is fumeless, and is suitable for the performance of all ordinary experiments where a current is only required for a short time.—Alfred W. Soward.

[46608.]—**Strength of Battery Current.**—Certainly; what you want is a galvanometer. Described frequently in back numbers. It is constructed as you assume, and is the best thing for the purpose of a visual test. If you have not back numbers, or want further information, write again and I will help you.—Sunlight.

[46608.]—**Measuring Strength of Battery-Current.**—"C. M. R." is evidently thinking of a galvanometer. Such an instrument may be readily constructed by winding some insulated wire into a small flattened coil, and suspending within it a magnetic needle in such a way that the needle, when at rest, shall be parallel to the longer axis of the coil, but shall be free to swing to the right or left. On sending a current through the coil, the needle will be deflected. But a galvanometer made in this way is of little use as a measurer of currents. The angle of deflection bearing no calculable relation to the strength of the current, it merely tells us that a given current is greater or less than another. The only way practically of using such an instrument for measuring purposes is by first calibrating it. A current of known strength is sent through the coil, and the deflection noted. A current of twice the strength is transmitted, and the new deflection noted, and so on. "C. M. R." will probably find a voltameter of more use to him than a galvanometer. See description by "Glatton," at page 89.— Alfred W. Soward.

[46609.] — **Monohydrate of Sodium-Carbonate.**—This substance may readily be prepared from common soda crystals (decahydrate of sodium carbonate), by pounding them up and permitting them to effloresce, or more speedily, by melting them (which can be done at a temperature of 34° C). In either case, nine molecules of water of crystallisation are given off, and the monohydrate remains.—Alfred W. Soward.

[46614.]—**Tricycle.**—To "Sunlight."—If the cranks were set at right angles, as with a steam-engine, a different action would take place altogether. With a tricycle, power is only applied on the down-stroke, none on the up-stroke; or, in other words, the rider produces revolution of the wheels by pushing only, and not by both pushing and pulling. With the cranks on a right line as now used, the power is applied all round the revolution nearly. The only time when power is not applicable is at the dead-centres. Now, if the cranks were set at right angles, what would result? For one-half of the revolution there would be no power at all applied—that is, to drive the machine forward. The one crank would be first passing on to the bottom centre, the other one in such a position that no force can be applied to it except to go backwards. And as the second crank follows it past the bottom centre, the same state of things still remains. Hence, if the cranks were so, the machine would be driven by the cranks during half each revolution, whilst during the other half the machine would be driving the cranks, thereby losing just half the power now applied. Set at a triangle would be equally bad.—Sunlight.

[46616.]—**Leclanche Battery.**—What do you call the copper pole? and how is it that the carbon does not form the positive pole in each cell? Have you reversed the middle cell of the three? Perhaps your solution was not pure and clean.—Kappa.

[46616.]—**Leclanche Battery.** — What does "Odd Fellow" mean by saying, "I find that.... the zinc in the cells in which the carbon forms the copper pole gets quite black, whilst the others remain quite bright"? Surely the carbon acts as a copper pole in all his cells. If "Odd Fellow" will write again, saying exactly how his battery is joined up (thus, copper plate of cell No. 1 to so-and-so, zinc plate of cell No. 1 to so-and-so, and so on), I will try to help him.—Alfred W. Soward.

[46617.]—**Sewer-Gas.**—"C. G. N." will find no difficulty in finding out a flaw, either by the drain, sink, or closet, by using what I term a sanitary ferret. This is what I contrived and made, and put in practice, to convince my landlord that the drain was defective, and because he could not smell the gas, he could actually see it, and he was thoroughly convinced. Make a rocket as big as a Roman candle, and of very smoky material, or, if you are any where near Mr. Jas. Pain, the ship-signal manufacturer, No. 1, St. Mary-axe, E.C., or 121, Walworth-road, you could be supplied with the real thing itself. Direction: Temporarily stop external gulley-holes connected with drain, and if you can serve the rain-water pipe the same, do so; have a good fire in kitchen, and close all doors; cause the ferret to fit like a cork in the gulley-hole of front area. Now set fire to the touch, and place it in gulley-hole to fire the powder; go in the kitchen, close the door, and wait the result, which will be, if the drain is bad, the room will be full of smoke; if not, if there is no smoke to be seen, you may consider that part sound. To test the sink, or closet, open the door leading to the room with the fire, and if any escape is there, it will be sure to show itself in the neighbourhood of either. For an out-door closet, I connected a half-dozen of common squibs without a bang, and although I succeeded, it was a clumsy job.—G. B.

[46619.]—**Tricycle.**—Whether you have an intermediate wheel or not does not affect the power. The size you have speeded to is easily found. Multiply the diameter of driver by diam. of wheel on crank, and divide by diam. of wheel on hub. Thus, 44 × 2⅜ / 4⅛ = 25⅓in., in your case.—Paugul.

[46619.]—**Tricycle.** — Did you measure the wheels over the ends of the teeth on the pitch-line, or on the line of the root of the teeth? Supposing that the wheel on the crank is 2⅜in, its circumference would be 7⅜in. The wheel on the hub is, you say, 4⅛in. diameter, therefore it equals 12⅞in. diameter. The intermediate wheel does not need to be considered, as it is a mere carrier of the power. The ratios, therefore, are nearly equal to 2 to 1. So that your 44in. wheel is going equal to about a 20in. one.—Sunlight.

[46619.]—**Tricycle.**—"Ex." has speeded down his driving-wheel to 25⅓in.:—4⅛ : 2⅜ :: 44 : 25⅓. The dimension of the intermediate wheel is immaterial. "Ex." has sacrificed speed to power—*i.e.*, with the same rate of treadling he will cover only 25⅓ miles in the same time as he would formerly have travelled 44 miles; but he ought now to overcome an external resistance of 44lb. with no more exertion than would formerly have been needed to overcome 25⅓lb.—W. H. S. W.

[46620.]—**Pantelephone Transmitter.**—Size of diaphragm 6in. square. Have not tried cork. The inventor recommends that material. The coil fuse is 2½in. long and 1¼in. diameter; primary wire, three layers No. 24; and secondary, ¼oz. No. 36, silk-covered copper wire. One Leclanché cell. Have tried carbon and platinum in contact, but find contacts of carbon only much the best. Size of carbons, on diaphragm a disc ½in. diameter and ¼in. thick; on spring, a short rod ½in. long and ⅛in. thick, rounded at the end in contact with disc. Receiver, Bell's Telephone. (See English Mechanic, Vol. XXXII., page 56.) In the sketch accompanying my answer to query No. 46353, a line has been left out by the draughtsman connecting the top right-hand post of switch with left-hand post of bell. Supply this by a pencil-line, and the thing is complete.—John C. Frank.

[46628.]—**Watch-Escapement Pendulum.**—Put the plates together with the escapement; now paint the ruby-pin with whiting and oil (this should be thin, and ground fine); while it is wet, put in balance so that roller-pin does not touch the fork; now place the lever against the banking, with its fork in right position to receive the roller-pin; now swing the balance on the other side, and back again; now remove balance and escapement. If you look at the fork you will be able to see if the roller-pin touches the bottom. Is the guard-pin (*i.e.*, the little pin in the lever) free of the roller? You can try this the same way. Not as a rule; if you cannot stop the balance without touching it, there is not much the matter with it; some light balances, when the watch is fresh cleaned, cannot be stopped.—A Fellow Workman.

[46631.] — **Somerset House Analysts.**—A certain number of gentlemen, members of the Inland Revenue Department, are selected yearly to receive a chemical training in the laboratory. The most promising are retained as temporary assistant analysts, and as vacancies occur in the staff they are filled up from the assistants. Salaries of the analysts vary from £200 to £600.—Somerset House.

[46631.] — **Somerset House Analysts.** — "South Kensington" will find it is not an easy matter to obtain one of these situations. The way they are obtained is as follows:—Appointments are only given to persons in the outdoor branch of the Inland Revenue. A candidate must, therefore, present himself at one of the examinations held half-yearly by the Civil Service Commissioners for the post of second-class assistants of Excise. If successful, he must serve as an assistant for at least twelve months, to obtain practical knowledge of the laws, &c., of excise. At the end of that time, on petitioning the Board of Inland Revenue, and receiving permission, he may be examined for the position of student in the Somerset House Laboratory. This examination is held yearly, in August, and is open to all first and second-class assistants, provided they have received permission, as above stated, and appointments are given to the first six or eight on the list, according to the number required. The examination includes chemistry, physics, and mathematics, and the competition is pretty severe, a much larger number of candidates presenting themselves than are required. The successful candidates have a year's instruction in theoretical and practical chemistry, after which they become assistants in the laboratory. At the end of about three years they return to the outdoor service, ready at any time to perform chemical work, and by their scientific knowledge, act as a deterrent to fraud in a service in which chemical analysis is often the only effective check. The staff appointments of analysts are made as vacancies occur from amongst those who have passed through the above course. These appointments are very rare, the last occurring, I believe, about seven years ago. The salaries given range from £130 to £500 per annum.—Somerset House Laboratory Assistant.

[46634.]—**Fixing Electric Wires.**—(1) Wires for electric bells or telegraphs do not need to be tightly strained, except when carried on posts and insulators. This is rarely needed for domestic purposes. (2) I prefer that all joints be made by twisting the wires one over the other, so that a joint, say, 2in. or 3in. long is made, and then sweat them together with solder. Always, if possible, solder the joints, and this is easy done with a spirit-lamp flame, such as gasfitters use. (2) The length of wire must depend on the size.—Sunlight.

[46634.] — **Fixing Electric Wires.** — 1. Straighten the wires by drawing them tightly through the fingers, and fasten them to the walls with double-pointed American steel tacks, driven about 5ft. apart, the slight tension which can be given with one hand whilst the tacks are driven with the other will be quite sufficient to keep them taut. 2. Twist the bared ends together, solder them, and afterwards cover with guttapercha, using a small spirit-lamp for these purposes. 3. Entirely depends upon the quality of bell, cells, and wire. Two improved Leclanché cells will ring a good bell efficiently through at least 500 yards of good wire.—R. T. Lewis.

[46637.]—**Mount-Cutting.**—I have witnessed "one in the trade" and to the manner born performing this operation, and he didn't spoil the point of his knife on glass, but used a cutting-board of beech wood; also cast-iron patterns got up smooth to any desired shape and bevel. I may observe that, requiring at one time an unusual size of oval mount bevelled, I made a wooden (oak) template, which fully answered the purpose.—J. J. A., Liverpool.

[46640.] — **Electric Dancing or Working Figure.**—Construct figure of cardboard, paint with water-colours, and gum it to give it stiffness. Joints to be made with very fine catgut. Rig overhead a lever contact-maker and breaker. Hang the figure by a horsehair, and it will dance deliriously. Let its feet rest upon a tambourine, and all you have to do is to whistle. — J. J. A., Liverpool.

[46642.]—**Drilling Fluid.**—It will be difficult, I opine, to beat soap and water for cheapness; but I would suggest the trial of urine as regards efficiency and economy. It will be all the better is the user "nose" nothing about it, though. For anything hard I would suggest the use of paraffin-oil.—J. J. A., Liverpool.

[46643.] — **Division-Plate.** — To "Kismet." To do what you say you want will require 180 rows of holes, beginning at 181 up to 360. The average number of holes in a row will be about 270, and the total number of holes will be 48,690. Suppose you put twenty rows on one plate, you will require nine separate plates. Anyone who gives a little consideration to the subject, soon perceives the immense advantage obtained by using a train of wheels for counting; there is no making mistakes, no straining your eyes to count the holes, and no fumbling with the division-peg. To show the enormous advantage the wheels possess, I have drawn up a little table to show what can be done with four wheels only—viz., those of the following numbers of teeth, 60, 40, 48, and 120:—

Number of Teeth.	Wheel on Tangent screw.	Wheels on Stud.	Driving-wheel.
32	48	60 40	120
40	40		120
48	48		120
50	60	48 40	120
60	60		120
72	60	40 48	120
200	120	60 40	48
240	120		60
288	120	40 48	60
300	120		48
360	120		40
450	120	40 60	48

One Turn of Winch-handle in every Case.

The worm-wheel into which the tangent-screw works has, in this case, 120 teeth; wheels of half the above number of teeth only require two turns of the handle, instead of one turn, giving thus 16, 20, 24, 25, 30, 36, 100, 120, 144, 150, 180, 225, and three turns of the handle give in addition, 80, 96, 100, and so on; and for double the above numbers half a turn instead of a whole one. I am now engaged in reconstructing an old-fashioned wheel-cutting machine, of which I will send the drawings some day, and I have entirely rejected the dividing plate on account of its great inconvenience as compared with a worm-wheel and tangent-screw, and a small set of change wheels. I have all the numbers up to 150, and the set of wheels to produce them are only about 46 in number, including several duplicates, and several that might be dispensed with. Another fault of a division-plate is, that supposing you have a circle of 360 holes, and you want to drill or cut 240, you cannot do it. Then, if you obtain a row of 240, the only additional gain thereby is the power of drilling 80, as you already have 40 and 20 in your 360 row; whereas with wheels you can obtain any aliquot part or any multiple whatever of any one that you already have.—J. K. P.

[46645.] — **Astronomical.** — J. Atkinson is making needless difficulty for himself. The value of 1″ of an arc, in *time*, is the same, no matter what latitude he is in. If he wishes to know what the value of 1″ of arc in *space*, say, feet or yards, he will find a table giving this in Simms's book on mathematical instruments; or I could send him a copy, should this be what he requires. The quantity decreases towards the Pole, where it becomes *nil*. It is easily calculated by multiplying the equatorial value by the cosine of the latitude.—David Simms, Limavady, Co. Derry.

[46649.]—**Mounting Micro. Lenses.**—Premising that I am only an amateur, I may say that if "Micro." will make known his address, I will give him instructions. I fear they would be too voluminous for the "E. M."—Paugul.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, A. W. Soward has replied to 45995.

46009.	Guttapercha Socket, p. 553.
46026.	G.W. Engines, 554.
46029.	Analysis of Silicates, 554.
46041.	Cement Testing, 553.
46044.	Melting Fat, 554.
46052.	Old Violin, 554.
46056.	Medical Coil, 554.
46057.	Planing Machine, 554
46059.	Potato, &c., Boilers, 554.
46060.	Digesters, 554.

46302.	L. and S.W.R. Engines, p. 19.
46307.	Barrow, 19.
46324.	Shuttle Tongue for Paper Tubes, 20.
46326.	Helical Epicycloids, 20.
46346.	M.S. and L.R. Engines, 20.
46347.	Indigo, 20.
46348.	Strophometer, 20.
46353.	Chemical and Other Action in Aquarium Fittings, 20.
46362.	Cast Steel, 21.
46363.	Turning up Cart-Wheel Axles, 21.
46367.	Furnace, 21.

QUERIES.

[46651.]—**Problem in Mensuration.**—In Nesbit, p. 120, is the following:—"A gentleman a garden had, five score feet long, and four score broad; a walk of equal width half round he made, that took up half the ground: Ye skilful in geometry, tell us how wide the walk must be?"—Ans. 25·96876ft. The walk must run parallel with two adjacent sides. If taken from the middle of one long side round by the short side to the middle of the opposite side, the walk would occupy the whole of the lower half of the garden. Will some mathematical correspondent favour me with a solution in an arithmetical form, or without using quadratics?

$$(100 + 80)\,W - W^2 = \frac{100 \times 80}{2} = 4{,}000.$$

$$W^2 - 180\,W = -4{,}000.$$

$$W - 90 = \sqrt{(4{,}000 + 8{,}100)} = \sqrt{4{,}100}.$$

$$\text{Whence } W = \pm\sqrt{4{,}100} + 90 = 25, \text{ \&c.}$$

But this is not the form of solution which I want.—John N. Dufty.

[46652.]—**To "Clerkenwell Clockmaker."**—I fancy you promised us particulars of a hall chiming clock once or twice in August last and before. Could you kindly say when you think you will give it?—W. N. B.

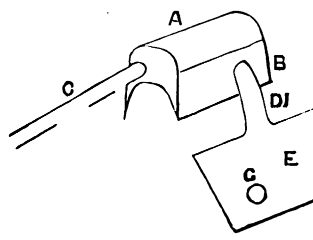
[46653.]—**Finishing Flax, Twine, and Cord.**—I will thank some of our readers to give a recipe for making up a good gloss or dressing with which to finish flax, twine, and cord?—Esquirer.

[46654.]—**Storage Battery.**—Will someone tell me how to make a small model storage battery? Could it be charged with a Bunsen?—Dix-Huit.

[46655.]—**Astatic Galvanometer.**—I wish to make an astatic galvanometer. In the directions given in science and art textbooks, I am told to make the needles as far as possible astatic, and that an astatic system consists of needles of equal power. Now, in Ganot's "Physics" (an old edition) I find that it is an advantage if the needles are not of equal power. Is this latter correct, and why? Any other information on this subject will oblige—Dix-Huit.

[46656.]—**Pitch of Propeller.**—I should be glad if any reader could inform me of an accurate and ready method of ascertaining the pitch of a screw propeller, or what forward moving distance one revolution would make?—Propeller.

[46657.]—**Turkish Bath.**—A B is a semi-cylindrical vessel (like a little boiler) placed over a furnace. Its object is to supply hot air to hot-room, E. And C is a pipe leading from garden intended to supply this vessel with fresh cold air. D. is a pipe to carry the air as it becomes heated into heated chamber, E. But, strange to say, the direction of the current of air is out through the pipe into the garden, thereby lowering the temperature to 80°, and spoiling the bath. How shall I remedy this?—J. H. M.



[46658.]—**Date Mark.**—Will someone kindly say how the age of silver plate can be determined further back than 1796, from that time to the present? I know the date marks. Any information on the subject will oblige—Alpha.

[46659.]—**Spongy Platinum.** — How can I obtain spongy platinum? I have failed in my attempt, though I followed minutely the process as given in Francis's "Chemical Manipulations." No difficulty in either making the solution of chloride, or in precipitating with chloride of ammonium; but upon washing the precipitate, as directed, it was entirely redissolved, leaving a clear deep yellow solution. How can I treat this so as to again obtain a precipitate? Upwards of two dwts. of the metal was dissolved, so that I am unwilling to lose it.—G. F.

[46660.]—**Sutton's Secondary Battery.**—I have just constructed a cell as follows:—A sheet of "lead," (about 120 sq. in.), a sheet of copper (about 100 sq. in.), each drilled with several holes, and bent into a spiral with indiarubber between top and bottom of the plates to prevent contact; the whole inserted into a stone jar containing about three pints water, in which was dissolved 1lb. sulphate of copper. It took about nine hours to charge with two quart Bunsens—the liquid in that time being almost colourless. Upon disconnecting the battery and connecting the lead and copper plates, I could get but a very feeble current. It has now been connected for over three days, and the solution is still nearly colourless, showing that no return action has been going on. If some reader can tell me the cause of failure, I shall be much obliged. The lead was amalgamated with mercury.—W. Stutchbury.

[46661.]—**Watch Balance-springs.**—Will some practical person give information as to what is the cost of a watch balance-spring of the best quality? If any better than the "tempered" ones (6d. each) are generally used?—the common ones costing 2d. and 3d. each. Also, if the balance-springs of M. Lutz, of Geneva (secret make), of whose extraordinary merit mention is make in Encyc. Brit. (art. Clock), have been adopted into use.—Hour-Glass.

[46662.]—**Electric Tell-tale Clock.**—I shall be glad to receive a few hints respecting the construction of the above. Diagrams will be esteemed by—Amateur Clockmaker.

[46663.] —**A Street Nuisance.** — Will Mr. Wetherfield advise?—I work six days per week, from 5 a.m. to 8 p.m. Unfortunately, a lamp-post is fixed opposite my street-door. On arriving home, my much-needed rest is denied me by a band of 15 to 18 preachers who are connected with the "Salvation Army" (and by singing hymns to the tunes of ribald songs, collect the blackguards from a radius of a mile), whose "performances" are conducted round the lamp-post until ten o'clock at night, and all day on Sunday. The police refuse to interfere, and the preachers to move on, although requested by the residents to cease their persecution, there being a number of sick people in the neighbourhood—16 miles from London. How can I stop the annoyance?—Ajax.

[46664.]—**Resistance of Electric Lamps.**—I have seen it stated that the resistance of a Swan lamp being 50 ohms, the resistance of four ranged in series will be 200 ohms; but if the four are arranged in multiple arc, the resistance is only 12·5—presumably for each lamp. If that is so, what is the resistance of a lamp when there are 50 in multiple circle?—Nun. Dor.

[46665.]—**Discolouration of Paint.**—Will some courteous correspondent of "ours" kindly explain the cause, and, if possible, suggest a remedy for the following?—In my business I use a great quantity of white paint, the bases being either white lead or zinc white. After painting and rubbing smooth, this white is varnished. Now if the article so painted is exposed to the light, as, for instance, in a shop-window, it changes to a dirty grey colour, and as long as it is so exposed, the tint continues to grow darker. If the article is then taken into a dark room, or is covered up, it gradually returns to its pristine whiteness. A plate of iron coated as above, and one-half covered over, and the other half exposed to the light would, in two or three days, be half grey and half white. I have tried varnishes of all kinds, and consulted every varnish-maker I know, and it still remains a mystery to us all. I have also tested the whites for adulterations, and have found both pure and impure are affected alike.—Achromatic.

[46666.]—**Organ.**—Can anyone inform me whether (when using the suction principle in a two-manual organ harmonium) the same effect is obtained by varying the air supply as by using a venetian swell-box and the pressure principle?—E. F. G. G.

[46667.]—**Medical.**—Will Dr. Edmunds kindly advise in my case?—Age 47, weight 10st. 4lb., and inclined to lose weight; have symptoms, I think, of "Bright's disease"; water very frothy, and remaining so for a long time; great feeling of lassitude and aching of limbs after any unusual exertion, and sometimes without; water clear when plenty of soda-water is taken—otherwise generally turbid. I have always lived freely, and smoked considerably. I also frequently suffer from heartburn after meals. This I have found relieved to some extent by hop-bitters.—B. D.

[46668.]—**Household Dyes.**—Having a few articles which I wish to dye a fawn colour, and not finding that shade in the household dyes, I should feel obliged if any of your correspondents could tell me what colours to mix to produce a fawn colour? Also, a few hints as to colours to mix to produce various shades.—J. C. B.

[46669.]—**Patterns for Engine.**—Will someone tell me how to set out the proportionate sizes in making working drawings for engines? I want to get out drawings before making the patterns. In one case the cylinder is 1⅜in. bore, with a stroke of 3½in.; in the other, 4in. bore by 8in. stroke, horizontal. Will "Sunlight," or some other reader, give the proportions of other parts, and state the nominal horse-power.—T. Hendry G. Brown.

[46670.]—**How to Gelatine Paper, Show-cards, &c.**—Could any reader kindly give any information about gelatining or the preparation which is applied to the glass to cause the gelatine surface to leave the glass easy? I have tried to gelatine some showcards, but I cannot get them off the glass properly.—H. Williams.

[46671.]—**Brown Marks on Skin.**—Like many others I should feel grateful to Dr. Edmunds if he would kindly give me his advice. I have had a yellowish-brown mark which covers nearly half my forehead. Also two or three smaller ones (varying from the size of a threepenny bit to that of a sixpence) on other parts of my face. They came suddenly about two years since, when suffering from weakness, a bad bilious attack, and cold. From those I have long recovered, and am now enjoying average good health. But the marks remain, and as they quite disfigure me, I should feel most thankful if Dr. Edmunds would advise me how to get rid of them. I am most careful as to diet, &c., and have taken several bottles of Camomile pills to see if they would have any effect; but if they have it is so slow as hardly to be noticeable. I am 26 years of age.—Sister of a Long Subscriber to the English Mechanic.

[46672.]—**Binding Screws.**—As these are an expensive item in electrical apparatus, can anyone suggest a ready substitute or mention a cheap form of them, and at what price they can be procured?—Crux.

[46673.]—**Varicose Veins.**— Will Dr. Edmunds kindly say, could a person afflicted with above reside in a hot country—such as Australia or India—without injury to health?—V. V.

[46674.]—**Telephone.**—I have noticed that one or two writers question the advantage of using the secondary current for the telephone. Will someone kindly point out where and how the advantage does come in, the only obvious disadvantage being the cost of induction coil, which is, however, a large item?—Crux.

[46675.]—**G N. Engine, 48.**—Could any reader of the English Mechanic inform me the cylinder size and stroke of the G.N. engine, No. 48? Also, dia. of driving-wheel and any other dimensions connected therewith? I believe she took the first prize at Darlington in 1876; but of this I am not sure. Who were the builders?—Amateur.

[46676.]—**Focus of Lanterns.**—Can any of "ours" tell me the best way to produce the largest picture with a 4in. focus lantern, 4in. condensers, using the safety limelight jet? Any directions would be acceptable to an—Amateur Exhibitor.

[46677.]—**Musical Box.**—I have lately purchased a second-hand musical-box, playing six tunes, and although the tunes are perfectly played, still there is (to me) a disagreeable screeching like the whistling of a bird all through the tune, something like the peculiar noise a fork would make when pushed in an upright position across a plate. Could any of "ours" tell me a remedy, or is it intended to be so to imitate a bird?—J. Acsird.

[46678.]—**High Temperature Fluid.**—Would any correspondent be good enough to name any oil, or other fluid which will not boil nor rapidly deteriorate at about 600° Fahr., nor corrode cast iron? Required for some peculiar hydraulic work.—S.

[46679.]—**To Mr. Lancaster.**—Thank you for noticing my query (46297), but I am afraid there is a misprint somewhere, and I have not made my meaning plain. I want to know what should be the thickness and resistance of the wire on the magnets to produce the maximum effect on the armatures which are already wound with 18, and have a resistance of about ·625 ohms. I am sorry to trouble you again.—Clôture.

[46680.]—**Horizontal Escapement.** — Would "Fellow-Workman" kindly tell me how to put a horizontal escapement in beat? It is very much out.—A. H. K.

[46681.]—**Windmill Pump.**—I shall be grateful to brother-readers for advice, with diagrams, if possible. I want to lift 100 gallons of water per hour by a 2in. force pump to a height of 30ft. from surface of water in well by means of a windmill, which shall automatically present its face to the wind.—O.

[46682.]—**Hydrometers.**—I have been at a loss for some time to know the difference between Baumé and Twaddell's hydrometers. Perhaps some of your intelligent correspondents will kindly give me a comparison of the two, so that I can work with Twaddell from Baumé.—Carrick.

[46683.]—**Magneto-Electric Machine.**—To Mr. Lancaster.—I have made a magneto-electric machine, but can get no current from it—a 5in. permanent horseshoe magnet, bobbins 1¾in. long, with ⅜in. turned iron cores and copper bobbins wound with two layers of 26 cotton-covered wire; the cores are joined at the end furthest from the magnet with a piece of iron, and the other end with a piece of brass One wire goes to spindle which has two flats filed on it, against which a spring makes and breaks contact. The other wire goes to washer insulated from the spindle, against which another spring rubs. I cannot get the least current from it. Thinking that there was not enough wire on it, I connected it on to an electric bell with the same result. Do you think the magnet is strong enough? A machine I saw the other day had cast-iron cores and bobbins with a double magnet, which was only bright on one pole. The spring at make-and-break of contact had two small holes in it—what were they for? Also, can I make a magnet of some pieces of square steel clamped together and joined by a piece of iron at the top, as the magnets in the machine I saw were bright only on one pole. Would not a straight magnet do as well? I revolved my machine at a very high rate by connecting it on to the lathe.—A. W. C.

[46684.]—**Photo. Background.**—I want to paint a plain background for outdoor photography—one that will take dark. The one that I have is a dark grey, and when the light falls on it it takes white at the bottom end. Could anyone give me a good colour and say how I am to prevent it from shining?—Dark Background.

[46685.]—**Piston.**—To "L. O. V."—A few weeks back you answered a query about taking out piston to clean it. I went by your instructions—put in the eyebolts in piston-end, then tried to pull off piston-cover, but found it would not come; then I put a long bar of iron through eye-bolt across end of cylinder, then turned round engine; but the eye-bolt broke at screw, leaving screw in piston. How should I proceed to get piston-cover off? There is very little room at back end of cylinder, as the condenser stands close to it.—Stoker.

[46686.]—**Organ Reeds.**—I have an organ of two manuals. In the Swell were two reeds—Cornopean and Oboe. In the Great there were no reeds, but an objectionable mixture of two ranks. I took out the Oboe from the Swell and put it into the Great in place of mixture. Pressure of wind little more than 2½in. The Oboe went only to Tenor C in the swell, but I put it all an Octave lower, so as to make it a 4ft. reed. The holes for the wind were too small for the boots, so I first enlarged them, and then found that the holes in the slider and wind-chest were also too small, and not wishing to take off the soundboard, I burnt the holes larger with iron wire. I doubt if there is wind enough now, as the reeds are (*a*) very slow in speech. Further, they are continually getting out of order. When in the Swell they seldom required anything but tuning. Now, sometimes, I find two or three (*b*) altogether dumb. In attempting to put them right I find a great number of difficulties. Some (*c*) will sound a note which gradually gets less in volume until it arrives at the right pitch and then goes off altogether. I try them with my mouth and they seem all right. Directly they are put into the organ they are dumb. Some (*d*) grunt—intolerably coarse. Some (*e*) vibrate well until near pitch, and then become hard and horny, having little of the tone of a reed. Will some of the "cognoscenti" kindly tell me the causes of these various defects? And a few hints on the mysterious subject of reed-voicing will, I am sure, interest many besides one who is nearly at his—Wits' End.

[46687.]—**Lifting Water by Motion of Ship.**—I want to put pipe through bottom of ship to lift water by the motion of the ship passing through the water. Would any reader kindly give me the height at different speeds (from 1 to 20 miles) that the water will rise?—R. W.

[46688.]—**Intensity and Quantity.**—In Jenkin's "Electricity and Magnetism," p. 88, there is the following par.: "Cells joined in series are sometimes described as joined for intensity, and cells joined in multiple arc as joined for quantity. These terms are remnants of an erroneous theory." In my electrical days we used to join all the similar plates of a battery in the expectation of getting quantity, and couple the plates alternately if we desired intensity. Is there really no difference between intensity and quantity now? Or is the above not the way to develop either? And if not, how do you do it?—B. H.

[46689.]—**Focal Length of Photo. Lenses.**—In the last paper on dry plate photography (p. 124), should it not be $\frac{f}{16}$ instead of $\frac{f}{14}$, as there given? $\frac{1}{16}$ is afterwards squared in reference to same lens, and ¾ is certainly 1-16 of 12. Will anyone please explain to me if, in calculating rapidity of a lens used with different stops, you have to take into consideration the varying focal length when nearer and more distant objects are focussed? Take for instance a lens of 12in. focus. Now in using this lens, the focal length will be slightly more or less at times—according as near or distant objects are focussed. Is the exact focal length at the time of using the lens to taken as 12in. always, or to measure the length on each special occasion, and then get at rapidity? Thus, with the lens I use, the focal length varies more than 1in., according to what is being focussed. I hope you will be able to understand what I mean. When a lens is spoken of as being 12in. focus, at what distance is the object supposed to be to make 12in. the exact distance between diaphragm and ground glass?—F. C.

[46690.]—**Waterproof Cloth.**—If any of the readers of the "E. M." could tell me of a cheap light material suitable for making a cover for my tricycle, I should feel obliged. Could I render canvas waterproof by oiling it or otherwise?—M. L. R. S.

[46691.]—**Retouching Photos.**—Will someone please give instructions for retouching negatives? What pencils to use, &c., and how to set about it? How can the tiny holes and thin cracks which make their appearance at times in gelatine negs. be avoided or repaired (they, of course, give dark tiny spots and thin lines on the prints, which are very objectionable)? In retouching, is it only the face that is usually done, or are flaws and holes, &c., made good by the retoucher? Are landscapes retouched? Any information will be thankfully received by—F. C.

[46692.]—**Scotch Bagpipes.**—Can some kind reader give me any information respecting the above? Should like to introduce them in a second part of a minstrel entertainment—but am rather in the dark regarding them. Are they difficult to learn? Could I get a book to instruct me, and music suitable for a solo?—Cosmo.

[46693.]—**Staves.**—Would someone versed in the timber trade state how Baltic staves are reduced to Petersburg standards? The writer can work out deals, &c., correctly. Any references to former replies touching timber calculations would be also valued.—H.

[46694.]—**Brick-Kiln with Down Draught.**—I shall be glad if any of your readers can give me, through your paper, a sketch of one such as are used at Stourbridge and in Staffordshire—either round or square, and to hold about 30,000 bricks.—Brick-Kiln.

[46695.]—**Spark Condenser.**—To Mr. Lancaster.—Thanks for former reply about induction coil. Will you kindly say construction of Browning's spark condenser to be used instead of Leyden jar? Also, what length of spark-coil would be required with a condenser of this kind to give spectra of the metals?—Volvox.

[46696.]—**Bichromate Battery and Intensity Coil.**—A month ago I constructed a bichromate battery, (containing 12 pint cells) to obtain a light from a toy-lamp, but found that it did not answer very well. I then resolved to try C. C. Cory's electric lamp (a description of which I saw in No. 723 of the "E. M."). Having got everything ready, I found that the solution had nearly lost all its power, having been used only twice. Can any kind reader inform me whether it would be best to strengthen the solution, or throw it away and make a new one? Also, how I could construct an intensity coil equal to 60 such cells?—Jack in a Fix.

Nearly 3,000 tons of charcoal iron are still made annually in the United Kingdom. There are, according to the report of the British Iron Trade Association, six charcoal furnaces in existence, all of them belonging to one firm.

ANSWERS TO CORRESPONDENTS.

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*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, April 19, and unacknowledged elsewhere:—

R. A. Lee.—Foxdale Institute.—R. Mills.—Rev. N. S. Godfrey.—A. Ledger.—F. Bartleet.—S. E. Peal.—Sir P. Radclyffe.—G. H. Cawthorn.—H. Maxted.—Jumbo.—E. R. M.—Grapho.—A. M. G.—G. W. Dunn—Philolectron.—H. B.—Anxious.—Minim.—A Captain's Wife.—Arc.—A. B D.—Semper Fidelis.—Foundry.—Amateur.—Orderic Vital.—Switch.—Gauge.—E. Gobert.—W. H. B.—Electric Light.—A. W. Soward.—E. Williams.—F. W. G.—Mottershead and Co.—Steel.—Prismatique.—A. Manock.—Practical Amateur.—Vega.—Working Blacksmith.—Mathew.—B. M.—C. S.—What Can't be Cured Must be Endured.—Tormented One.—H. R.—Wm. Johnstone.—Blackwater.—Circular Saw.

Expulsion. (The cause is having eaten the scolex of the worm in the shape of measly pork or infected beef; the best remedy is male fern, which any druggist will make up for you; but you will find other suggested remedies in back volumes.)—B. H. (Yes, a new edition is being prepared, but when it is coming out we do not know.)—D. Williams. (We cannot give the date, as the translator is away, but it is in the *Comptes Rendus* of the meeting of Feb. 20.)—Young Hand. (See p. 480, No. 800, and a series of papers on Soldering in Vol. XXXIII., pp. 170, 264, 334, 455. 2. With a needle drill.)—Reflector. (One of the silver powders sold by the makers of Bessemer's paint may answer your purpose; but looking-glass is made by coating with an amalgam of mercury and tinfoil, or by depositing silver. See indices for processes. For prices, you must ask at the dealer's.)—Silurian. (The process is described in the cyclopædias, but is rarely used nowadays. See p. 231, Vol. XIII., for the improved process, or p. 606, Vol. XXIX.)—Sanitary Inspector. (We do not know the address of the Institute; but their examinations, &c., are periodically reported in the *Building News*.)—Jacques. (Try the "Vulcan" cement, mentioned on p. 115.)—Georgiana. (What do you mean by a "provisional" will? If the wife was appointed sole executrix, and all the property devised and bequeathed to her absolutely, she can, of course, dispose of it as she pleases.)—J. A. Smith. (You had better advertise for it in the "Sale" column. Our pages would be altogether inadequate for a full-size working model, even if we could spare the space.)—Surgeon. (The odour is usually sufficient; but a method of ascertaining whether sewer-air can find its way into the house is to pour some essence of pennyroyal down the drain. Care should, of course, be taken that the odour of the pennyroyal reaches the house only through the suspected inlets.)—J. S. (No one can tell you without examining the apparatus.. You should take it to an optician.)—Charles Newton. (Unfortunately, the transference takes the form of a notch, which goes on deepening until the connection is broken. Edison has endeavoured to overcome it by making the bridge as a whole revolve very rapidly. Merely changing the direction after a given interval would simply prolong the life, as the carbon would not be deposited in the notch.)—An Amateur in Electricity. (You will need 30 quart cells of Bunsen form. They consist of an outer jar or porous pot, a piece of zinc bent to surround the porous pot, and a rod of gas carbon in the latter. Nitric acid is placed in a porous pot, and dilute sulphuric acid in the jar; but for practical instructions in the making of batteries, see pp. 321, 373, 395, 419, 468, 539, 630, Vol. XXVIII., and pp. 65, 137, 312, 362, Vol. XXIX. See also the indices of more recent volumes.)—Grateful. (No, it must have been erased before the silvering was done, or it would still appear—that is, if the coat was put on by electro-deposition.)—Steam Rubber Tube. (The size is rather small, but we should advise you to try another maker. Look through our advertisement columns.)—Dealer. (It is a police regulation, full particulars of which can be had from the superintendent in your district. We know of no other license, except in the case of the precious metals.)—J. M. B. (No advice worth anything can be given in such a case without examination of the eyes. If you reside in London, and cannot afford to pay fee, take him to University College Hospital, or one of the special hospitals.)—A Cornchandler but Old Subscriber. (If you have your old volumes you will find your questions answered many times. For instance, p. 229, Vol. XXX.; pp. 273, 296, Vol. XXIX.; pp. 342, 388, Vol. XXVI., &c.)—Oil. (See p. 511, No. 775, and elsewhere. Full particulars would require too much space, but the principles are to be acquired, and the rest is easy.)—Wensley. (Do you mean the cases of the pens? It is vulcanite or ebonite, made by mixing sulphur and rubber, and subjecting to heat and pressure.)

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, APRIL 28, 1882.

PHOTOGRAPHY OF OBJECTS IN MOTION.

THE art of photographic representation of the successive phases of a phenomenon which occurs with considerable rapidity, has of late been remarkably advanced by the labours, more especially, of Mr. Muybridge, and MM. Janssen and Marey. We propose here to indicate some recent achievements by the French physicists in this interesting art.

It is known that the principle of M. Janssen's "photographic revolver," employed during the Transit of Venus in 1874, consists in rotatory movement of a sensitised plate, on which images of different phases of the variable phenomenon are successively produced. In that instrument, the sensitive plate is stopped mechanically each time that an image has to be taken, and it only moves to allow of a neighbouring unimpressed part receiving a fresh image. Notwithstanding those stoppages, a certain number of photographs can be obtained in a second, and the method has been successfully applied by M. Marey to the flight of birds (in a way already alluded to in our "Scientific News," and to be described more in detail presently); but it will be readily understood that this condition imposes a limit soon reached after exceeding about a dozen images per second. The reason is, that it is extremely difficult to stop suddenly, and for a very short time, a body animated with rapid motion.

For example, the study of the flight of insects requires that images be taken at extremely small intervals, probably much less than 1-100th of a second. Now it would be impracticable to give a plate motions and stoppages following one another with such rapidity. Thus the applications of the revolver, which would be the most interesting and fruitful of new facts, would be impossible if this condition of successive stoppages were absolutely indispensable.

M. Janssen has long been of opinion, however, that it would be possible to take photographic images on a plate in motion. If we analyse the question, we find that there is a relation, according to the delicacy of the elements of the image, between the motion that may be given to the plate, and the time of the luminous action. To give an experimental demonstration of the principle, M. Janssen chose solar images. It is known that the solar surface is one of the most difficult objects to see in telescopes, and that its reproduction by photography has only been accomplished quite recently. Now, M. Janssen proposed to obtain this granulation on a plate which had a motion of 0·15m. to 0·20m. (say 6in. to 8in.) in a second.

The result was quite satisfactory. M. Janssen has exhibited to the French Academy plates on which two similar portions of the solar surface were reproduced. One of these portions was taken on the plate while the latter was at rest, and the other while the plate was moving about 6in. in a second. A comparison shows that the motion did not at all hinder the manifestation of the granulation, that is to say, of one of the most delicate phenomena of astronomical photography.

The ascertainment of this fact doing away with the requirement of successive stoppages, it will be understood that, in some sort, nothing limits the number of images which the revolver might furnish in a given time. It is only necessary to establish a right relation between the delicacy of details of the image, the velocity of the sensitive plate, and the time of luminous action.

In the new arrangement, the support of the sensitive plate, and the slitted screen, have each a continuous rotatory movement, and it is the magnitude of these movements and their relation that determine the rapidity in the succession of images and the conditions of their formation. By some simple calculations, M. Janssen has convinced himself that it will be easy to obtain images of a phenomenon, following one another at intervals of 1-100th of a second, and even to go beyond that.

The results of M. Janssen's further studies will doubtless be looked for with much interest. Let us now turn to the photographic rifle (based on the principle of the old photographic revolver), which M. Marey has now described, together with some of his experiments with it on birds' flight, to the French Academy. He constructed an apparatus of the size of a fowling-piece, which photographs the object at which it is pointed twelve times in a second. Each image requires an exposure of only 1-720th of a second. The following is the author's account:—The barrel of this rifle is a tube which contains a photographic object-glass. Behind, and solidly mounted on the butt end, is a large cylindrical breech, in which is a piece of clockwork. When one presses the trigger of the rifle the clockwork is set in motion and imparts to the different pieces of the instrument the necessary motion. A central axis, which makes twelve revolutions in a second, commands all the pieces of the apparatus. There is first an opaque disc, pierced with a small aperture. This disc forms a screen, and only admits the light from the object-glass twelve times a second, and each time during 1-720th of a second. Behind the first disc, and turning freely on the same axis, is another which has twelve apertures, and behind which is applied a sensitive plate, of circular or octagonal form. This perforated disc has to turn in an intermittent manner, so as to stop twelve times per second opposite the beam of light that penetrates the instrument. An eccentric placed on the axis produces this jerky motion, giving a regular to-and-fro motion to a ratchet-rod which, at each oscillation, catches in one of the teeth forming a crown on the perforated disc.

A special screen stops finally the penetration of the light immediately the twelve images have been obtained. There are other arrangements to prevent the sensitive plate exceeding, by its acquired velocity, the place where the ratchet brings it up, and where it should be perfectly motionless during the time of luminous impression. The adjustment to focus is done by lengthening or shortening the barrel, with the effect of displacing the objective forward or backward. The right position is verified by observing through an aperture in the breech the distinctness of the image received on ground glass. A conjuror's box (*boite à escamoter*) of circular form served as holder for twenty-five sensitive plates, and for passing them into the rifle without exposure to light. Before applying the apparatus to birds' flight, M. Marey tried it on a rotated arrow and on a pendulum. A chronographic apparatus was adapted to the rifle. M. Marey photographed a gull in flight. As the bird gave exactly three strokes of the wing in a second, the twelve figures show four successive attitudes reproduced periodically. By enlarging the figures, images are got which are visible at a distance. They were somewhat indistinct, owing, as the author says, to his small experience in photography. Reproduction of the images by heliogravure gives dark silhouettes (see *Comptes Rendus*, April 10th). With exact focussing, details of form (imbrication of the feathers, &c.) could be made out in the microscope. If the protographs be arranged in a phenakistiscope, the appearance of movements of flight is, indeed, reproduced; but the images corresponding to each revolution of the wing are still too few to allow of analysis. Their number must be augmented. This can be done by doubling the velocity of the plate and the screens. M. Marey did so with the same rifle, and still had enough light for production of the images. The time of illumination of the plate was only 1-1400th of a second, yet the objective used was not a very rapid one. By photographing a bird under various conditions—*e.g.*, when withdrawing from the observer or approaching, when seen from above, and when seen from below, &c.—various information may be acquired as to the mechanism of flight. M. Marey found his principal results with the graphic method confirmed by the fresh data, and he anticipates a considerable further elucidation of the subject of flight by the new method. He gives a brief account of observations on a bat's flight, which is difficult to photograph. The photographic rifle, of course, lends itself to observation of the movements of other animals as well as birds.

REVIEWS.

Railways and Locomotives. By JOHN WOLFE BARRY, M.Inst.C.E., and F. J. BRAMWELL, F.R.S., M.Inst.C.E. London: Longmans.

THIS volume contains the lectures delivered by the authors at the School of Military Engineering, Chatham, in 1877, and is published in its present form because it was thought to be a useful book for the general reader as well as for those who wish to study the constructive details of railways. It contains six lectures by Mr. Barry, three of which are mainly extracts from his well-known textbook on "Railway Appliances," and three by Mr. Bramwell, the latter dealing with the locomotive exclusively. The volume is freely illustrated with engravings, most of them taken from actual constructions, where such a course was possible. Although specially intended for military engineers, the lectures form in reality an excellent treatise on railways, and a useful textbook for students going up for technological examinations. The whole minutiæ of signalling, with the details of interlocking arrangements, are set forth in tolerably full description, while the construction of rolling stock is explained by the aid of diagrams and tables of dimensions. In the lecture on rolling stock, &c., Mr. Barry says that the best theoretical arrangement of buffers, &c., would be to concentrate the buffing arrangements at the head and end of the train, and to couple-up the intermediate carriages tightly—the buffing carriage to be of sufficient length to take up the momentum of the blow before any serious damage is done to the rest of the carriages. On the question of supplying signalmen with speaking instruments at all boxes, Mr. Barry takes up the chief objections, and points out that the advantages enormously outweigh the alleged disadvantages, the chief of which can, however, be easily removed. The idea that speaking instruments would encourage a lax working of the block system is somewhat like the notorious objection to the general use of a continuous brake on a certain railway, for at least others besides the two signalmen would be aware of the breach of rules, and where the latter are really enforced, railway employés do not exhibit an absorbing desire to break them. It is rules that are not enforced that they disregard—too often to their own destruction. As to the objection that if speaking instruments were provided they would be used for idle conversation, it could easily be arranged that the instruments should record the number of times they were used, or even the messages sent; but in the absence of such devices the signalmen could not be certain that an inspector was not in the other box. At any rate, the advantages are so great, as some companies have lately learned to their cost, that it is probable before long all boxes will be furnished with speaking instruments of some kind. What is generally held to be the most perfect system of electric interlocking of signals and points, is briefly referred to in a note, whereas an appendix or a separate chapter might well have been devoted to an explanation. Sir Frederick Bramwell's portion of the volume is devoted to the engine, of which it is a popular explanation, though scarcely entering so minutely into details as might be wished. The movements of the slide-valve and the use of the indicator are explained at some length, and the diagrams help to make the matter very clear, and bring it within the comprehension of the average intelligent reader. Hence, this book might find an appropriate place on the bookshelves of all public libraries, and those of mechanics' institutes. One of the most interesting portions of these lectures is that in which Sir Frederick Bramwell describes the methods of reversing the engine prior to the introduction of the link.

Modern Metrology. By Lowis D'A. Jackson. London: Crosby Lockwood and Co.

This manual of the metrical units and systems of the present century shows very clearly the necessity that exists for some reform in the systems of weights and measures used in various parts of the country; and it is, therefore, natural that the author should append to his work a proposal for a systematic and uniform English scale of weights and measures. To alter the measures of a country by any arbitrary act is felt on all sides to be a difficult and harassing undertaking, for customs of the kind are often looked upon as part and parcel of the national life—that is, in the respective districts and the trades interested. A knowledge of the way in which produce or articles of manufacture are bought and sold often constitutes the sole secret of trade, and it is not surprising that a conservative feeling should predominate amongst those immediately concerned. Nevertheless, a strong feeling has always existed, and is steadily gaining strength, that weights and measures should be put on a uniform basis throughout the kingdom, and that the diversity in custom, which we now find even in adjoining counties and neighbouring market-towns, should cease to perplex the uninitiated. In the work before us, Mr. Jackson has laboriously compiled tables of the various weights and measures used at the present day by civilised nations, or at least by those of commercial importance, and opposite to the figures he gives the proposed English scientific equivalent and the existing French weight or measure, as the case may be. The basis of the English scientific system was laid down by the Warden of the Standards in his work on the "Science of Weighing and Measuring" (Macmillans, 1877), and Mr. Jackson points out that an English scientific system, to suit all purposes, must be either strictly decimal, or mixedly decimal, centesimal, and millesimal, at the same time being in some accord with the English trade units. The proposed system would, for measures of length, divide the foot into ten tithes, a rod would be 10ft., a chain 10 rods, a cable 10 chains, and a mile 5,000ft. The square foot would be 100 square tithes, and similarly the square rod 100 square feet, the square chain 10,000 square feet, and the acre 40,000 square feet, the square mile being 25 million square feet. The cubic foot would be divided into 1,000 cubic tithes, and for wet capacity the cubic tithe would equal a fluid ounce (= 1,000 fluid mils), while 16oz. would equal a fluid pound. For measures of weight there would be a uniform "foot weight or talent," equal to 1,000oz., or 62½ pounds of 16oz. each. The ton would be 40 foot-weights, or 2,500 pounds. There is, we think, small chance of any reform of the kind, but those who are interested in the subject of metrology will find much valuable information in this work.

The Scientific Basis of National Progress. By G. Gore, LL.D., F.R.S. London: Williams and Norgate.

The author in his preface says that there exists at the present time in this country a considerable degree of uneasiness respecting our ability to maintain our position in the race of progress, and he thinks it desirable, as our future success as a nation depends largely upon science, to call attention to the great public importance of scientific knowledge, and to the means of promoting its development. Such "uneasiness," as did unquestionably exist a few years ago, has been quieted by the efforts made to give technological instruction to the industrial classes; and though we are amongst the first to acknowledge the value of original research, and that human welfare depends, to a great extent, upon scientific progress, we cannot admit that it is the business of the Government to establish a fund for the Endowment of Research—though it might appropriately enough interfere with some existing endowments to the extent of seeing that the money is not absolutely wasted. As Dr. Gore points out, progress is the result of new ideas, and the chief source of new ideas is original research, and he happily suggests that probably one of the most satisfactory ways of rewarding scientific discoverers and serving national interests at the same time, would be to create salaried professorships of original research, and appoint discoverers of repute to fill them. Further on, he says that the money paid to young men in Oxford alone now amounts to about £80,000 or £90,000 a year—funds which were originally intended for promoting knowledge, "but vested interests prevent their being used for discovering new truths." It is obviously to the national advantage to elicit new ideas in science—that is, to obtain new knowledge; but we suspect it will be a long while before the nation will consent to the endowment of State laboratories. Dr. Gore's little work will, however, be read with much interest, and the probable effect will be that the laboratories he desires will be established by private munificence—certainly not by the State, or by corporations out of municipal funds.

Vibratory Motion and Sound. By J. D. Everett, M.A., F.R.S. London: Longmans.

In this volume Prof. Everett treats the subject of vibratory motion in a manner suited to the capacities of students who have mastered the elements of dynamics. Simple harmonic motion, which is the key to the whole subject, is treated in chapter I., and the two succeeding chapters contain explanations regarding the composition of motions, with some novelties in the shape of geometric proofs of propositions usually established by trigonometry. The method of treating the subject involves a knowledge of mathematics; but, though the book is mainly intended for students, it will interest many who will read it as a popular treatise. For instance, while in one chapter we find the mathematics of Lissajous' curves, in the next, we have some mechanical illustrations of simple harmonic motion, which include the tide-predicter of Sir W. Thomson and Donkin's harmonograph. Other chapters discuss in a popular way the theory of sound-waves, while accurate investigations of the rapidity of stationary vibrations of strings and columns of air, the velocity of propagation and the energy of undulations are treated in a very readable manner. Finally, to render the treatise complete, there are a couple of chapters which treat sound from the point of view of the student of musical intervals.

We have also received *The Sphygmograph*, by R. E. Dudgeon, M.D. (Baillière, Tindall, and Cox), a description of the instrument devised by the author, with examples of its use. We illustrated Dr. Dudgeon's sphygmograph on p. 104, last volume, and his little book gives a history of the development of the instrument, and of the important part it plays in diagnosis.——*Chess Players' Annual and Club Directory*, edited by W. R. Bland (Bemrose and Sons), is the vade-mecum for the regular player, and will be found of much interest to those who only indulge in a game occasionally. The lists of clubs and chess resorts in this country and on the Continent will be useful to many, while the papers and problems will serve to amuse the reader.——*Plane Geometrical Drawing*, by F. E. Hulme (Longmans), is a volume of worked examination questions for the use of students at the military and engineering colleges, and also for those who are endeavouring to teach themselves. The preface contains instructions for using the book, and some sound advice; but the drawings which form the great bulk of the volume are drawn of such a size that they cannot be merely blindly copied for examination purposes.——*Homes and Farms in America*, by G. H. Everett, M.D. (Dickie), is a readable little guide to those desirous of emigrating to the United States. It recommends Kansas to the agriculturist.——*Half-holiday Handbooks* (T. Fisher Unwin). We have eight of these useful guides to the country around London, all of them referring to districts south of the Thames. One of the guides is entitled "geological rambles," and will be found useful by the amateur geologist. Most of the books are provided with a clear map, and a distance guide for the road from London.

ASTRONOMICAL NOTES FOR MAY, 1882.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination. North.	Sidereal Time.
	h. m. s. a.m	h. m. s.	° ′ ″	h. m. s.
1	11 56 57·32 ,,	2 34 12	15 7 47	37 14·99
6	11 56 26·42 ,,	2 53 24	16 35 4	2 56 57·76
11	11 56 9·92 ,,	3 12 50	17 55 30	3 16 40·54
16	11 56 8·22 ,,	3 32 32	19 8 27	3 36 23·32
21	11 56 20·80 ,,	3 52 27	20 13 19	3 56 6·10
26	11 56 46·34 ,,	4 12 35	21 9 33	4 15 48·88
31	11 57 23·55 ,,	4 32 55	21 56 40	4 35 31·66

The Method of finding the Sidereal Time at Mean Noon for any other Station will be found on p. 390 of Vol. XXXIV.

Spots, faculæ, and prominences continue to testify to the activity of Solar disturbance. On and after May 22nd, there will be no real night in England; the Sun never descending as much as 18° below the horizon, even at midnight.

There will be an

Eclipse of the Sun

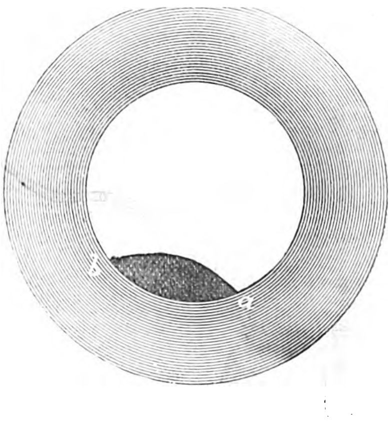
During the early morning of May 17th, which, seen as a total one in Northern Africa and

Arabia, and Central Asia, will be visible as a partial one at Greenwich. Its magnitude there, however, will only be ·186 (that of the Sun's diameter being = 1). It

Begins May 17 6h. 10·5m. a.m. }
Greatest Phase 6h. 46·0m. ,, } Mean Time at Greenwich.
Ends .... 7h. 23·0m. ,, }

Viewed with the naked eye, the angle from the Sun's North Pole of first contact, 158° towards the West; angle from the Sun's North Pole of last contact, 130° towards the East; angle from the Sun's Vertex of first contact. 118° towards the West; angle from the Sun's Vertex of last contact, 172° towards the East.

Our figure represents the Sun as seen at Greenwich at the instant of the greatest Phase. The Moon will enter on his disc at the point we have marked *a* and pass off at *b*.



The Moon

Is Full at 8h. 30·8m. a.m. on May 3rd, and enters her Last Quarter at 34·7 minutes past noon on the 10th. She will be New at 7h. 32·6m. a.m. on the 17th, and enter her First Quarter at 12h. 41·0m. p.m. on the 24th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	13·6	10 49·5 p.m.
6	18·6	2 15·5 a.m.
11	23·6	6 47·0 ,,
16	28·6	0 0·0 ,,
21	4·2	3 39·2 p.m.
26	9 2	7 16·3 ,,
31	14·2	11 10·9 ,,

The Moon will be in conjunction with Saturn at 5 p.m. on the 16th; with Jupiter at 1 a.m. on the 18th; and with Mercury at 4 p.m. on the same day; with Venus at 1 a.m. on the 19th; and with Mars at midnight on the 22nd.

Occultations of (and a near approach to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
1	B.A.C. 4312	6½	1 35 a.m.	Dark	115	145	2 24 a.m.	Bright.	206	240
3	ι^2 Libræ	5½	‡7 24 p.m.	Bright.	62	25	8 25 p.m.	Dark	263	230
4	B.A.C. 5395	6	10 10 ,,	Bright.	146	119	10 36 ,,	Dark	189	165
6	14 Sagittarii	6	12 39 ,,	Bright.	51	28	1 34 a.m.	Dark	315	301
8	*d* Sagittarii	5	†4 20 a.m.	N. by W.	195	197.				
24	19 Sextantis	6	8 42 p.m.	Dark	70	100	9 53 p.m.	Bright.	237	273
25	55 Leonis	6	7 25 ,,	Dark	115	124	8 12 ,,	Bright.	187	206
27	B.A.C. 4201	6	9 42 ,,	Dark	357	14	10 13 ,,	Bright.	311	333
30	B.A.C. 4700	6	1 3 a.m.	Dark	140	169	1 35 a.m.	Bright.	194	227

† A near approach. ‡ Star below the horizon.

Mercury

Comes into superior conjunction with the Sun at 7 a.m. on May 2nd, after which he, of course, travels in the order of the signs through the sky and becomes an Evening Star. The end of this month will be as favourable a time as the student can possibly embrace for seeing this planet with the naked eye, as he will not set until past 10 o'clock at night. His North Declination during the last third of May is about as great as it can be. His angular diameter, which is 5″ at the beginning of May, increases to 7·8″ by the end of it.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	2 30·8	14 33·1	11 53·6 a.m.
6	3 13·1	18 33·0	0 16·1 p.m.
11	3 56·3	21 50·3	0 39·5 ,,
16	4 38·0	24 7·0	1 1·4 ,,
21	5 15·8	25 20·2	1 19·5 ,,
26	5 48·4	25 37·9	1 32·4 ,,
31	6 14·8	25 12·3	1 39 0 ,,

The above Ephemeris shows that Mercury will travel from Aries, right across the entire width of Taurus into the confines of Gemini. He will pass to the North of σ Arietis on the 3rd, and somewhat to the south of δ in that constellation two days later. On the 9th he will be some 3° south of η Tauri. He will be about as much south of β Tauri on the 21st and 22nd, and North of η Geminorum on the 29th. He will be in conjunction with Saturn at 7 a.m. on the 4th; with Neptune at 3 o'clock in the afternoon of the same day; and with Jupiter at 9 a.m. on the 13th.

Venus

Is an Evening Star during the entire month, but presents no particular features of interest for the telescopic observer, her departure from a circular form becoming only just now at all noticeable. Her angular diameter increases almost imperceptibly from 10·2″ at the beginning of May to 11·2″ by the end of it.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 45·0	20 2·8	1 7·5p.m.
6	4 10·5	21 29·7	1 13·3 ,,
11	4 36·4	22 41·9	1 19·5 ,,
16	5 2·7	23 38·1	1 26·0 ,,
21	5 29·2	24 17·4	1 32·9 ,,
26	5 55·9	24 39·2	1 39·8 ,,
31	6 22·6	24 42·9	1 46·8 ,,

Starting thus from a point to the South and somewhat to the East of the Pleiades, Venus, like Mercury, will cross Taurus into Gemini. She will be some 4° South of β Tauri on the 19th and 2° North of η Geminorum on the 28th. She will be in conjunction with Jupiter at 8 a.m. on the 5th.

Mars.

Is visible from dusk until about midnight, but is wofully shorn of his glory now, and appears very little more than a very large and misshapen red star. His angular diameter dwindles from 7″ on May 1st to 6″ on the 31st, and scarcely any amount of optical power suffices to show any details of interest on his surface. After this month we shall take leave of him for the year.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	7 55·6	22 41·9	5 17·5 p.m.
6	8 6·5	22 6·7	5 8·7 ,,
11	8 17·5	21 28·5	5 0·0 ,,
16	8 28·6	20 47·3	4 51·4 ,,
21	8 39·7	20 3·2	4 42·9 ,,
26	8 50·9	19 16·2	4 34·4 ,,
31	9 2·2	18 26·3	4 25·9 ,,

The whole of the arc indicated above is described in Cancer. On the 14th and 15th Mars will be just to the North of η Cancri, and in the same telescopic field of view with that star; and on the 19th and 20th somewhat to the South of Cancri.

Jupiter and Saturn

Have both left us us until the autumn, the former coming into conjunction with the Sun at 9 a.m. on the 30th, the latter at 8 a.m. on the 6th.

Uranus

Is approaching the West, and should be looked for as soon as ever it is dark enough to be seen to any advantage at all. His angular diameter remains sensibly constant at 3·8″.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	11 4·5	6 48·0	8 25·9 p.m.
6	11 4·2	6 49·6	8 5·9 ,,
11	11 4·0	6 50·7	7 46·0 ,,
16	11 3·9	6 51·4	7 26·2 ,,
21	11 3·8	6 51·5	7 6·5 ,,
26	11 3·8	6 51·1	6 46·9 ,,
31	11 4·0	6 50·2	6 27·4 ,,

Hence Uranus will travel slowly in a northwesterly direction from that curious little variable star S Leonis.

Neptune,

Like Jupiter and Saturn, has left us until the autumn.

Shooting Stars

Are rare in May, but may be watched for on the 2nd and about the 18th.

Greenwich Mean Time of Southing of Nine of the Principal Fixed Stars on the Night of May 1st, 1882.

Star	Souths. h. m. s.
α Ursæ Majoris	8 17 52·61 p.m.
β Leonis	9 4 20·68 ,,
β Corvi	9 49 22·58 ,,
α Canum Venaticorum	10 11 37·81 ,,
Spica Virginis	10 40 1·63 ,,
Arcturus	11 31 11·20 ,,
α Libræ	12 5 10·40 ,,
α Coronæ	12 50 22·87 ,,
α Serpentis	12 59 7·44 ,,

The Method of determining the Local Mean Time of Transit of either of the Stars in the above List, as also that of ascertaining the instant of its Meridian passage at Greenwich, on any other night in May, will be found on p. 392 of Vol. XXXIV.

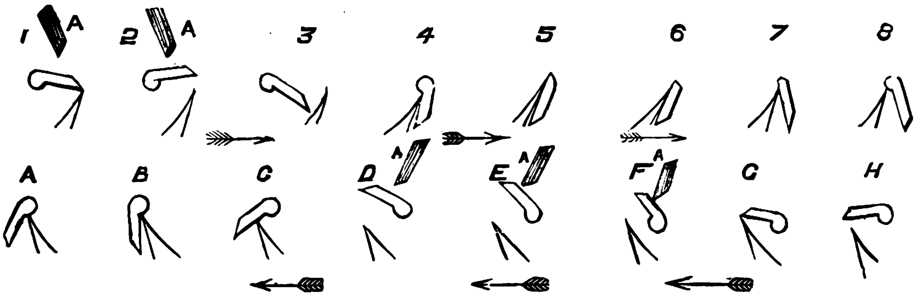
WATCH-CLEANING AND REPAIRING.

By "A Fellow-Workman."

(*Continued from page* 119.)

THIS week we will take the escapement. The verge should be escaped as shown Fig. 1, 2, 3, 4, and A, B, C, D. Fig. 1 is the top pallet, which has just got high enough to let the escape-tooth free, the bottom tooth A is just about to drop on to bottom pallet. A are the bankings, which are fixed inside the potence. Now (Fig. 2) the verge has travelled nearly to the banking, the bottom pallet (B) has also travelled with the bottom tooth resting on the angle made by the body of the verge and the face of the pallet; Fig. 3, the tooth, has got out of top pallet's way, but bottom tooth (C) is hard at work; which has driven pallet D, from some cause, right home to the banking. This gives us position of top pallet (Fig. 4). Now you see what the bankings are for. If they were not there, the balance would go on, if it were given the power, until the top pallet had got sufficiently far up the face of the escape tooth to bite and hold, and where the pallets are at right or acute angles, would go far enough to rest on the top of the tooth: the same with the bottom pallet. It is necessary, then, for us to see that the banking pins are of sufficient length to prevent the balance from "throwing over," but not long enough to interfere with the "play" of the balance; if you put the balance back so that the pallet rests against the banking pin, as shown at E, Fig. 5, and it will swing of its own accord, then you will know that the banking pin is long enough; but if it hangs, then you must lengthen the pin. If it then "hits the banking," *i.e.*, swings too far, or as we should say, has got too much play, then you must draw the follower a little; this will give it more "drop" and less "play"; but the more uninterrupted play you can get, the better time your watch will keep.

Fig 36.



Then again, you must not get the balance wheel (or escape wheel) too near the verge, *i.e.*, "too deep"; if you do the tooth will, if the pallet is short, drop on the body of the verge (see Fig. 8), or if the pallet is long enough, it will catch against the top or back of the escape tooth. On its return journey, if sufficiently deep, it will stop dead; if only a little too deep it will "catch"; therefore, if it drops on the body of the verge you must, if there is sufficient substance in the potence slip, fit a bush which protrudes beyond the face of the potence, then put the escapement together and try it; if it has then got too much drop, you must keep shortening this new bush with a piece of oilstone until you get the proper drop; but if it drops on the face of the pallet (B, Fig. 2), then by easing the follower, after the watch is together and going, with a pair of long-nosed pliers, and be careful of the contrate wheel, then if you put the blade of your screwdriver against the plate of the watch and the handle in your ear, you will easily hear if it catches—the catch is very easily distinguished from the beat of the watch; but if the potence slip is not of sufficient substance to hold a bush, you must fit another—there is wire sold for this purpose at 2d. per piece; if you have to fit a new potence slip first get height of hole with tool, Figs. 16 and 17 (page 25), and mark position as shown Fig. 18 (read "To put a Hole in Potence Slip," page 25). The bankings in the cock plate are treated in the same way, and are much easier.

You will understand better what I am telling you when you have had a little practice. It is not to be supposed that you will read what I say and then sit down and do a job. You might just as well read a music-tutor, and after you have read it fancy you can play a tune. Practice alone will teach you.

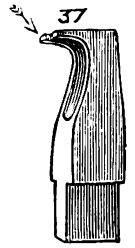
It is often the fault of some jobbers to file the pallets too short: therefore, they get too much drop and no play, and if they put the escapement closer to get less drop, they find the escapement in the position as shown, Fig. 8. Then, to remedy this, they cut away half of the body of the verge to give more face to the pallet. If you do this you must be very careful that the point of the escape wheel tooth cannot reach the centre of the body of the verge or go beyond. If it does, you will find it in the position as shown, Fig. 6, and the tooth will not begin to work until the pallet has gone too far for it to be of any use as a propeller. The tooth will remain in its position on the centre of the verge until the pallet has travelled sufficiently far to allow it to leave its position. There will not be any catching or dead stopping to show you what is the matter—only an unequal swing, sluggishness, sometimes stopping, very irregular as a timekeeper; in fact, a regular nuisance to the owner.

The Frenchmen cut their verges this way; but then they have complicated potences, so that the escapement can be put to any depth when the watch is together, by means of screws. Their escape wheels, too, have such small teeth that they are obliged to have short pallets. But, it is not so with our escapements, they must be escaped, as shown Fig. 1, 2, 3, and 4.

You must see that the bottom pallet does not touch bottom of potence; that the bars of the balance do not touch the curb pins in regulator or hairspring stud; that the collet does not touch top of escape wheel; that the hairspring does not ride in regulator; that hairspring stud is not loose; that hairspring does not touch balance or plate; that the collet is not loose on the verge; that the pallets of the verge do not touch anywhere inside the potence; that the front pivot of escape wheel does not go beyond the points of the teeth; that the escape wheel runs freely when all other wheels are removed; that the cockplate does not touch the inside of the case; that the escape wheel is not loose on its pinion.

If the bottom pallet touches the bottom of potence, or the bars of the balance touch curb pins, or hairspring stud or collet touches escape wheel, you can alter them by raising the balance as follows:—Make a stake out of an old file, Fig. 37. There should be a piece filed out where the arrow points, so as not to stop the bush; put this stake in your vice, place potence (C) as shown Fig. 38; take a punch (A, Fig. 38) and drive the bush towards the inside of potence; offer it until you get balance clear; if the bush is too far gone for this treatment, then you will have to fit another. On no account shorten curb pins or stud, or interfere with the collets; if your verge is not long enough you had better put another. If it is only the balance that is in fault, you can bump that.

37



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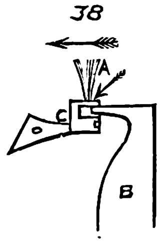
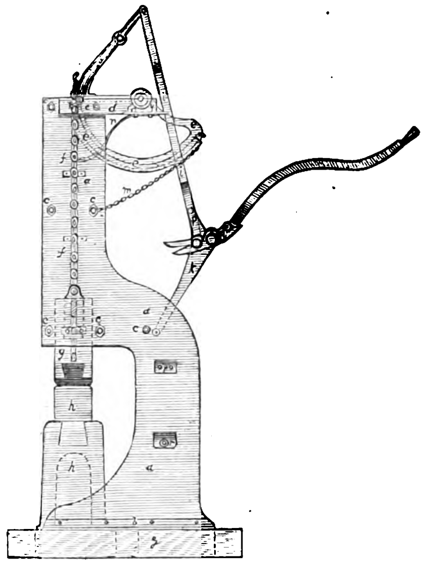


Now, with a little practice, you ought to know how to put an escapement in order, and always bear in mind that if the verge is wrong *alter the verge*, if the escape wheel is wrong, *alter the escape wheel*, &c., do not alter the part that is *right*, to remedy the part that is wrong.

(*To be continued.*)

CUTHBERT'S COMPOUND LEVER-HAMMER.

THE lever-hammer, illustrated in the annexed engraving, has been recently patented in this country by Mr. J. Cuthbert, of Landport. It is intended for use in shops where steam-hammers are either unobtainable or inconvenient, and its capabilities are said to be from 20 to 25 blows of 1000lb. per minute, or an increased number of lighter blows according to the nature of the work. The frame *a*, consisting of two vertical side-pieces, secured to a base-plate *b*, is held together by stays *c*. At the top they carry a cross or head-piece *d*, on which is centred the eccentric-shaped quadrant *e*. This quadrant at its upper corner is connected by a chain *f* with the hammer-head *g*, shown resting on the anvil block *h*, which stands within the vertical sides,—at this part curved out for its reception. By the motion of the quadrant, which is operated by the lever *i*, having a movable linked connection or other suitable connecting-rod *k*, the hammer-head is raised to the required height, and is operated by the lever-handle shown. A recoil-chain is seen at *m*, and springs at *n*, which are compressed in contact with the hammer when that is raised to its extreme height. The portion of the angular-shaped lever represented by *i* is forked or slotted to allow of the working of the quadrant through it. The radius-pawl is indicated by *p*, and the lever-pawl by *q*. The weight of the hammer and frame is about 700lb., and it is said to be capable of giving as many as 60 quarter-ton blows a minute.



AUTOGRAPHIC TRANSFERS FOR PRINTING PROCESSES.

AN improved autographic transfer process for lithographic and zincographic printing has been patented in this country on behalf of J. J. Magne, of Paris. The process consists in writing or drawing upon unprepared paper with inks or crayons having an affinity for fatty lithographic ink, then moistening the paper with a liquid having a repellent action for such ink, then inking up the writing or drawing with a lithographic roller, and finally transferring to the stone or zinc. The fatty lithographic ink is retained by the ink or crayon, but repelled by the liquid that moistens without attacking the cellulose of the paper, and the transfer is thus made without injury to the original manuscript, which may be preserved for an indefinite period. For the reproduction of printed matter by lithography or zincography, the same liquid is used, inasmuch as ordinary printing ink has the same properties as the inks of this invention. By moistening a printed paper with the liquid, and rolling up with lithographic ink, the typographic or other impression may without injury to the original be transferred to stone or zinc. The composition of the liquid is as follows:—water, 1000 parts; acid (preferably sulphuric), 150 parts; alcohols (or their congeners), 350. These proportions may be varied, but it is essential that the proportion of alcohol should be high, in order to avoid injury to the original.

The formula above indicated gives good results; but it must be understood that the process is not limited to the employment of the precise ingredients herein mentioned, as this part of the invention consists essentially in the protective intervention of a substance (alcohols or other) in an acid liquid for the purpose of repelling the fatty ink. Under the term "acid liquid" is included not only acids properly so called, but also combinations of these acids with substances which, as they do not neutralise the acids, permit the combinations to act in the same manner as if the acids were pure. The patentee is thus enabled to use salts which by reason of their acid nature repel fatty ink; we may also add to the composition which fulfils the double purpose of preserving the paper and of repelling fatty ink, certain substances of a hygroscopic nature, which will retard the evaporation of the composition and keep the material impregnated therewith at a suitable degree of moisture. These substances may be briefly stated as being either of organic origin, such as gelatine rendered soluble, either hot or in the cold, soluble gluten, starch, dextrine, mucilages, gums, sugars, and glucosides, &c., or of inorganic composition, such as deliquescent salts, &c.; and, in short, all substances capable of retarding the desiccation of materials impregnated with the composition. These substances may either be mixed directly with the composition, or they may be applied upon the originals to be reproduced either before or after impregnation with the composition.

For the production of autographic transfers any kind of paper of medium thickness, sized or not, or other material may be used. The inks employed are composed of protein substances (albumens, caseins, fibrins, &c,), and of bichromates, prussiates, alums, &c., forming liquid compositions capable when dry of retaining fatty inks. The following is the method of preparation:—dissolve in a quantity of water 2 to 3 times greater than the quantity of albumen (or other protein substance) a mixture of 2 parts of bichromate, prussiate, or alum, &c,, to 1 part of ferrocyanide of potassium, by which a limpid brown solution is obtained. Beat up separately a certain quantity of albumen and its equivalent of water. The proportion of the mixture of salts relatively to the albumen employed should be about 6 per cent. The two liquids are intimately mixed together with the addition of a suitable quantity of colouring matter. The ink thus made is unalterable, remains constantly fluid, and drawings or writings may be executed in it with a pen, brush, or drawing pen upon any paper of medium thickness, avoiding cardboard and tissue-paper.

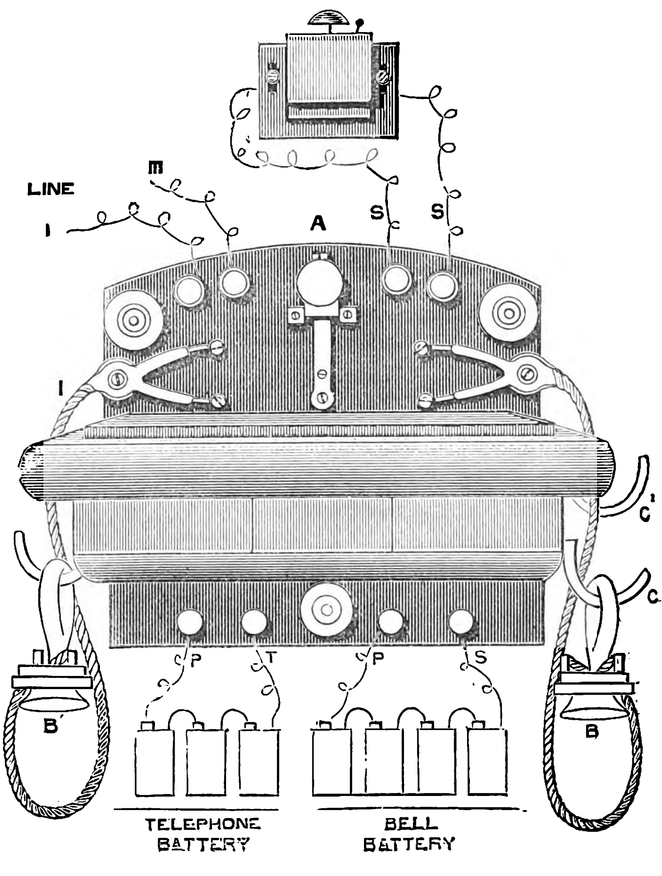
The crayons to be employed for the same purpose are of paraffin or its congeners and lampblack, bone-black, ivory-black, &c., or other impalpable colouring matter, so as to form crayons marking like those of blacklead, red chalk, or charcoal. The proportions for lampblack crayons are about 100 parts of paraffin to 16 parts of lampblack, but may be varied according to the depth of colour desired. To produce crayons of different degrees of hardness there should be melted with the paraffin before mixture with the colouring matter a certain quantity of common or other resin, regulated by experience, but which should not in most cases exceed 10 per cent. The melted mixture is run into moulds, and after cooling the crayons are cut into lengths and either inclosed in stiff paper or cased in wood in the manner of ordinary lead pencils. If the drawing has been executed with ink alone it may be used as soon as it is dry, but if executed with ink and crayon, or crayon only, the face of the drawing should be held for one or two seconds over a vessel containing boiling water. The paper is then allowed to dry by exposure to the air, more especially if the drawing be done both in ink and crayon, after which the paper is placed face upwards in a bath of water, acid, and alcohol, as before specified, and allowed to remain until it is thoroughly saturated, which is known by a sort of exudation of the liquid through the pores. The paper is then carefully spread out upon a glass plate or on a board, and an inked lithographic roller passed over it, whereby all the lines of the drawing are coated with fatty ink. When sufficiently inked a damp sponge is passed over those parts of the paper which have retained any of the ink, taking care not to blur the drawing, which is then washed and placed to drain upon a slab of plaster, and when brought to the proper degree of humidity it is laid down upon the stone or zinc plate, and the transfer pulled in the ordinary way. In order to preserve the drawing in an unaltered condition it is necessary (1), to wash it with a solution of carbonate of ammonia or of soda filtered; (2) to rinse it in pure water; (3) to drain upon a plaster slab or blotting paper; (4) to dry it by strong pressure between blotting paper.

The process of reproducing printed matter is as follows:—The mixture of alcohols and sulphuric acid, before referred to, is applied with a brush either upon the front or back of the printed matter to be reproduced. The paper becomes instantly saturated with the liquid, and the surface is then immediately washed by applying or plunging in pure water. The sheet is then spread very carefully upon a glass plate or board previously wetted, and a lithographic ink roller passed over the print, taking care if the roller is passed more than once over the print to moisten the surface of the latter with pure or slightly acdiluted water to prevent the paper adhering to the roller. If this operation, which is very simple, has been performed by a skilled hand, it is only necessary to lightly wash the print to remove the excess of acid, which would otherwise bite the stone too deeply, then to drain upon a slab of plaster, and when brought to the proper degree of humidity to lay it down upon the stone and pull it through. The transfer is then complete, and the ordinary lithographic process proceeded with in the usual way. When it is desired to reproduce both sides of a sheet, one side is inked and transferred first, and then the other side is inked and transferred. For the reproduction of typographic printing the transfer would be made upon a polished zinc plate, and then bitten in with acid in the ordinary way.

THE APPLICATIONS OF ELECTRICITY.*

(*Continued from page* 145.)

THE telephone is certainly one of the most important recent applications of electricity, and formed one of the greatest attractions of the Exposition. The telephone was invented by Professor Bell, and consists essentially of three parts: a vibrating plate, a magnet, and a coil of insulated wire wound round one of its poles. This is the simplest form of telephone; we have only to connect the coils of two such instruments by means of two wires, in order to be able to converse at a distance.



The working of the telephone is easily understood. When we speak in front of the iron vibrating plate, we cause it to vibrate in unison with our voice. The plate vibrating to-and-fro in front of the magnet, causes fluctuations in the strength of its magnetism, and these fluctuations suffice to induce small electrical currents in the coil wound around the magnetic pole. These currents are transmitted along the line wires, and received in an exactly similar instrument, where they cause the receiving plate to vibrate in unison with the sending plate. In Bell's instrument only one pole of the magnet is utilised, but in Gower's and Ader's telephones both poles are made use of by bending the magnet. In connection with the telephone, we have to describe another important piece of apparatus, the microphone. Hughes' microphone is certainly one of the simplest electrical apparatus. It merely consists of a pencil of carbon pointed at both ends, and supported by two pieces of carbon, which have each an excavation to receive the ends of the small pencil. Let us make up a telephonic circuit, and insert in it a battery and a microphone. If we touch the microphone or speak before it, we move or set in vibration the carbon, which, by pressing more or less against its carbon supports, allows more or less of the current to flow through the circuit. We can thus set up important variations in the current, and the iron plates of the telephones in the circuit will vibrate in accordance with these variations. Prof. Hughes's microphone, when properly regulated, is an extremely sensitive instrument, and you may easily judge of it by applying the telephones to your ear, when you will easily hear the ticking of my watch which I have placed upon it; by listening attentively, you will distinguish the noise which the different parts of the watch make in moving. If I stroke the microphone but very lightly with a feather, you will hear a perfect roar in the telephone. Such an instrument is much too sensitive for practical purposes, for it converts articulate speech into a continuous roar and buzzing, altogether unintelligible.

Let us now turn our attention to the practical and every-day applications of the telephone for transmitting articulate speech to a distance. I think I can do no better than to show you the instruments most frequently employed for that purpose, on the lines of the Société générale des Telephones, and which have been kindly installed here for this lecture by Messrs. Lencksewski and Co., the constructors. (See annexed figure). We have here a complete Ader telephonic post. The transmitter has the form of a desk, the sender speaks in front of this thin plank of pine, to which are fixed six carbon microphones. The number of microphones is thus increased to avoid sputtering noises. This compound microphone is connected with the telephone battery, but is not connected directly with the line wire. An induction coil is made use of, the primary being in connection with the microphoneand the secondary in connection with the line. The reason of this will easily be seen. Suppose we have a line three or four miles long, the resistance of the line wire will be considerable, and the variations of resistance caused by speaking to the microphone will be insignificant when compared to it. When, however, we use an induction coil, the microphone is in a short circuit, and its variations of resistance have a great relative importance. The secondary current sends them along the wire without diminishing their relative importance. The receiving instruments are Ader's telephones (B, B′). When we wish to call attention we do so by means of this push (A), which rings a bell; our correspondent answers by ringing our bell. We then unhook the two telephones from their supports and apply them to our ears. The act of doing this releases the automatic commutator C, which springs up to position C′, this unconnects the bells and puts the telephones and microphones into circuit ready for use. We have only to speak in front of the desk and listen in the telephones. In order to show you the delicacy of these instruments, I will converse with my assistant, who is in another part of the building, in so low a voice that no one around me will be able to catch anything of our conversation; on the contrary, I will now ask some one at the other end to sing in front of the instrument, and to play a tune on a brass instrument, and you will be able to hear from your respective seats. These were the instruments used for the auditions of the opera at the exposition. Several microphones were placed near the footlights, and were put into communication with the telephones at the Palais de l'Industrie, and you had only to apply these to your ears in order to hear the music as well as if you were at the opera.

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* Lectures delivered by C. Detaille, at the Palais du Trocadéro, Paris.

We will now turn our attention to another kind of electrical phenomena—the decomposition of chemical substances by the electrical current. Water is thus decomposed into two gases—oxygen and hydrogen. Metallic salts are also decomposed, the metal going to the negative pole. Copper, silver, and gold can thus be deposited on to metallic surfaces by dipping them in the bath and connecting them with the negative pole of the battery; a plate of the metal to be deposited is hung in the bath opposite the object to be plated, and is connected with the positive plate. The applications of this to silvering and gilding are known to all. In recent times another metal, nickel, has been added to the list of easily-deposited metals, and you see here a brass object, which we are now going to cover electrically with nickel by M. Gaiffe's improved process. Nickel is a brilliant white metal, which does not oxidise in air, and can be easily deposited on to metals by electrolysing ammoniacal sulphate of nickel. We shall see further on that these experiments have been reversed, and that electrolysed substances can be utilised for giving back the current which has been required to decompose them.

(*To be continued.*)

IMPROVEMENTS OF THE GAS BATTERY.

UNTIL water-power has been successfully pressed into service it is clear that the electric light will depend for its existence as a means of illuminating on the consumption of fuel through the medium of steam, gas, or hot-air engines. If the coal could be used directly in producing current, the question of Electricity *v.* Gas would be settled at once. Mr. G. E. Dering, of Lockleys, Herts, has recently obtained a patent for a method of generating dynamic electricity on the principle of Grove's gas-battery, by which he asserts that 85 per cent. of the energy contained in the gas may be transformed into current. Gas-batteries comprise five elementary parts, viz., two different gases answering to the positive and negative metals in an ordinary galvanic couple, two conductors consisting of metal or carbon in contact with the two gases respectively, and an electrolytic conducting liquid in contact with the two gases and two conductors. The negative gas may be oxygen or atmospheric air, and the positive gas carburetted hydrogen or "generator gases," or water gas, or carbonic oxide. The gases are conducted from holders or retorts to the battery cells, and are kept by automatic means at such a pressure that the level of the conducting liquid is constant. When other elements than oxygen or hydrogen are employed, an escape is provided for the gases that will not enter into combination with each other. As the electromotive force of a gas-battery increases in a high ratio with the degree of compression of the gases, it is advantageous to work the cells under pressure. The solid material in contact with the negative gas is coke. When this gas is atmospheric air the coke may be freely exposed, or may be alternately exposed and submerged. It must, of course, be provided with means for collecting the current, such as plates of retort carbon. The same conductor may be used in contact with the positive gas; but it is preferred to employ lead or tin, or alloys of these metals; or sheet metal coated with lead or tin in a dense condition, or moulded carbon, the surfaces of all these to be electro-plated with platinum or other non-oxidisable metal in a spongy condition. In every case it is most important that a large surface of metallic conductor should be exposed by bending it into an open coil like a watch-spring. The distances of the several surfaces of metal should exceed that at which capillary attraction would draw up the conducting liquid, or not less than one-sixth of an inch. Another method of forming a battery is to employ for the positive and negative conductors a disintegrate mass, such as broken up gas-retort carbon, or granulated lead, platinised when in contact with the positive gas, the whole being pervaded throughout by the conducting liquid, and to cause the gases to bubble or percolate upward through the interstices. The effect of a gas battery may also be augmented by bringing the solid conductors in contact with the gas and liquid alternately by mechanical means. Another part of the invention relates to substituting the negative metal and associated liquid of a Daniell battery for the negative gas and its conductor in a gas battery.

WHAT TO OBSERVE, AND HOW TO OBSERVE IT.*

THE greatest difficulty, next to getting a good telescope, is, it seems to me, what to do with it; and though there are a great many first-class instruments in England, yet the amount of valuable contributions to astronomy in the country is steadily on the decrease. The reason is, I believe, that a man reads the exaggerated accounts in popular works of what a telescope will do, and then he is disappointed when he looks through his own. Now, just as we must learn to walk before we attempt to run, so in astronomy the beginner must be content with doing only a little at first. The eye must be trained, and trained long and carefully; and probably no one is competent to give his opinion on the performance of a telescope before he has had five years' practice at least. Now, the question arises at once—How is the eye to be trained? Well, as a preliminary trial, the ordinary sight-seeing of the heavens is as good as anything. The beginner will thus quickly see which of the two great branches of telescope work his eye is best suited for. It is quite absurd to imagine we can see all celestial objects equally well; on the contrary, he who sees faint stars best will generally see planetary markings worst. A few years ago Mr. Webb and myself were observing Saturn together in his 9⅓in. reflector. The night was superb. A very curious thing happened. Mr. Webb saw distinctly the division in the outer ring, which I could not see a trace of; and I picked up a faint point of light, which turned out to be Enceladus, and of which Mr. Webb could not see a trace. As a rule, I find I can do little with planetary markings; hence I have devoted myself of late to stellar work. I purpose then to confine myself chiefly to stellar work, and this reminds me that I would advise each beginner to make up his mind as to which branch he will choose, for planetary and lunar work quite ruins the eye for stellar work, and I don't think he will be able to do them both. I believe that planetary work, to be valuable, will, on the whole, require larger apertures than stellar work; but I shall dismiss the planetary work with a very few remarks, because having directed my attention more particularly to the other branches, I feel but ill qualified to enlarge upon it. Firstly, to my eye, planetary markings are deeper in a refractor than in a reflector. I have compared a 12in. refractor and a 13in. reflector side by side, and have observed the planets with all sizes of aperture under 12in., both with reflectors and refractors, and my impression has always been that refractors give the planetary detail darker than the reflectors. Secondly, I have found a light shade of green or blue glass deepens the markings very much. Again, the belts on Jupiter I always see better with a terrestrial eyepiece than with a celestial one. This is due, I imagine, to some peculiar absorption in the extra two lenses; for, reducing the aperture of the object-glass has not the same effect. Thirdly, I find it well to begin with a low power and gradually increase the magnifying power till it has reached the highest point the night will bear. Now, if this high power be suddenly changed for a low power, the markings on the planet will stand out in a wonderful manner. Lastly, the different satellites of Saturn I see best with a low power. If the power is too high the satellites disappear. As regards the apertures they may be seen with:—Titan is visible in a finder of 1½in. aperture; 2½in. should should show two, 3½in. four, 4½in. should show five, and 5½in. should show six satellites. I have never seen more than five with my 5in. refractor; but I think it would reach Enceladus, which would make the sixth, if the air and the eye were in the best condition. To turn to stellar work. The beginning is here beset with two dangers—first, the endeavour to see impossible stars with small apertures; second, the splitting of double stars inseparable with his aperture. But as this kind of thing is necessary for testing a telescope, a few remarks may be of service. If you know the distance of a faint star from its brighter companion and its approximate position, you are sure to see it; therefore, when testing a telescope, never look at the position angle of a test object, but look at the distance and then estimate the position angle for yourself. If your estimation is nearly right, there can scarcely be a doubt but that you have seen the object. As to mere sight-seeing, you can never have too low a power. I have an eyepiece the field of which is nearly a degree in diameter, and I cannot conceive a more glorious, and at the same time awful, sight than to sweep with this through the constellation of the Swan. Stars of every shade of colour defile through the field, from orange and bright blue to the pure white of Deneb and the two deep yellow suns of 61 Cygni. More ideas will thus be obtained of the structure of the heavens than in any way I know, and it will be found impossible to resist the conviction that the juxtaposition of two stars of the same magnitude, colour, and glory implies a real connection. Now, here is work for all apertures; and it would be as well to make notes of such pairs for subsequent publication through the columns of the English Mechanic and kindred scientific journals. I will here take exception to Mr. Burnham's limits of the distances of double stars. That the closer two stars are, the more probability of their binary or physical character being discovered I allow. But when we come to think of what time is in astronomy, that thousands—nay, millions—of years can in this science be reckoned but as moments, and that the accurate measures of most of our double stars are scarcely 50 years old, we must admit that it is premature to put "relatively fixed" to systems of which we can know but little. It is, for example, a singular fact that no deep blue star is ever found alone. A blue star has always a big neighbour. Surely this implies a real connection. But perhaps in variable stars lies the true work of the amateur, and the one which is likely to lead to the greatest results. There are nearly 400 stars which have been suspected of variation. Many need only an opera-glass to watch them, and scarcely one of them a telescope of more than 2½in. aperture. The short-period variable will be found generally among stars visible to the unassisted eye, and their distribution is probably pretty even all over the heavens. The stars of long periods will be found in a zone inclined to the equator at about an angle of 15° or 20°, and crossing it, to pass southwards about R.A. 12 hours. To sum up. Telescopes of 5in. upwards may be employed for planetary work, and the search for new double stars. Telescopes under 5in., and down even to an opera-glass, may yet do good work amongst the variable and coloured stars. No aperture is too small. Some of the most valuable work has been done with small apertures—for instance, Argelander's N. Zones, made with a telescope under 3in., and Beer and Mädler's great map of the moon was made with an instrument equally small in size. In conclusion, my object to-night has not been to repeat what may be found written in the excellent works, such, for example, as "Celestial Objects for Common Telescopes," and many others that have been written especially for the guidance of amateurs, but rather to put forward some original notes of my own, which nearly a decade of years has furnished me with, in the hopes that they may be found useful to brother star-gazers, and also provoke some discussion and suggestions from others.

PROFESSOR TYNDALL ON KOCH'S THEORY OF TUBERCULOSIS.

IN a letter contributed to the *Times*, Professor Tyndall has called attention to an address delivered by Dr. Koch, before the Physiolegical Society of Berlin, on the etiology of Tubercular Disease, or in colloquial phraseology, the cause of consumption.

Koch first made himself known by his reseaches on the contagium of splenic fever. By a process of inoculation and infection he traced this terrible parasite through all its stages of development and through its various modes of action. This masterly investigation caused the young physician to be transferred from a modest country practice, in the neighbourhood of Breslau, to the post of Government Adviser in the Imperial Health Department of Berlin. From this department has lately issued a most important series of investigations on the etiology of infective disorders. Koch's last inquiry deals with a disease which, in point of mortality, stands at the head of them all. If, he says, the seriousness of a malady be measured by the number of its victims, then the most dreaded pests which have hitherto ravaged the world—plague and cholera included—must stand far behind the one now under consideration. Koch makes the startling statement that one-seventh of the deaths of the human race are due to tubercular disease, while fully one-third of those who die in active middle age are carried off by the same cause. Prior to Koch it had been placed beyond doubt that the disease was communicable; and the aim of the Berlin physician has been to determine the precise character of the contagium which previous experiments on inoculation and inhalation had proved to be capable of indefinite transfer and reproduction. He subjected the disease organs of a great number of men and animals to microscopic examination, and found, in all cases, the tubercles infested with a minute, rod-shaped parasite, which, by means of a special dye, he differentiated from the surrounding tissue. It was, he says, in the highest degree impressive to observe in the centre of the tubercle cell the minute organism which had created it. Transferring directly by inoculation, the tuberculous matter from diseased animals to healthy ones, he in every instance reproduced the disease. To meet the objection that it was not the parasite itself, but some virus in which it was imbedded in the diseased organ, that was the real contagium, he cultivated his *bacilli* artificially, for long periods of time and through many successive generations. With a speck of matter, for example, from a tuberculous human lung, he infected a substance prepared, after much trial, by himself, with the view of affording nutriment to the parasite. Here he permitted it to grow and multiply. From this new generation he took a minute sample and infected therewith fresh nutritive matter, thus producing another brood. Generation after generation of *bacilli* were developed in this way, without the intervention of disease. At the end of the process, which sometimes embraced successive cultivations extending over half a year, the purified *bacilli* were introduced into the circulation of healthy animals of various kinds. In every case inoculation was followed by the reproduction and spread of the parasite and the generation of the original disease.

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* A paper read by Mr. T. E. Espin before the Liverpool Astronomical Society on April 19.

It is not necessary to give an account of the actual experiments made by Dr. Koch—suffice to say, they leave no opening for doubting the correctness of his conclusions. The important question is, knowing the cause, can a remedy be devised? That remains to be seen. Koch determines the limits of temperature between which the tubercle-bacillus can develop and multiply. The minimum temperature he finds to be 86° Fahr., and the maximum 104°. He concludes that, unlike the Bacillus anthracis of splenic fever, which can flourish freely outside the animal body, in the temperate zone animal warmth is necessary for the propagation of the newly-discovered organism. In a vast number of cases Koch has examined the matter expectorated from the lungs of persons affected with phthisis, and found in it swarms of bacilli, while in matter expectorated from the lungs of persons not thus afflicted he has never found the organism. The expectorated matter in the former cases was highly infective, nor did drying destroy its virulence. Guinea-pigs infected with expectorated matter which had been kept dry for two, four, and eight weeks respectively, were smitten with tubercular disease quite as virulent as that produced by fresh expectoration. Koch points to the grave danger of inhaling air in which particles of the dried sputa of consumptive patients mingles with dust of other kinds.

BURNISHING.

By burnishing the roughness of an object is flattened down until the surface is smooth and polished like a looking-glass. Burnishing is an important operation for electro-deposits, which consists of a multitude of small crystals, with intervals between them, and with facets reflecting the light in every direction. The deposited metal is hardened, and forced into the pores of the underlying metal, and the durability is thus increased to such an extent that, with the same amount of silver, a burnished article will last twice as long as one which has not been so treated. The instruments employed for burnishing are made of different materials, and must be of great hardness and a perfect polish. Such are hardened cast steel, agate, flint, and blood stone. For metallic electro-deposits steel and blood-stones are especially employed. There are several qualities of blood-stone; its grain should be close, hard, and without seams or veins; it should leave no white lines on the burnished parts, nor take off any metal, and its colour should be of an intense black red. The steel must be fine and close grained, and perfectly polished. Should the polish of any burnishing tool alter by use, it is restored by friction upon a skin or leather attached to a wooden block, which is fixed to the bench. The leather is covered with polishing rouge in impalpable powder, or, preferably, with pure alumina, obtained by calcining ammonia alum in a forge fire. Venetian tripoli, rottenstone, tin putty, emery, or many other hard substances finely powdered may be employed. The burnishing tools are of various shapes, such as a lance, a tooth, a knife, a half sphere, or a dog's tongue, and a considerable stock is necessary. The burnishing is divided into two distinct operations. The first consists in roughing, and the second is finishing. The tools for the first have a sharp edge, while for the second operation they have a rounded surface. The tools for the hand or the lathe are fixed by copper ferrules into short round wooden handles, so that the hand is not influenced by their weight. The tools for the arm or vise are fastened to wooden handles sufficiently long to rest their slender part upon the arm or shoulder. The stouter lower portion is grasped by the hand. The burnishing tools and the objects must be frequently wetted by certain solutions, some of which facilitate the sliding of the instrument, or with others which have a chemical action upon the shade of the burnishing articles. Of the first are pure water, solutions of soap, decoctions of linseed, and infusions of the roots of marsh mallow or liquorice. The second includes wine-lees, cream of tartar, vinegar, alum in water. When burnishing gold applied upon electro-deposits of copper, as in gilding with a dead lustre by that method, use pure water, for fear of producing a disagreeable red shade. A solution of green soap is sometimes preferred by operators, although when old, it imparts an unpleasant tinge, owing to the sulphides of the liquor. When the burnishing is completed, the surface is wiped longitudinally with a soft and old calico rag. The polish obtained by burnishing is called black when it reflects the rays like a mirror, and should the presence of mercury or a bad deposit prevent the tool from producing a bright surface, the object is said to be greasy. Articles which have been previously polished, and which generally receive a very trifling deposit, are not burnished, but rubbed with chamois leather and the best polishing rouge. Too thick or too rapid electro-deposits cannot be burnished, but must be polished by rubbing with a leather and a mixture of oil and powdered pumice-stone, tripoli, or tin putty. Coarse powders are used at the beginning, and impalpable ones at the end of the operation. Polished silver deposits are more agreeable to the eye than burnished ones, but the hardening of the latter renders them more durable.—*Scientific American.*

ELEMENTARY LESSONS IN DRY-PLATE PHOTOGRAPHY.—VII.*

The Management of the Camera in the Field.

We cannot have transcribed by the camera the broad contrasts which are frequently brought out by colour alone. We must trust to form and to light and shade apart entirely from colour. Very frequently a scene will make a most perfect picture on the camera ground glass, when the experienced photographer knows it will make nothing in the print. Alas! the colour which makes the picture cannot be reproduced. This fact makes it the more necessary in the camera picture to have the form and light well balanced. The picture must not be all on one side, nor must there be running through it in any direction long uninterrupted lines. For the rest, there is wanting to a perfect landscape picture—be it painting, drawing, or photograph—a foreground, a middle distance, and a distance. It is in the latter that photography fails. What to the eye appears a definite distant landscape, the distance, but lending enchantment and softness, comes out in a photograph so dim and faint that it would seem to be almost hidden by a thick mist. The slight haze which, in this country at least, always stands between us and the distance, is exaggerated so as almost to obscure those things which are quite clear to the eye. A certain amount of haze covering distant objects is necessary to give the idea of distance, but the exaggeration of fog, mist, or haze, which the camera always gives, must be allowed for.

Perhaps the greatest difficulty in photographing, however, is that the sky is not, as a rule, rendered at all. An exposure which will suffice to bring out all the detail in a landscape is such that the sky will be so over-exposed as to show no trace of clouds. It is necessary, to get the sky, to make a special exposure, perhaps about one-tenth of that required for the landscape, and to resort to a "double printing" process, which it is without our province to describe.

The subjects best suited for the camera are of the nature of the following: Any landscapes having, apart from colour, broad and well marked contrasts of light and shade, and decided outline of form, are specially suitable. Trees of all kinds are well rendered, both with and without their leaves; in the former case, the difficulty is to get them motionless. A quiet windless day is necessary. Architectural subjects of all kinds are most perfectly reproduced by the camera.

The most charming effects of all are, perhaps, produced in a scene in which there is water—a quiet pool with reflections of trees, for instance.

We will suppose our pupil has determined on some locality where he is sure to find some subjects such as those we have indicated. We shall follow him, indicating how he should act as he proceeds. First, he has to fill his slides. We will suppose he has three of these; they must be packed into a case which should be made to hold them and the camera. Besides these, he must take his lens, his tripod—and let him be most careful not to leave the screw behind him—his focussing cloth, and possibly a "focussing magnifier." This is a small eyepiece to magnify the ground glass image, and enable him to focus with precision. It is useful mostly because it increases the light. When a small stop is used the ground glass image is frequently so dull that it can barely be seen.

Arrived at the scene of action, the photographer must select his point of view most carefully. Let him be in no hurry. Frequently a picture will be made or spoiled by altering by a few yards the position of the camera. When he is quite sure of his point of view, let him unfold his camera, erect it, and place it opposite the scene to be depicted.

Let the stand be placed on the ground with its three legs about equally apart, and with one of them pointing towards the middle of the scene to be photographed. There will be room for the photographer to focus comfortably standing between the back legs. To tip the camera up, all that is necessary is to draw the forward leg towards him; to tip it down, he need only push it from him. He may still further tip it up by spreading the back legs apart; and down, by bringing them together.

When the camera is fixed, and the view focussed, it will probably be found that there is too much foreground and too little sky. Now, one of two things may be done. The camera may be "tipped" up. In this case, if there be any parallel vertical lines in the picture, they will be made to converge at the top, and it will be necessary to bring the swing-back into play, so as to make the ground glass more vertical. If there be no vertical parallel lines, the camera may be tipped a little without appreciably modifying the result. The camera front and lens may be raised. This is usually the best course to adopt. The use of the swing-back always strains, so to speak, the lens, and necessitates the use of a very small stop. Raising the lens also strains it, but to a less degree. Tipping the camera does not at all. Most cameras are made so that either a vertical or horizontal picture can be taken, and judgment must be used to determine in which position it shall be. All the points above indicated having been considered, and the picture being all on the ground glass—proceedings so far having been conducted with open aperture or a large stop—the final focussing must be done. The principal object—generally in the middle distance—must be made absolutely sharp. Now, stops smaller and smaller must be tried till the distance is just sharp.

We described fully in the last chapter the means of comparing the rapidity of different lenses and stops. The student ought, therefore, to be able to make the necessary estimation for the particular stop he is using.

With a good spring or summer light and "open landscape" (that is, a view having no objects with very heavy shadows in the foreground), and with the average of rapid commercial plates, the exposure with $\frac{f}{20}$ will be from one to two seconds; with river scenes or seascapes, it may be reduced to one-quarter of a second—about the shortest possible to give by hand. With heavy shadows or dark-coloured trees it may run up to four or five seconds, and, in the shades under trees, even up to minutes. In interiors, such as churches and cathedrals, it is very much longer, even when they appear well lighted. Four or five minutes is a short exposure for an interior with $\frac{f}{20}$, and even when the eye can penetrate to every corner of the building, exposures of several hours may be necessary. We should say that, for a landscape, the most pleasing lighting is usually a side-lighting. The lighting looking towards the sun is sometimes very pleasing, but care must be taken not to include the sun itself. This must be either to one side or above the picture, or may be kept out of it by the camera being placed in the shadow of a tree or some such object.

(*To be continued.*)

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* Condensed from the *Photographic News.*

SCIENTIFIC SOCIETIES.

THE METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this Society was held on the 19th inst. The papers read were:—1. "Barometric Gradients—Wind Velocity and Direction at the Kew Observatory," by G. M. Whipple, B.Sc., F.R.A.S., F.M.S., and J. W. Baker, F.M.S. For the purpose of investigating the subject of the relation of the force and direction of the wind to the distribution of barometric pressure, the authors have discussed the Kew Observations for the five years, 1875-79. The results show that the rate at which the wind blows increases almost directly with the inclination of the gradient in an arithmetical proportion, the mean rate of increase being 1·85.mile per hour for each additional ·0025in. of difference in the barometer readings at each end of the slope. The authors find that the angle at which the wind crosses the line of gradient at Kew does not vary with either the steepness of the gradient or the velocity of the wind to any material extent, and also that the angle is found generally to lie between 40° and 60°, the average of the whole series of observations giving a deviation of 52°.

2. On "Difference of Temperature with Elevation," by George Dines, F.M.S. In this paper the author gives a summary of his observations made at Walton-on-Thames during the last six years. Two stands, almost identical in size and construction, were used, one being placed on the ground and the other on the top of the tower of the house, the bulbs of the thermometer in the former being 4ft., and in the latter 50ft. above the ground. The results show that the average maximum temperature for every month is always greater, and the average minimum lower, on the ground than on the tower.

SCIENTIFIC NEWS.

THE news of the death of Darwin has brought expressions of profound regret from all parts of the civilised world. Already in quarters where we might least expect to find a just estimate of his work a fitting tribute has been paid to his memory; but the exact value of his labours, and the important services he rendered to science, cannot yet be fully appreciated. The distinguished naturalist happily lived long enough to find his views adopted almost universally; and even before he was buried, much of the objectionable criticism to which his earlier works were subjected was practically withdrawn and atoned for by those who represented his, at one time, bitter opponents. Of the many sermons delivered last Sunday, in which Darwin and his theories were mentioned, there was none more truly appreciative and none in which they were more accurately delineated than in that preached by Mr. W. R. Dale, at Carr's-lane Chapel, Birmingham. Charles Robert Darwin was born at Shrewsbury, on Feb. 12, 1809, and died at Down, near Beckenham, Kent, on the 19th inst., in his 74th year. He was buried on Wednesday, at Westminster Abbey.

The Darwin medal, founded by the Midland Union of Natural History Societies, bears a likeness of Mr. Darwin on one side, and on the other an inscription relating the history of its foundation, surrounding a branch of coral—the subject of one of the deceased naturalist's most important researches.

Dr. J. Palisa has discovered another small planet, his fourth for the present year, making 224 in all. It was discovered on March 30th, whilst seeking for Callisto, and is described as very faint—less than the eleventh magnitude.

The lecture arrangements for the Friday evening meetings of the Royal Institution are as follows:—To-night (April 28th) Prof. Abel, "Some Dangerous Properties of Dusts"; May 5th, Prof. R. Grant, "The Proper Motions of the Stars"; May 12th, A. G. Vernon Harcourt, Esq., "The Relative Value of Different Modes of Lighting"; May 19th, a paper by Sir Frederick Bramwell; May 26th, Sir Henry S. Maine, "Sacred Laws of the Hindus"; June 2nd, H. H. Statham, Esq., "The Intellectual Basis of Music"; June 9th, Prof. Burdon Sanderson, "The Excitability of Plants."

On Thursday last week the Rev. W. H. Dallinger delivered, at Firth College, Sheffield, an interesting lecture on the origin of epidemic diseases, in which he briefly described the advances which have been made in recent years in our knowledge of the causes of such diseases as splenic fever, chyluria, elephantiasis, madura foot, chicken cholera, &c., with especial reference to the part played by the microscope in their discovery.

It is stated that M. Henry Giffard, the inventor of the injector and distinguished aëronaut, who died recently at Paris, has left the whole of his large fortune to the French Government, to be employed in the promotion of scientific research. M. Giffard was not married.

From America we learn that Bell's claim to be the first to invent the magneto-telephone is disputed by another rival in the person of Mr. Daniel Drawbaugh, of Cumberland county, Pennsylvania. Over a hundred witnesses have been examined, and their testimony shows that Drawbaugh invented at least half a dozen telephones before Bell conceived the idea. So long ago as 1867 he had invented an apparatus which conveyed sound by means of a battery, and in 1871 he made the magneto-electrical instrument which is said to embody the principles of Bell's telephone. What he has been doing all this time is not stated, but the People's Telephone Company have taken the case up, and there is consequently a lawsuit to be tried shortly, at the instance of the American Bell Telephone Company.

The Board of Trade have sent round a circular asking for suggestions as to the standard to be adopted for wire-gauge. A proposed (or suggested) scale accompanies the circular. It is quite time that something was done, for complaints have lately been rather loud as to the loss and inconvenience of buying by a gauge which turns out to be based on the private opinion of the maker of the wire.

The Naval and Submarine Exhibition was a success, not only from a popular point of view, but also financially to all concerned. The great majority of the exhibitors are, we understand, more than satisfied. Some had to decline orders—and the only regret expressed appears to have been that the exhibition was not open longer.

During 1881, nearly 16,000 patents were granted in the United States, the largest total ever known. No marked increase is observable in any particular class except one—viz., electricity. The greatest increase in the subdivisions of that class is found in connection with telephones and electric lighting apparatus.

Mr. John Perry, M.E., has been elected professor of Mechanical Engineering in the City and Guilds Technical College, Finsbury.

The secondary battery question, so far as patents are concerned, appears to be complicated by a paper by J. B. Oster, which appeared in a German serial in 1881. He covered a sheet of lead with a coating of peroxide, wrapped it in flannel, soldered on an anode of copper, and rolled the whole tightly in a cylinder; sheet-lead was then put round, and the whole introduced into a porous pot, containing dilute sulphuric acid. That was placed in a glass cell containing a similar solution, with amalgamated zinc plates. The author found it to be a powerful and constant voltaic cell, which he now proposes to modify and convert into an accumulator.

During the scientific cruise of the *Travailleur*, last year, measurements were made of the density and saltness of the water in different parts of the Atlantic (near Europe) and the Mediterranean. The results, tabulated by M. Bouquet de la Grye, in a paper to the Paris Academy, prove clearly the increase of those two qualities, on passing from the ocean through the straits. Thus, while the density in the Bay of Biscay is represented by 1·02718, it rises to 1·02964 off Nice. The less dense of two connected liquids (as in two vessels communicating with each other) is, of course, the higher; and it is estimated that the mean height of the Atlantic is about 1 metre (say 40in.) higher than that of the sea near Marseilles. This accounts for the surface-current through the Straits of Gibraltar; a constant current, inasmuch as the cause which maintains the differences of saltness is a permanent one. The measurements by the *Travailleur* savants verify those of M. Bourdaloue; and a good example is presented of the important bearing of a study of water-density on the constitution and general movements of seas.

The emigration last year from Switzerland was the highest yet known. The number of emigrants after 1872, when 4,957 left the republic, diminished till 1877, then rose to 2,608 in 1878, to 4,288 in 1879, to 7,285 in 1880, and last year it was 10,935. The emigrants are almost exclusively German Swiss.

The instructive results obtained by M. Spring in strong compression of various powdered substances he has lately supplemented by applying the method to mixtures of metals. A coarse powder of filings of bismuth, cadmium, and tin, in proportions the same as those of Wood's alloy (which is known to fuse about 65° C.), was subjected to a pressure of 7,500 atmospheres. The block obtained was powdered by filing, and the powder again compressed; and a metallic block with properties quite like those of Wood's alloy was produced. Put in water at 70° it melted directly. Next, a mixture of lead, bismuth, and tin, as in Rose's alloy (which melts about 95°) was twice compressed. The block melted in boiling water. A mixture of zinc and copper filings, after five or six pressures, yielded a block similar to brass, only a little darker. M Spring believes it may be generally affirmed that matter takes the condition corresponding to the volume it is compelled to assume.

A piece of iron, in being magnetised, is appreciably heated. This phenomenon M. Pilleux finds to be rendered very apparent, when alternating currents are used to produce sudden inversions of magnetisation in a core of iron or steel. Thus with a Meritens machine, he was able to heat a piece of iron to more than 200° C. How is this production of heat to be explained? M. Pilleux sought the cause first in induction currents produced in the core; but having replaced the iron core successively with cores of red copper, brass, and tin, he got no heating. Steel was considerably heated. Using iron more or less annealed, he found the heating to decrease as the amount of annealing increased. The coercive force of the magnetic cores seems to play the same *rôle* as the resistance to passage of electricity in the case of heating a metallic wire with a battery current.

Two Italian physicists, Srs. Cantoni and Gerosa, have lately sought to determine the mechanical equivalent of heat by sudden stoppage of a mass of mercury, let fall from a given height, and measuring the increase of temperature. The mean of the results closely agreed with that obtained by Joule.

French soldiers have in recent years taken part, to some extent, in the operations of haymaking, harvest, and grape-gathering. In the circular in which the Minister of War expresses his consent to this arrangement for the present year, he allows thirty days to soldiers going to join their families at a distance in harvest work, and twenty to those who go to work for farmers near their garrison town. The number so permitted will be such as is judged strictly indispensable for the requirements of each district. The soldiers will be mostly taken from those in their second, third, or fourth year of service, and from all corps of the army; but in the cavalry, artillery, and engineers, the number will be very limited (on account of the care of horses, and the special instruction given to the men).

The provincial assembly (or Zemstvo) of the Government of Simbirsk, and several others in Russia, give prizes for the destruction of wolves—viz., about 15s. for each young wolf taken in its lair, and 7s. for each wolf-skin (the ears and tail are kept as evidence, and the skin is returned). If it be proved that the wolf was rabid, a prize of about £7 is paid. In 1879 the Zemstvo above named paid some £290; in 1880, only £75. While Russian law guarantees to the proprietor the rights of the chase on his domains, any one may generally hunt any kind of game in forests. The officials who pay the prizes make no inquiries as to where the skins, &c., were obtained.

Herr Kalischer, who lately arrived at some instructive results concerning the influence of heat on the molecular structure of zinc, has examined various other metals (in the rolled form), and finds that (besides zinc), cadmium, tin, iron, copper, brass, tombac, lead, silver, gold, platinum, and german-silver, are crystalline, or become crystalline through heating. On the other hand, nickel, aluminium, magnesium, and cobalt, are uncrystalline; also zinc containing bronze, (a fact which probably has a bearing on formation of patina). The author is lead by his researches to the following general result: The crystalline is the natural state of most metals, of which state they may be deprived by mechanical action, some easily, some with difficulty, some perhaps not at all, and into which many of them may be brought back under the influence of heat. The assumption of the crystalline structure of some wires under this influence explains, at least in part, the greater electric conductivity they acquire though heating or incandescence.

In a pneumatic-rotation indicator, lately brought out by the German makers, Schäffer and Budenberg, and especially meant for ships (indicating on the captain's bridge the speed of the engine), motion is imparted by the engine to a rotatory blower, by which, with the engine working in the direct sense, air is compressed into a wind-chest. When the engine is working in the reversed direction, the blower acts as an air-pump, sucking the air from the chest. The variations in the chest are transmitted to an indicator on the bridge, as also to one in the engine-room. These are like the ordinary steam-pressure gauges and vacuum-meters. The air presses on a diaphragm which affects a pointer, or it acts by suction on the diaphragm, moving the pointer in the opposite direction. The indicators are empirically graduated, so that the pointer indicates directly the number of revolutions.

There are several objections to the method of cleaning out old oil and dust from the axle-beds and grease-boxes of railway-waggons by burning. These evils have been avoided in various German railway workshops during the last 1½ years (according to Herr Garbe), by lixiviation, the axle-beds being hung in iron vessels filled with cold water, containing 5kg. soda per cubic metre. Steam is led into the liquid, and after two hours' boiling, the axle-bed is thoroughly clean. The soda is renewed every day. The oil and fat boiled out are collected in holders and sold to soap manufacturers; every four days the vessel is cleared out, the water being let off, and the residue collected. The method proves one-third cheaper than the old one.

It has been lately proved by Herr Schuller, that when hydrogen is burnt in oxygen, or oxygen in hydrogen, under certain conditions, some peroxide of hydrogen (H_2O_2) is produced. An essential point is the rate at which the burning gas penetrates the other; when this is slow, very little peroxide is formed. The presence of sulphurous acid prevents or hinders the formation. Experiment further proved that in explosion of mixtures of H and O peroxide of hydrogen is produced, and in still larger quantity than in ordinary combustion. One deduction from the data is, that in precise determination of the heat of formation of water, regard should be had to the H_2O_2 produced.

Hardening and Tempering Steel.—The following preparation for imparting to steel great toughness and improving its quality, was the subject of an application for a patent. It consists of 200 parts resin, 120 parts liver oil, 60 parts sheep's tallow, 30 parts paraffin, 40 parts colophonium, 20 parts yellow prussiate of potash, 10 parts chromate of potash, 10 parts refined borax, 15 parts powdered ox's hoof, 15 parts tartaric acid, 10 parts alum, 10 parts soft soap, 20 parts charcoal powder from lime-tree wood, 15 parts burnt ivory, 5 parts dry cooking salt, 10 parts gum arabic, 5 parts aloe powder, and 5 parts gentian powder, the whole being mixed and boiled together for an hour.

Areas of Circles.—One is able mentally to compute the area of a circle by simply remembering that the area of one is to the area of another as the squares of their diameter. The application of this is thus suggested by the *American Manufacturer*:—"For instance, if we happen to remember that the area of an 8in. circle is 50 square inches, it is easy to mentally calculate the area of 1in., 2in., 4in., 16in., 32in., or any other binary diameter. Thus we say: area of 2in. circle : area of 8in. circle : : 4 : 64 or 1 : 16; or, in other words, the 2in circle has an area of one-sixteenth of that of the 8in. circle, that is to say, 50 : 16 = 3⅛ square inches approximately."

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

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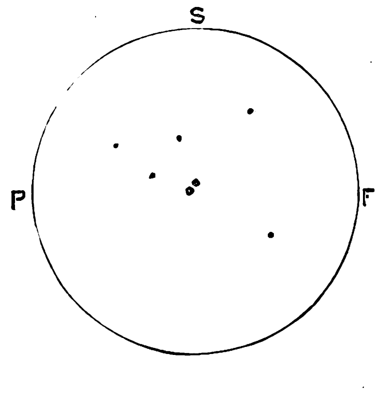
P VII. 173 CANIS MINORIS.

[19965.]—P VII. Canis Minoris, described by Mr. Webb ("Celestial Objects") as an admirable "test," and, following a little south of Procyon, is a very interesting double, and the field around well worth examining. On the night of the 20th April I perceived, besides the 13th mag. *comes* mentioned by Webb, a much fainter but more distant *comes*, which at first I picked up with averted vision, but which, when once seen, I could keep steadily in view. It is in the north following field, about as far again as the *comes* of "Amici" from 170. Has Mr. Webb noticed it? It will, I think, severely test the light-grasping power of a good instrument. I give a drawing of (170) with these two companions, and a few of the other stars, which make the whole group very beautiful, as seen with my 12¼ mirror. As Procyon is fast getting out of good position, this field should be examined as soon after dark as possible.



S. Mills.

A REMARKABLE SUNSPOT—TO "F.R.A.S."

[19966.]—The disturbance you describe on p. 150, on the Sun's surface, was well seen here, and was one of the most remarkable I have observed during a long course of observations. An aurora borealis seems to have accompanied it.

East Molesey. H. Peacock.

DR. HASTINGS' METHOD OF MAKING FLAT SURFACES—TO MR. WASSELL.

[19967.]—In my English Mechanic just received I note Mr. Wassell's query in regard to the colours referred to in the test for flat plates. I presumed that this was well understood by optical students; but I must agree with Mr. Wassell in his excellent articles on working specula, that while some may know what we happen to know, it is the best rule to presume nothing of the kind. In this way things will always be made clearer, and not one of us should be ashamed to ask a question when in the dark, no matter how simple it may seem to *some*. I was once told by an honest man "that it would take a big book to hold all *I did not know*." And he told a truth that takes considerable of the conceit out of us that was left us as a legacy by father Adam. But enough of this pleasantry. However, I would say that if we amateurs do not endeavour to make things clear, that we have in a measure mastered, for the benefit of those who have had less or probably no experience, from whence are they to get any light? Generally, when a question is asked of one who should give a clear and lucid answer, we get it "as clear as mud." It is, therefore, a most pleasant task to pick up and read the excellent and exhaustive articles of Mr. Wassell and "Orderic Vital." I move a vote of thanks to them. In reference, then, to what is meant by colours of the first or second order. The phenomena is indissolubly joined with the name of the great Sir Isaac Newton, as he first measured and established the phenomena and laws of the appearances presented when a slightly convex lens or piece of glass, or other transparent substance is laid on a flat reflecting surface. We are all familiar with this beautiful experiment, and it is only a modification of it which serves us for a test for reflecting surfaces that are flat, or approximately so. When a piece of glass of very slight convexity is laid on a flat reflecting surface, say a piece of plain polished glass, a series of bright and dark rings will be seen, which are more and more closely approximated from within outward, and are gradually lost. The centre of all the rings is black, and the *colours* from the centre to the first dark ring, Newton called, colours of the first order. From this to the second dark ring colours of the second order, &c. The colours of the first order are black, pale blue, white, orange, yellow, red. Second order: violet, purple, yellowish green, yellowish red. To explain why these colours are seen would be a big undertaking, and as the explanation may be found in any advanced work on optics, I refer those of "ours" who have not studied it to these works. Probably one of the most excellent works on the subject is found in the International Scientific Series, "On the Nature of Light," by Eugene Lommel, of the University of Erlangen. I might say briefly that the colours are formed by the interference of the two reflected rays; one starting from the under surface of the top plate, and the other from the upper surface of the under plate. Now, in regard to the phenomena we should see in our flats, it is evident that if the thickness of the film of air were exactly the same thickness throughout, or, in other words, if the two surfaces were exactly flat, then the two rays of light would suffer identically the same interference from every part of the reflecting surfaces, and as a result we should have a single colour, deviations from the rigorous flat in one plate or the other would produce wave-length interference, determined by the errors of the surface, and as a consequence we would get other colours and other arrangements of them. The phenomena of interference is a study enchanting indeed, clearing up as it does many of nature's "mysteries." I hope this explanation will make the matter clear. I hope Mr. Wassell, with others who may try this process, will note the correction I made in regard to the size of the polisher, in a letter I wrote to the Editor, but which I have not yet seen, though no doubt it will come in due time. I note an error which I am not sure whether I corrected in my last or not, under the head "Advantages of this Method," the types make me say "*not* much less than 1-10 wave-length," when it should read "*out* much less," &c. I hope our friend "W." will succeed in making as good "flats" as he has specula.

Pittsburg, April 8th. J. A. Brashear.

ABERRATION OF MIRRORS.

[19968.]—It would seem that the rule used by Mr. Wassell in calculating his zonal errors, is in exact agreement with the one I gave in these pages some time ago. I feel certain it is correct both theoretically and practically, as it was confirmed in the first respect by two other correspondents using a different method of analysis, and in the second by the "Optical Bricklayer." Since the central error is quadruple the focal aberration, the corrective process seems even easier to apply than Dr. Draper anticipated; but for diaphragms decreasing by single inches, it requires delicate measurement, and presumably considerable practice. Mr. Wassell's aberration values differ by little more than 1-100th of an inch, which is certainly a very small quantity, and not easily distinguishable unless there are definite points to measure from. I am not practically acquainted with these matters, but should think that the main point is to keep the central and marginal parts in proper relation; then if the whole surface be free from rings and uniform, the intermediate parts cannot be far from the truth.

Mr. Wassell is doing good service in so thoroughly elucidating the subject of mirror testing. To enable anyone to understand the character of a surface from the appearance of the shadows, long experience must be required; but if Mr. Wassell can show the amateur where to start from, and what to expect, he will have removed the great stumbling-block to the serviceable use of the Foucault test. A parabolic mirror is in relation to the primitive sphere—an over-corrected spherical one—that is the marginal rays are thrown beyond those from the central parts; consequently there is no definite focus, and a variety of shadows may be produced by a very slight change in the place of the shutter. Hence the problem is to give just so much error at the centre. as shall be destroyed at the focus. Now it mus necessarily happen that the nature, regular grada tion, and extent of this error is not an easy matter to deal with; but I believe Mr. Wassell's plan is as good as any that can be devised for ascertaining what to do, where to begin, and when to stop.

Has Mr. Wassell discarded the use of the eyepiece in testing the quality of a mirror? I would also ask what considerations have led him to adopt the quadruple ratio of aberrations instead of the duplicate given by Draper? He appeals to the mathematical readers to settle the question, which is correct; but the best plan is to refer it to some of our practical friends. There are very many who possess specula of Calver or With's splendid workmanship. Will any of these oblige by testing his mirror for the difference between the central and maginal foci, at the centre of curvature? I feel certain that if this meet the eye of Mr. Calver he will say which rule agrees best with practice.

In connection with telescope matters, I may observe that there is an interesting article in the March number of *Harper's New Monthly Magazine*. The writer says that the Clark's always work a lens (a large one, I suppose he means) *on* the polisher, not the polisher on the lens, and this by hand, not by machine motion. What advantage is this particular process supposed to have over any other?

I am sorry to miss Mr. Lancaster's articles on practical telescope work. I believe he said they did not seem to interest many readers, but surely he was mistaken. The non-appearance of queries is not a sign that little interest is excited, for the simple reason that the articles would probably render the asking of many queries unnecessary. Considering that he has made many promises, may I ask him to favour us with the fulfilment of at least some of them? **Orderic Vital.**

GRINDING AND POLISHING GLASS SPECULA.

[19969.]—Owing to great pressure in other matters I have not been able to write quite so frequently just now. However, our readers have been well supplied in the interesting, instructive, and in many instances original plans described in the letters of our friend, Mr. H. A. Wassell. I am sure, as those results are the outcome of many years of application, most amateurs will have occupation sufficient for a few weeks in getting by heart the modes of working, testing, &c., described by him. In whatever way these modes differ from the usual practice in the trade, the fact remains, that good specula can be produced by the means he employs. With regard to polishing on paper, dry, I feel sure that with proper management and study of the working, stroke, grooving, &c., of the polishers, as Mr. Wassell has done with the pitch, it will be possible to pitch our old and useful, but tricksey and tenacious, friend out—I have not certainly tried actually with *glass specula* to finish off with paper, but I have got it so completely under control from the production of perfect flats and o.g.'s of over 3in. diameter, that I do not despair of getting much larger. One great advantage of dry polishing over wet is the entire absence of capillary attraction between the surfaces; this is the reason why I advocate its use as an intermediary. This at once brings us to face a difficult matter. Amateurs complain that they do not grind their tools to perfect contact with the surfaces; this is owing to the capillary attraction going on between them when *wet* abrasives are used. The right degree of moisture is only got by practice; the last emery in smoothing should be worked down to a *greasy* consistency at least. I have by practice got to work off dry; a dozen or so of dry rubs works wonders. This must not, however, lead any to suppose that dry emery to begin with is the thing. I know dry emery has been advocated as a cure many years ago, by no less an authority than that great master of the art, the late Andrew Ross. It has, however, never been much used on account of the fault he saw in it—viz., the continual cloud of dust of emery produced in the workshop. Thus, the remedy was productive of greater trouble in other ways. The ring caused by this capillary attraction is a depression equidistant between centre and edge, to speak roughly, and if plain tools are used amateurs will certainly get it to a less or greater extent as they approach the proper form of smoothing. The advantage, however, of having a finer surface to polish from than can be got from facetted tools, is great; the very small quantity of fine emery plain tools use, and the comparative freedom from scratching in the smoothing process, commend the plain tool to the amateur as well as the workman. He must however, not expect, without experience, to smooth his surface or fit his tools like a workman. It took me years to master the ring in flat surfaces, both in tools and work; even now with very soft glasses, such as the very dense flint used for spectroscopic prisms, I find it easier to correct with paper polishing, if the surfaces are large, than to dwell on the smoothing too long. Tools, however, should fit, although the work does not fit them; the error is lessened, and the tool (forming as it does the base for the polisher) should have no error, as it does not grind away anything like so fast as the glass. So that a palpable error on the glass is no proof that it is also present on the tool. In grinding a pair of tools it is easy to rub down the emery to a degree of fineness that cannot be done with the glass, and this is necessary to make the tools fit. The emery also requires to be moist—not wet. When a pair of tools fit, the emery is black and greasy in appearance. The stroke in rubbing is straight, or very narrow in the minor axis of the ellipse. I find it a good plan, when tools are very refractory, to use for a few minutes, with all varieties possible of stroke, a little No. 2 emery, and then wipe the tools perfectly dry, and with long straight strokes rub them together; this invariably has the desired effect. The coarse emery gives a sort of file-like surface to the tools, and they file each other up by mutual abrasion to perfect contact, unless the error be very considerable, when a continuation of rubbing with very fine emery is required, and *must* reduce the error. I find I must leave my promised pitch tests for my next, as I have got to the end of my tether.

Prismatique.

OBJECT-GLASSES AND EYEPIECES.—TO "LENS."

[19970.]—As most of the queries have been ably answered by "Orderic Vital," I will just say to "Lens" that the o.g., paradoxical as it may seem, may be absent in measuring its power, or rather the power of an e.p. on it. By using a hole of the exact aperture of the actual or presumptive o.g., placed at its focal distance from e.p., measuring from the diaphragm or stop in the latter, the spot of light will give, by simple proportion, the power of the o.g. So "Lens" can measure off fabulous apertures. Or he may closely arrange lenses if he uses a 3 to 1 proportion by deducting ⅓ from the power of first lens if of Huyghen's form, and adding ⅓ if of Ramsden's, supposing the lenses to be arranged at proper distances—viz., one-half their sum for Huyghen's, and one-third for Ramsden's. Although I have seen many arrangements of the Huyghenian, including crossed convex and meniscus lenses, in proportions of 2½ to 1 and 2 to 1, I still adhere to the opinion that 3 to 1, especially for high powers, is the best, all things considered. The 2½ to 1 proportion has a very questionable preference on account of its nearer approach to aplanatism, but is not so well achromatised. The 2 to 1 proportion is generally used for the microscope. In this case illumination of the field needs such a form. Plano lenses are the rule, I think; nothing has ever been gained by the other forms. **Prismatique.**

FINDING DISTANCE BETWEEN THE MIRRORS OF A CASSEGRAIN.

[19971.]—I do not know whether the following rule for finding the distance between the mirrors of a Cassegrain will help "Lens" (letter 19964, p. 156); but if so he is welcome to it. It was set as a rider to the construction of the Cassegrain in the Cambridge Mathematical Tripos for 1881:—

"Construct a right-angled triangle having the radius of the "concave" for one side, and twice the radius of the convex for the other; add to the hypotenuse the algebraical excess of the first side above the other, and the result will be four times the required distance; the first real image being supposed to be formed at the aperture in the large mirror." Perhaps "Orderic Vital" could prove it for us. **E. C. A.**

ORNAMENTAL LATHE-THREADS.

[19972.]—As no answer has been given in the last issue of the "E. M." to Dr. Edmunds's question, No. 19830, in March 24th, I inclose the calculated pitch and depths of Holtzapffel's deep and shallow screw-threads in thousandths of an inch:—

		Depth of Thread.	
No.	Pitch.	Deep.	Shallow.
1	152	163	132
2	121	131	106
3	106	114	92
4	76	81	66
5	61	64	52
6	50	54	43
7	45	47	38
8	39	41	33
9	35	37	29
10	28	30	24
11	25	26	21
12	18	19	16

The actual measurement of the screw tools I possess being Nos. 3, 4, 5, 6, 8, and 10, of the above series, differs slightly from that calculated. The angles of the teeth are given, however, of "about" only as 50° and 60°; and a small error in this may account for the difference. **B.**

[19973.]—Thanks to Mr. Holtzapffel, we are now in possession of all the data of the celebrated screw-threads which have so long clung to our ornamental lathe apparatus. Much of this information might have been arrived at in other ways, but Mr. Holtzapffel's letters to the English Mechanic (letters 19712, 19731, 19768, and 19874) have put these data upon record in authentic form.

In the table given herewith, I have collated Mr. Holtzapffel's data, and have arranged them so that all the relationships of any one element may be realised by passing horizontally along the line in which it stands. To the right will be seen the nearest element in the Whitworth and Sellers standards. The complication of the Holtzapffel screw-threads is such as to make it difficult to present them in intelligible form. But, starting from the numerical denotements by which Charles Holtzapffel strung them together, I take, as their second classifying character, their screw-rates in pitch sequence; afterwards, I take their alphabet denotements and diameters. Should there be any plan by which these screws might have been exhibited more clearly, I trust that Mr. Holtzapffel, while correcting me with academic severity, will believe me to sympathise with the vexation of spirit with which he will contemplate this collection of screw-tools when set out side by side with the systems of screws which, for a whole generation, have been agreed upon by mechanical engineers. *Omne ignotum pro magnifico*; but now that these screws are tabulated and comprehended, Mr. Holtzapffel will have no difficulty in inducing his clients to adopt the advice given so long since by his father, and, in all new apparatus, to supersede these screws by aliquot threads. No one will be fatuous enough knowingly to prefer a screw 39·83 threads to the inch in place of one of 40; 36·10 in place of one of 36; 19·89 in place of one of 20; or a mandrel-nose of 9·45 to the inch when he can have one of 10.

Sir Joseph Whitworth's screw-rates below the ¼in. are generally thought to be too coarse. The ¼in. screw, when used in mechanical engineering generally, has to take its hold in cast-iron, and therefore has 20 threads to the inch. But for other purposes in which the exigencies of cast-iron are superseded by those of steel, nickel, bronze, or brass, the ¼in. screw should have 24 or more threads to the inch. The fine threads for watch and instrument-makers are now under consideration by a committee of the British Association, and the report of that committee will probably settle the standard threads for screws whose diameters are below a ¼in., and for which the uses of cast-iron as a material scarcely need to be considered. Pending the report of that committee, the spaces in the table of standard screws are left blank below the ¼in., while in the aliquot screws, which I have ventured to indicate, it will be seen that Holtzapffel's incommensurable threads have been simply replaced by aliquot approximations. The screw-rates of Whitworth and Sellers are identical except in the ½in. screw, in which Whitworth cuts twelve threads, while Sellers cuts thirteen. But the advantage of keeping down the number and variety of screw-tools is so great that, unless some adequate reason is given for thus differentiating the rate of the ½in. from that of the 9-16th, the Whitworth is the better. The woodcuts seen below represent profiles of the threads as obtained by sectional planes containing the axes of the screw-bolts. In angle, the American thread is 60°, the English thread 55°, and the Holtzapffel thread 50°. The profiles are all contained in isosceles triangles. The Holtzapffel thread is a full triangle of 50° whose height is greater than the length of its base. In cutting this thread, the point of the tool is just smoothed down to prevent fracture, and the apex of the thread is similarly smoothed down after the screw is completed. The American thread is contained in an equilateral triangle whose height is ·866 the length of its base. The height of this triangle is divided into eight portions; by horizontal planes one-eighth is cut off from the apex of the thread, and another eighth is cut off from the bottom of the channel, leaving two flats. The truncated angular thread thus formed is in height three-fourths the height of the full triangle, or ·65 of the pitch. The Whitworth thread stands in an isosceles triangle of 55°, whose height will be ·96 of the length of the base. This height is divided into six portions, of which one is rounded off from the top by an arc of a circle, centered at the point where the perpendicular and the second horizontal line intersect, while another sixth is rounded off similarly from the depth of the channel. The height of the thread is thus two-thirds the height of the full triangle, or ·64 of the pitch. Taking the triangle drawn in a square, as given by "J. K. P.," page 83 "E.M.," the height of that triangle will, of course, be exactly the length of its base. Here we get an angle of 53° 8′—nearly 2° sharper than that of the Whitworth thread, and, therefore, approaching somewhat more nearly to that of Holtzapffel. If now we divide the height of this triangle of 53° 8′ into eight portions, as in the American thread, and then round off at top and bottom, as in the Whitworth thread, by an arc of a circle—but rounding off the eighth part instead of the sixth—we get the Steinlen thread

Holtzapffel Screw-Threads, as now used for Ornamental Lathe Work.						Whitworth Screw-Threads (English Standards).			Sellers Screw Threads (United States Standards).			Aliquot Pitches, suggested for Ornamental Lathe Work.			
Comb Screw-Tools. Number Denotements.	Mandrel-Guides. Number Denotements.	Threads per inch. Angle 50° or 60°.	Taps and Dies.			Diameters outside Thread.	Threads per inch. Angle 55°.	Diameters at bottom of Thread.	Threads per inch. Angle 60°.	Diameters at bottom of Thread.	Width of Flat.	Diameters outside Thread.	Threads per inch.	Mandrel-Guides.	Denotation.
			Alphabet Denotements.	Diameters outside Thread.	Diameters at bottom of Thread.										
1		6·58	A	1in. = 1·0000	Undefined	1in. = 1·0000	8	·8399	8	·837	·0156	1in.	8		The comb screw-tools and mandrel-guides to be denoted solely by a number, indicating the number of threads per inch. Taps and dies to be denoted by the number and the diameter of screw, outside thread.
2		8·25	B	7/8in. = ·8750	Undefined	15/16in. = ·9375	9	·7952	9			15/16in.	9		
2		8·25	7in. centre mandrel nose	9/8in. = 1·1250	Undefined	14/16in. = ·8750	9	·7327	9	·731	.0138	14/16in.	9		
3	1	9·45	6in. centre mandrel nose	15/16in. = ·9375	Undefined										
3	1	9·45	5in. centre mandrel nose	13/16in. = ·8125	Undefined	13/16in. = ·8125	10	·6844	10			13/16in.	10	10	
3	1	9·45	C	3/4in. = ·7500	Undefined	12/16in. = ·7500	10	·6219	10	·620	·0125	12/16in.	10		
4	2	13·09	4in. centre mandrel nose	3/4in. = ·7500	Undefined	11/16in. = ·6875	11	·5710	11			11/16in.	11		
4	2	13·09	DD	5/8in. = ·6250	Undefined	10/16in. = ·6250	11 .	·5085	11	·507	·0113	10/16in.	11		
4	2	13·09	D	·5600	Undefined	9/16in. = ·5625	12	·4557	12	·454	·0104	9/16in.	12	12	
4	2	13·09	E	1/2in. = ·5000	Undefined	8/16in. = ·5000	12*	·3932	13*	·400	·0096	8/16in.	12		
5	3	16·5	F	·4500	Undefined	7/16in. = ·4375	14	·3460	14	·344	·0089	7/16in.	14		
6	4	19·89	G	·4100	Undefined										
6	4	19·89	H	·3600	Undefined	6/16in. = ·3750	16	·2949	16	·294	·0078	6/16in.	16	16	
7		22·12													
8	5	25·71	I	·3300	Undefined	5/16in. = ·3125	18	·2413	18	·240	·0074	5/16in.	18		
8	5	25·71	J	·2900	Undefined										
8	5	25·71	K	1/4in. = ·2500	Undefined	4/16in. = ·2500	20	·1859	20	·185	·0062	4/16in.	20	20	
9		28·88	M	·2100	Undefined							4/16in.	24	24	
10	6	36·10	L	·2400	Undefined										
10	6	36·10	N	1/5in. = ·2000	Undefined							1/5in. = ·2000	30		
10	6	36·10	P	·1800	Undefined							1/5in. = ·2000	36	36	
11		39·83	O	·1900	Undefined							3/16in. = ·1875	40		
11		39·83	Q	·1625	Undefined										
12		55·11	R	·1500	Undefined										
12		55·11	S	·1350	Undefined										
12		55·11	T	·1200	Undefined							2/16in. = ·1250	50		
12		55·11	U	1/10in. = ·1000	Undefined							1/10in. = ·1000	60		

FIG. 1

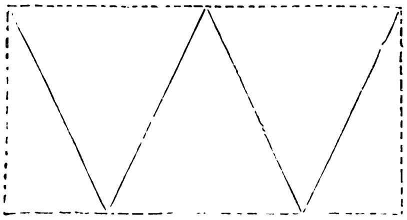


FIG. 2

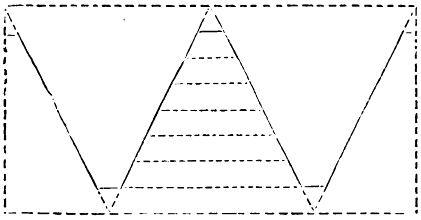
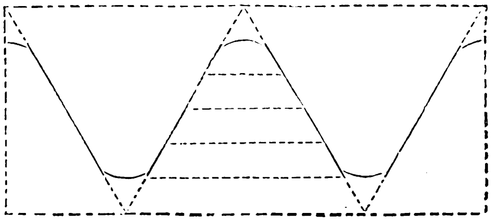
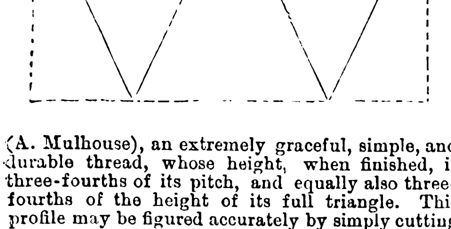


FIG. 3



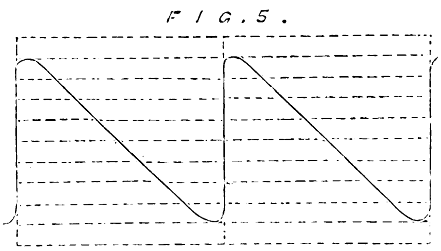
(A. Mulhouse), an extremely graceful, simple, and durable thread, whose height, when finished, is three-fourths of its pitch, and equally also three-fourths of the height of its full triangle. This profile may be figured accurately by simply cutting out a square of paper, folding it in half, and drawing across the two parallelograms diagonal lines meeting at a point. On dividing the surface into eight bands by horizontal lines, and rounding off at top and bottom by arcs of circles* centred upon the intersections of the perpendiculars and second lines from top and bottom, the profile of the Steinlen thread is complete. The Holtzapffel thread, if rounded off one-eighth both at top and bottom, would be much more generally useful than it now is, and its shaft would be much stronger; but, if a model thread were to be adopted for scientific or ornamental lathe purposes, the Steinlen thread is probably the most simple to strike and to verify, as well as the most useful and durable. Sir Joseph Whitworth has done an incalculable service by introducing and accurately manufacturing his standard threads; but he had to make a compromise with the then existing systems, rather than to devise a theoretic thread. The following diagram explains the Steinlen thread:—

FIG. 4.



If the triangle in the square, instead of being isosceles, as in the Steinlen thread, be made a right angle by dividing the square diagonally across, and then rounding off the thread at top and at bottom to the extent of one-tenth, we get a right-angled thread. Here, from a well-known property of triangles drawn upon the same base and between the same parallels, the area of the profile is the same as that of an isosceles triangle; but the material of the thread is disposed so as to be extremely solid in resisting deformation, while its vertical face minimises friction, and relieves the nut of bursting strain. It is, in fact, a square thread, of half pitch, *i.e.*, of a double number of threads per inch, and, therefore, practically twice as strong as a full square-thread screw. Mathematically, this right-angled thread is the strongest and best thread by which a screw-bolt can be held, and it would answer excellently for the mandrel-nose and its chucks. Its cutting by hand-screw tools would be more difficult than that of isosceles threads, but less difficult than that of square threads. In cases where extreme durability is of more consequence than strength, the full height of the thread might be left as in a square thread, and the rounding off would be limited to the sharp edges, as in the Holtzapffel thread. This right-angled thread is shown in Fig. 5.

FIG. 5.



Among the three angular threads which are before us, the full Holtzapffel thread is by far the most difficult of all to cut. It is by far the most liable to injury and deformation. It is entirely unsuitable for taking hold in cast iron, and the sharp deep V-thread weakens the shaft and endangers its safety if ever so placed as to have to take real strain or sudden jerks. The thread, being higher than the width of its base, is also liable to deformation wherever strength is called for. Considering the depth of its thread, its pitch, screw for screw, must be finer, or the shaft is dangerously weakened. Its best position is probably on a steel bolt holding in a steel nut. For brass, cast iron, and wood it is the most unsuitable. The large bearing surface offered by its thread makes it more durable under very frequent fixing and unfixing, as long as no real strain falls upon it.

The Whitworth thread is said to be the easiest of all to cut by ordinary screw tools, but needing much care to cut accurately in the screw lathe. The full rounding of its thread and channel leave the shaft at its maximum of strength, the thread the most difficult to deform by injury or by strain, and for holding in cast-iron most excellent. For durability, when frequently fixed and unfixed, it is said not to equal the Holtzapffel thread. In cutting the Whitworth threads, it should be recollected that the rule is to "keep down the pitches," *i.e.*, to put as many threads on intermediate sizes as the table allows. Thus, for ¾in., and up to ⅞in., the threads are 10 to the inch; for ⅞in., and up to 1in., the threads are 9; for 1in. the threads are 8.

The American thread is very difficult to cut by ordinary screw tools, but very easy to cut in the screw lathe. Its thread is a simple one to figure and to verify, and it is cut with a minimum of waste material.

The aliquot pitches suggested are of course those of the English standard, which, as I have said, differ only in one case from the American standard. Below the ¼in. aliquot approximations of the finer Holtzapffel threads are provisionally inserted pending the settlement of fine threads by the British Association. These aliquot pitches may of course be used with any shaped thread, but considering the ease with which the Whitworth thread is cut, the medium angle of its profile, its general utility, and its wide currency, no other thread is likely to come into vogue, and the multiplying of standards is to be deprecated. Six of the most useful of these threads I have also indicated as mandrel-guides for those who still use the traversing mandrel.

The aliquot guides commence with 10 threads to the inch, a rate which will govern the mandrel-nose, slide-rest screw, and back poppet cylinder, and which will be most useful for coarse general purposes. They end with 36 threads to the inch, which gives the universal screw for microscope objectives, and is most useful for fine general purposes. All these aliquot threads, and many others, can be cut by the slide-rest, with six change-wheels, and thus the traversing mandrel and mandrel-guides may be got rid of.

Against the ornamental pitches there is no need for further argument. Their appearance in the table is enough, and we shall wait in vain for any-one to advocate them. Our valued friend and adviser in such matters, "J. K. P.," writing recently in the ENGLISH MECHANIC (p. 108) says, "as a practical man I should never dream of putting anything but a Whitworth thread on a new mandrel." The author of "The Lathe and its Uses" (p. 3), says, "It will be found of great convenience to have the screw on the nose of the mandrel (and, indeed, *all* screws about the lathe) of standard Whitworth pitch." Mr. Holtzapffel himself does not demur to the sentence which his. father passed upon these screws in 1846. Recently in the English Mechanic, so accomplished and experienced a lathe-maker as Mr. Evans, who has used these screws all his life. got into such great obscurity as to give Mr. Holtzapffel ground for imagining that he does not even yet understand these screws; and when I compare Mr. Evans's last letter (19873) with the table now published, I conclude that Mr. Holtzapffel must have been right, and that my table will be of use even to Mr. Evans. The screws of ornamental slide-rests were made 13·09 to the inch, but that was "too-too-utter," and they have been superseded by 10 to the inch. The back poppet cylinders are still, however, screwed 13·09 to the inch, and, therefore, when boring a chuck you have to stop and bore your own brains in order to figure out how much is an inch divided by 13·09, and how much that quantity, multiplied by, say, six or seven turns, amounts to. Kennan's poppets contain a square 10-thread screw, and the number of turns gives you in tenths of an inch the depth you have bored. The 15-16th and 13-16th mandrel-noses are both still screwed 9·45 to the inch. All the ornamental mandrels ought to be screwed 10 to the inch; and as the larger ones are generally drilled out, this screw-thread will be in more equal mathematical ratio, as well as of vast practical convenience. Now, when all these simplifications can be accomplished without sacrificing strength, proportion, or utility, why should an amateur of the year 1882 be worried by having to recollect that his mandrel is screwed 9·45 to the inch, his slide-rest 10 to the inch, and his poppet-cylinder 13·09 to the inch? There is no answer to these queries except that they indicate vices which, at present, permeate the whole of our ornamental lathe apparatus, and which tire out and disgust, and put to useless expense at every turn, those who take up the charming and instructive pursuit of geometric turning. A geometric lathe should be to the boys in every house of refinement and culture, what the sewing-machine has become to the girls. But that can only be when the apparatus is simplified by scientific development, and made capable of being multiplied without the cost of laborious individual reproduction and fitting. I trust that Mr. Holtzapffel will help us to bring this about.

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* The radius of this arc would be one-eighth (·125) of the pitch. The exact radius, as given by Mr. Steinlen, is ·1011 of the pitch—*i.e.*, little more than one-tenth of the pitch, and this would round the thread off rather more sharply.

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WATCH MAINSPRINGING.

[19974.]—In my last letter (19893) on the above subject, a slight correction is needed as regards Fig. 2. The hooking should not be as depicted there. It should be a *hole* not a *hook.* The text, however, sufficiently explains it. In pursuing the subject of mainspringing a little further for the benefit of those who followed me in my former letter, I wish it to be understood that I do not intend to write an elaborate treatise upon the art, but just to set as clearly as I can before the reader the various ins and outs of the work and the tools required, or such as are generally used. Having that object in view, I made my letter as brief as was consistent with the subject.

A few words of advice and instruction upon the work of punching and hooking springs is necessary as a continuance of that. I introduce here figures of the various tools used in fitting springs. To the initiated they will be perfectly familiar, but to amateurs they will be a guide as to what tools to purchase for the purpose. Fig. 1 is actual size of a small turning tool which is worked in the centres of a pair of "turns." A I is the wheel, A the pivoted shank, B a flat round table solidly set on shank, C is a small coned collar, the coned end setting in a "sink" in B, D is a squared nut screwing on pivoted and threaded continuation of A, and butting against C. The shank is turned off to a pivot at E. In twining out a barrel-bottom or barrel-lid, no better simple tool can be found than this. The collar C holds the barrel or lid flat against the table B, and the squared nut D makes all firm and tight for turning or hollowing. A light horsehair bow is used with this tool; the turning out being done with a graver, flat edged, not pointedly, as that makes a series of rough rings. The inside surface of a barrel cannot be too smooth.

Fig. 2 represents a very simple form of punch, making a small round or other shaped hole, accordingly as the punch-point and bottom-hole are made. It is screwed in the vice, and the softened end of the spring placed exactly central over the hole. The punch is then held firmly down on the spring and struck with a hammer. The hole, if too small, is easily opened with a broach. Any burr should be removed with a file or a small steel chamfer, as shown in Fig. 7, which has three or four cutting faces upon it, and is fixed in a wooden handle. In Fig. 3 we have what is called a riveting-stake, but this tool is exceedingly useful for piercing springs that are too narrow for the other punches to pierce correctly. Fig. 5 shows a form of steel punch which may be used in conjunction with this stake. The end of the spring is placed over a hole, and the point driven centrally through.

Fig. 4 represents the ordinary jack punch. As will be seen, there are three punches in this tool A; these are set in the upper jaw, and held firmly there by screws, whose ends set in deep notches cut in the punches. The first punch is generally round, the others square and oblong, or both oblong, and of two sizes. A hardened steel plate C is screwed to the lower jaw—which is a double one—and in it are cut three holes corresponding in shape to the punches, and just a shade only larger. A check-screw B limits the fall of the punches through the plate C. The spring is placed under the punch, at right-angles with the tool. The handles are then closed until the spring is pierced. This tool is shown about quarter size.

FIG. 1.

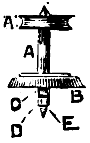


FIG. 2.

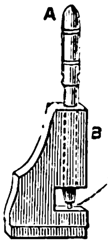


FIG. 3.

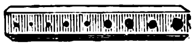


FIG. 4.

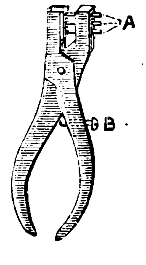


FIG. 7.

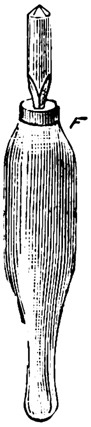


FIG. 5.

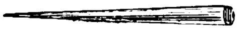
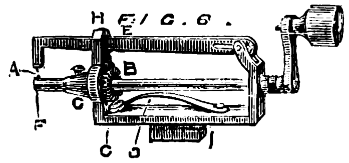


FIG. 6.



In Fig. 6 is seen the usual form of spring-winder drawn half-size. Any kind of watch-spring may be wound into barrels with this tool. It has a double action, which is controlled by the rocking-click C and the shifting spring D working into the toothed-wheel B, the arbor of which passes from the crank-handle through the uprights of the frame to the collar G, which has a poppet F screwed into it, and which carries a small protruding pin or hook A. Round this poppet the spring is hooked, and wound up, and when wound, may be securely held by the movable lever E, which is free to move upwards, or slide backwards or forwards; but, when pressed down, is held firmly by friction between the chaps H. The part I is screwed in the vice.

Reverting to the subject of springing; some old-fashioned workmen ignore all these methods of punching, and drill all the holes, opening out with a fine square file, if so required. The result is the same, but it takes very much longer to drill through a piece of comparatively hard steel than it does to punch it. The extreme end of a new spring should always be thinned off a little, and either rounded or pointed. It very frequently happens that the barrel-hook or hole is not set in the centre of the barrel-ring. The spring-hook or hole should, in those cases, be accommodated thereto; otherwise, unless the spring is low in the barrel, it will not sit properly down in its place. This should not be overlooked, as if the lid rises it will possibly jam against the barrel cock, and retard or stop the watch.

The barrel-holes should never be allowed to go large. When they are so, they should either be carefully punched up or rebushed. The latter job requires skill, and can be done only with a mandrel or a Swiss turning tool. These remarks apply to every kind of watch-barrel. Frequently, the barrel-lid does not hold firmly in the groove. When this is so, the edge of the lid should be slightly spread with a smooth-faced hammer on a smooth steel face of the vice. When sufficiently spread, it may be turned true with the centre, and bevelled off in the little tool, Fig. 1. The groove of the barrel may also be re-cut in the same tool. It should always be observed to keep the barrel perfectly free on the arbor, and clear of the cock and bottom plate; any rubbing retards the power exerted by the spring it contains. Occasionally, one finds that the barrel wobbles on the arbor. This may often be corrected by shifting the lid round. The barrel should not be let run unevenly. It is a commendable plan to always try the freedom and truth of the barrel when the spring has been taken out for any purpose. Geneve barrels in particular are prone to stick a little on the arbor. Watches often stop from this cause alone. The roller on Geneve arbors is readily removed by unpinning or unscrewing. The shoulder or hole should be reoiled before putting together.

In concluding this subject of mainspringing, I hope my instructions will prove of service to a few, if not many. With the Editor's permission I will, at a future convenient time, give a little instruction upon fitting new teeth to watch and clock wheels. The subject has been slightly touched upon by our esteemed "Fellow-Workman," who, I regret to see, has lately not been free from mud-throwing.

It is not often that men unite in themselves the artist as well as the mechanic; so I am sure any little want of correct drawing of the various parts of watchwork illustrated should not be too closely criticised. I had no difficulty at all in following and understanding all that "F. W." has illustrated, and I think he is to be warmly commended and encouraged for what he has done for the readers of the Mechanic, and for what he evidently intends to do. Certainly, while he has such a warm supporter as "Guyot," he should not quail or refrain from doing his desires in his own way.

Alfojoe.

WATCH-REPAIRING.

[19975.]—"Guyot," in letter No. 19917, tells us that the only and proper way to repair a wide hole is to rebush and repitch, but does not tell us how to do that. Now, I am not going to criticise, but, for the benefit of others, I will give my way of repitching and bushing holes. We will suppose we want to put in new third and fourth holes in verge watch, we will bush the third first. Broach the holes out top and bottom, chamfer both sides, and rivet in a brass stopping. Pitch centre and third wheel together in depth-tool; place one leg of depth-tool in centre-hole, and hold the tool upright and score off on to third wheel-bar. Now, take out centre-wheel from depth-tool, and put in contrate or fourth wheel, and pitch them together; now place one leg of depth-tool in old hole of contrate-wheel and score off, the lines where they cross will be the place for third wheel pivot. Mark it carefully. Now place pillar-plate in mandrel, upright with back-centre—*i.e.*, set the mark to run true and drill through; place top-plate in, and pin down upright top-hole, and drill off in the same way; remove from mandrel and stop up contrate pivot-holes, and pitch third and fourth wheels together again in depth-tool; score off on plate; drill off same way as before described. I think, in this way, you will get the wheels upright and not lose the positions. Of course there may be better ways than this, but I always adopt this plan for new watches as well as for old ones. Of course it cannot be done for the small charge of 2s. 6d.; the punch is generally used at that price.

I agree with F. C. Putley respecting hair-springs; they should not be drawn or interfered with to weaken them; better to fit a new one—it would be more workmanlike.

I would also ask "A Fellow-Workman" to give us a few more hints respecting the way to test the angle of verge pallets, and to know when they require opening or closing, also width of pallets. I think he has skipped it over. I may say that I am only an amateur **Working Blacksmith.**

BACK-STAYS.

[19976.]—There are a great many patterns of back-stays, both fixed and travelling, used in turning slender work which would otherwise spring from the tool, and of course some of them are much better than others. I give four illustrations of those made and used by myself, each for its own particular work. Fig. 1 is the one I use with the self-acting mechanism of my lathe when turning iron which is sufficiently long and slender to spring under the cut. It consists of a cast-iron upright, A, having a flat sole, which bolts on the saddle with two screws, which pass through the slots shown and into two holes tapped in top of saddle; the bottom of this sole is planed true, and has an arch cast in it to bridge over the surfacing screw. The side of the upright has a rectangular receptacle planed out to fit the shank of the frame B, which is of wrought iron, and is secured to the upright by a bolt, the head of which is seen, and the nut is at the far side. This bolt, passing through a slot in B, allows a certain amount of adjustment. The front (C) of the frame is a loose piece fastened by two screws, and can readily be taken on or off to change the dies. The inside of C, as well as the opposite side of frame, are V-chamfered, and between them slide two dies similar to a stock and dies for cutting screws, but of course not tapped. These are clamped together on the rod,

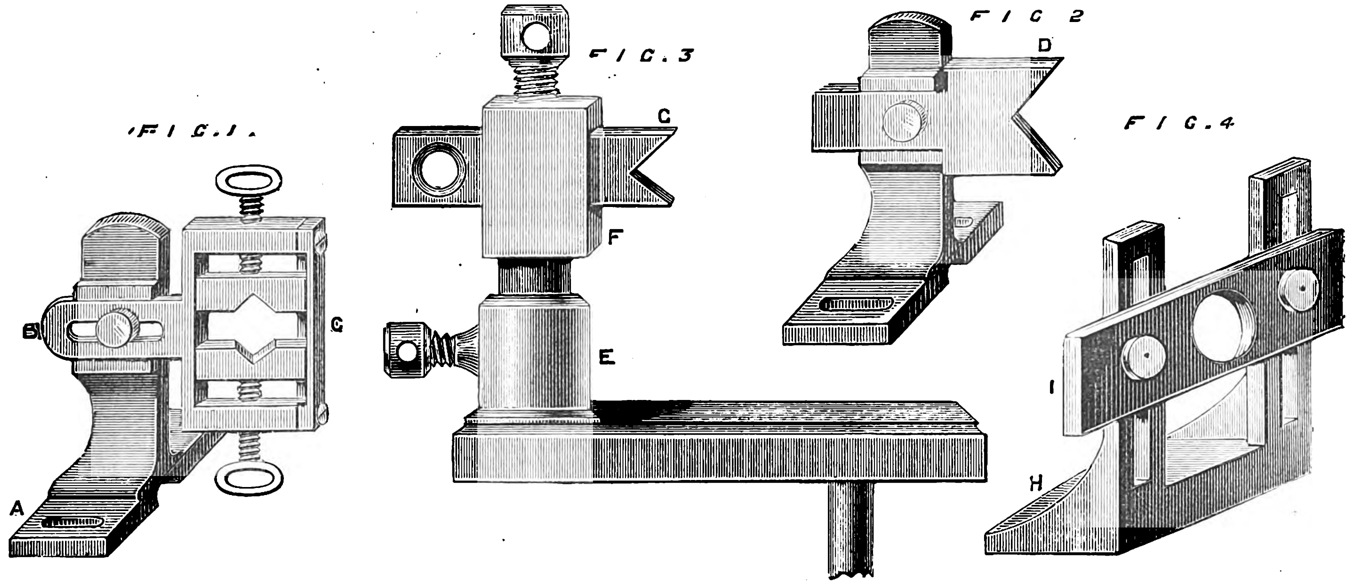


FIG. 1. FIG. 3 FIG. 2 FIG. 4

to be turned by two thumb-screws; the dies must be a good fit between the guide bars. In using this stay, the tool is set to cut in front of the dies; and while travelling, by a turn of the thumb-screws, the dies are at once adjusted to the diameter of work, and move along with the tool the entire length of cut. For roughing cuts, I find hard-wood dies are best. as the tool leaves a fine screw-thread which imbeds itself in the wood, but which metal dies would break down and allow the rod to spring a little; but when screw-cutting, hard steel dies, a pair of which I have, work very well. With this stay I once turned a rifle ramrod for a friend, 3ft. long, ⅜in. diam. Fig. 2 is what I use in cutting spirals in wood or ivory, with a revolving cutter driven from overhead. The upright is the same as Fig. 1; but in place of the frame and dies I simply put a piece of hard wood like D; this is sufficient support when using a revolving cutter as tool, but would not do in turning iron. Fig. 3 is the one I use when hand-turning in wood; for instance, for balusters or towel-rails. E is an ordinary tee-rest socket, which is bolted to lathe-bed under the middle of work. F can be adjusted vertically, and G slides through it horizontally, and the work is supported in the notch at the end. At the other end of G is a coned hole, and you may have a number of these holes of different sizes if G is made long enough. These are used for supporting the ends of rods while being bored. G is clamped in desired position by the capstan screw at top. Fig. 4 is used for supporting one end of work while the other end is secured in a chuck on mandrel. For instance, in cutting a screw inside the end of the box of a carriage-wheel, or as a temporary bearing to run the mandrel of a friend's lathe in while fitting a chuck to it. H is an iron casting which is bolted across the lathe-bed with the side H next the mandrel, it can be set true by a carpenter's square laid across the bed. I is a rectangular piece of well-seasoned mahogany nicely planed up, and fastened to the uprights with two bolts which pass through vertical slots, and so can be adjusted for height. In I a central hole is turned, either coned or plain, to fit whatever job is in hand. This, of course, can be made of metal, but I find mahogany answers admirably. These four stays I have found to do their work remarkably well, though there may be other patterns as good or better.

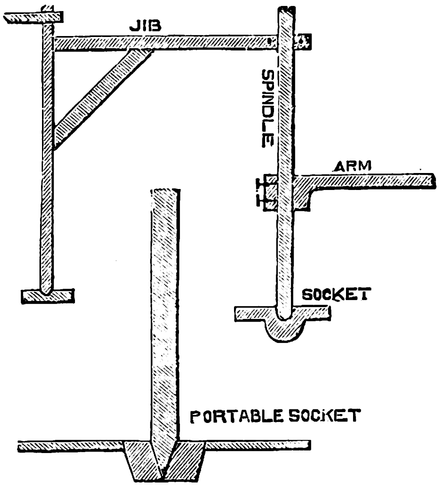
F. W. G.

IRON MOULDING.

[19977.]—I shall try, with the indulgence of my fellow-workmen, to place something before them which will sometimes prove useful. I shall speak on the different branches of loam, green-sand, and dry-sand moulding; show the different modes, and what I consider the proper one. Loam-moulding is considered the higher grade, and comes into use where there are large and heavy castings required, such as the cylinders, condensers, &c., of land and marine engines, turbines, &c.

Where they are wanted sound and free from dirt a full pattern is never required, as in sand moulding. To be a thorough loam moulder, a knowledge of geometry, and able to read a drawing, are very essential. In dry and green sand moulding the operation is much the same. In each case you require a pattern of the casting that is to be made. The difference consists in coating the dry sand mould with blackwash, and having the damp extracted in a stove or oven. Green sand moulding is handy and cheap, and does well enough for the general run of castings. In well-conducted shops there is hardly a limit to the difficult and heavy castings that can be made in green sand. I will take into consideration first the branch of loam in all its workings. The most essential tools required in a loam-shop to commence with are a spindle about 2in. in diameter and 8ft. long, some more and less. It requires to be turned true, and about 9in. at one end to be tapered or cone-shaped. Some require only to be rounded at one end.

A socket or cross (as it is generally called) is required for spindle to work in. To make a cross, a large centre or boss is rammed in what is called open sand with three or four arms (see figure).



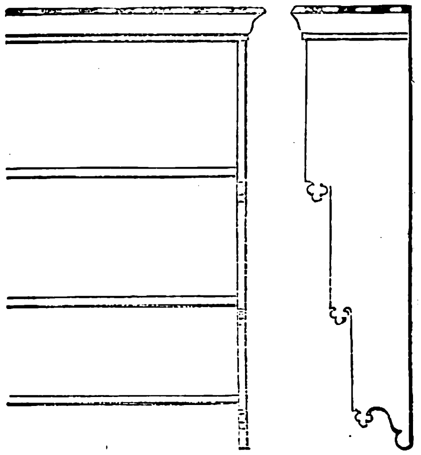
The tapered end of spindle is coated with oil and blacking or tar, placed upright in centre of mould, and then metal poured in. After the casting has cooled the spindle will come freely out, when, after being oiled and replaced in socket, will work better than had the socket been drilled out in a lathe, as is sometimes done. In some shops, where convenient, stays or jibs are placed against the side-walls with pedestal attached to steady and keep plumb the spindle. In such a spindle the socket will do 1in. deep, and will make the truest job. The deep socket is portable, and can be wrought with anywhere, and almost at any job, provided care be taken when setting the loam-board. To complete the tackle, an arm is required, to move up or down the spindle, with screws attached (as shown in figure), to fasten where necessary. When starting to a job, a good strong plate is required to build it on, all of which will be afterwards explained. Then come the loam-boards, or skeleton patterns, according to the different kind of jobs. The subject for my next letter will be screw-propellers, showing the different ideas and ways of moulding them.

Foundry.

(*To be continued.*)

HOW TO MAKE A CHEAP AND ORNAMENTAL BOOK-CASE.

[19978.]—As no one has answered the last letter of "Beta's" (19854), I venture to reply by sending an original design for bookcase, the sides of which can easily be cut by fret-saw or bow-saw, and smoothed up by file. The shelves are chamfered, and come within a ¼in. from the front, are grooved into the sides. The cornice is indented as shown.

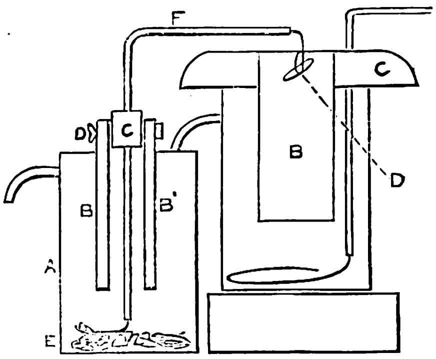


It may be made of pine, and stained with oak stain, or pitch-pine got up clean and polished, with parts of it ebonised if preferred.

Vega.

HIGGINS' CASCADE BICHROMATE BATTERY.

[19979.]—Many users of batteries must have regretted the waste which ensues from the necessity of discarding zinc plates before completely worn away, and bichromate solution when only partially spent. Mr. Higgins has constructed a battery wherein these waste materials are utilised, and wherein the mercury used for the amalgamation of the plates is recovered. A is a stoneware jar of about a quart capacity, and provided with a spout near the top; B and B′ are carbon plates, supported by the wood block C, and secured thereto, and placed in electrical communica-



tion with one another, by means of the binding-screw D; E is a mass of fragments of old zinc plates mixed with mercury; F is a guttapercha coated copper wire, bared and bent into a ring at the bottom end. It serves to make contact between the negative element of one cell and the positive of the next. The cells are placed in a row, one above another, as shown in the sketch, and above the highest is placed a reservoir of bichromate solution, below the lowest an empty reservoir. When in action, bichromate solution flows in a constant stream from the reservoir into the first cell, from that into the second, and so to the empty reservoir, whence the name of cascade battery. A single cell is stated to have, when used with new solution, an electromotive force of 1·9 to 2·0 volts, with a resistance of 1-10th ohm. The current is said to be very constant, even when the battery is worked for hours together. The bichromate solution may be passed until the colour changes. The necessity of adding fresh zinc is indicated by the formation of a red insoluble salt of mercury. It is stated that this battery costs 2¼d. per cell per day, and that 32,000 ft.-lb. of work cost 1s. 6d. The battery was exhibited in action before the Society of Telegraph Engineers the other day, and the account of its capabilities, when published in the Society's *Journal*, will be read with interest by those concerned in the question of economy in batteries. **Alfred W. Soward.**

ORNAMENTAL SLIDE-RESTS.

[19980.]—With regard to 19952, no doubt an eccentric lathe and drill can be adapted to "F. W. G.'s" slide-rest, but my objection referred to its not being well fitted to receive the ordinary cutters, &c., in use. For my own part I prefer a slide-rest which does not require such a special tool. So also with regard to the screw ferrule, which makes one independent as to the level of the cutting part of any tool. Like "F. W. G.," I make most of my own tools, but so various are they, made occasionally for the nonce, that it would be an intolerable nuisance to have to make them all accurately to one level.

As to the backlash, if "F.W. G.'s" plan stands the test of long wear and does not cause stiffness in working the leading screw, it is at least as good as mine, but I have the advantage of the easier working of the square threaded screw. I can screw up my divided nut without taking any of the slide-rest to pieces.

When, however, "F. W. G." proceeds to explain the modus operandi, then I prefer my theory to his explanation. However the screw is made, if backlash ensues in the course of wear, I fail to see how his clamping adjustment can act on the principle of a wedge. It may tighten the screw against the nut after some fashion, but I should think that backlash must soon ensue again.

The suggestion I gave as to drilling and tapping the nut before sawing it in two was a practical one. The first nut I experimented upon was not tapped before it was divided, and to this I attributed the imperfect working of the four screws. In the next nut I bored each of the four holes with two drills, and tapping the smaller interior holes, procured perfect action of the screws after the nut was sawn subsequently. With regard to this method of curing backlash, it is a very simple and obvious one, and I do not take any credit to myself for devising it when the requirement arose; but so far from "evidently quoting from Mr. Evans' article," I mentioned the plan to that gentleman a year ago, though I daresay it was no novelty to him.

As to "F. W. G.'s" question, I really can see no difficulty in the case. Supposing I had drilled and tapped the four screw-holes throughout, which, I suppose, is the dilemma, I should simply have had to cut away the thread half through with a larger drill. I did not care to occupy your space with such minutiæ, thinking that if a man had the skill to repair a slide-rest after my fashion, he would have the wit to work out such details.

M. A.

LATHES AND LATHE-MAKING.

[19981.]—In answer to "Tinker" (letter 19951), as to giving the dimensions of the different chucks and tools, they must be proportioned to each separate lathe. For instance, mine, though only a 5½in. centre, has the mandrel-collar against which the chucks bed 2in. diameter, and the nose screw 1¼in. There is also a boss, 3in. diameter, cast on front of headstock around mandrel, so that the ring of the oval chuck has to be rather large to go outside all, and the dimensions of it would probably be no use to anyone else.

In making any apparatus I always first make a working drawing full size, then wooden patterns of all parts requiring to be cast or forged, leaving them ⅛in. too large to allow for trueing up. From these patterns the castings and forgings are made, and anyone who follows my example can, by careful measurements, easily proportion their patterns to suit their own lathe. With respect to "Tinker's" plan of cutting a worm-wheel, I do not think an ordinary Whitworth pattern tap makes a good hub. In the first place the hub, and, of course, the tangent screw, requires to have the threads cut deeper and sharper than ordinary screw-threads—that is, if you want them to last well; and they should be cut with a single point tool of a smaller angle than 55°. Next, the straight flutes in a tap are not so well suited as spiral ones to give a good lead, as, during the passage of the flute there is no part of the tap touching the wheel unless the semicircular groove is pretty large, and if the flute is of any considerable width, the teeth of wheel might suffer damage through its revolution being slightly checked. I think it is of great importance that the teeth should be equally spaced if you want to have a close fit between wheel and tangent screw, instead of distributing any error over the whole number, as the milling wheel does. With regard to the dimensions of my combined eccentric cutter and drill, the front part B, Fig. 1, is 2¾in. diameter, the part of head which revolves is 1¼in. long, and the hole through it for spindle ⅝in. diameter, and the stem ⅝in. square. **F. W. G.**

DIVISION-PLATE FOR LATHE. — TO "J. K. P." AND OTHERS.

[19982.]—All lathe amateurs who read this journal must be delighted to see "J. K. P." back again. I know I am. I remember the old days from about Vol. X. to, I think, XIV. or XV. We used to get some real lathe articles and letters then. Just to keep his hand in, and to help an admirer a little, will "J. K. P." kindly consider the following?—I have a very nice little back-geared lathe to which I wish to fit division-plate. I shall have to fix plate to left-hand side of smallest speed-cone, left-hand end of mandrel. The largest plate I can get in will be 5¼in. in diameter; but I think the plate can be made thick enough to take two or three rows of holes on its rim; and to prevent crowding many rows of holes all on one side, I have an idea of placing half the rows on one side, and the remaining half on other side of division-plate. The arrangement of head stock will allow of this. Will "J. K. P.," and other lathe correspondents, think this over and kindly advise me how many rows of holes, and how many holes in each will be best, assuming the plate to be 5¼in. diameter, and three rows of holes to go on rim.

Division-Plate.

ELECTRIC LIGHT DANGERS.

[19983.]—There is some misunderstanding current upon this subject, which, I observe, is being made the basis of some little puffing and quackery. Among the reports as to the new lighting experiment of Edison's apparatus at Holborn, it is stated that, notwithstanding the magnitude of the machine and its great power, there is no danger from it. To prove this, the exhibitor is said to have taken the whole current through his body. Now, this statement is mere quackery, meant to humbug the observers. I should not have troubled to notice it if it had been stated only in the daily press, whose nonsense about these matters is too constant to be worth attention; but when the statement finds its way into "Scientific News," p. 149, it is time to explain the fallacy. If the whole current given by that dynamo were to pass through any human body, it would simply destroy life. It is quite safe for any man to lay hold of the conductors, for this reason, *that the current will not pass into the body.* That big dynamo would send no more current into the body than one of the medical batteries of 60 Leclanché cells.

That is where the humbug comes in very neatly, and leads reporters who are not up to the trick to state that the exhibitor, by way of showing the safety, passed the whole current through his body, when he simply laid hold of the two wires. Now, had he tried to do so by putting himself in the circuit between the machine and the lamps, the trick would have been at once exposed, as the lights would be instantly extinguished. The conditions would have been 120 / 8,000 = ·015 ampère instead of 1,000. If the exhibitor merely added himself in multiple arc to the lamps, even a smaller current would go through his body, and my ·015 is much too great, as it takes no account of the diminished E.M.F. of the machine.

The fact is that danger to life exists only with machines of high electromotive force, which are not used in any case with incandescent lights. The serious danger is in connection with the Jablochkoff candles, where alternating currents are employed, and the violent shocks incidental to these are brought into play in addition to the mere passage of current. **Sigma.**

NOTES ON DYNAMO-MACHINES.

[19984.]—1. Two closed coils, in which currents are flowing in the same direction, attract each other. Two coils in which currents flow in opposite directions, repel each other.

2. If a current is flowing in one coil and another be brought near it, a current will be induced in the latter, and will flow in a direction tending to oppose the motion, i.e., in a direction opposed to the direction of the current in the first coil. If the second coil be withdrawn, the current will flow in the same direction in the second coil as in the first.

3. The marked pole of a magnet behaves like a coil, in which the current flows in a direction opposed to the direction of the hands of a watch. An unmarked pole behaves like a current flowing in the direction of the hands of a watch.

4. Hence, if lines of force from a N. pole be added during the motion of the coil, the current will flow (looking on the side of the coil next the magnet) in a direction opposite to the hands of a watch, and if lines of force from a N. pole be subtracted during the motion, a current will flow in the direction of the hands of a watch. Let us call lines of force from a N. pole N. lines of force, and lines from a S. pole S. lines of force.

5. The induced current always flows in a direction such as tends to oppose the motion. If iron is placed in the coil the current tends to oppose the induced magnetism—that is to say, if by bringing the end of an iron bar, on which a coil is wound rapidly towards a marked pole, we make the end next the magnet a S. pole, the current flows in a direction which tends to make that end a N. pole.

6. Placing iron in the coil does not increase the number of lines of force, but renders the field more intense in the vicinity of the iron by bringing lines of force inside the coil, which otherwise would have passed outside it.

7. Adding N. lines of force on one side of a coil, and subtracting N. lines of force on the other side of the same coil, generates currents in the coil in similar directions. Adding N. lines on one side, and S. lines on the other side generates currents in the same direction. Adding N. lines on one side of the coil gives the same result as subtracting S. lines on the same side.

8. The E.M.F., in any coil in which a current is induced, is proportional to the rate of adding or subtracting lines of force; and the E.M.F. is at a maximum when the lines of force are being added or subtracted with the greatest rapidity.

9. For the same weight of wire on the field magnets, the strength of field is nearly proportional to the square root of the resistance, if current is constant and iron cores large enough to prevent saturation.

10. The E.M.F. of the machine, if the field remains the same, is proportional to the number of coils in the armature connected in series. Coupling the coils up in parallel circuit does not increase the E.M.F., but diminishes the internal resistance.

11. As a general rule, the efficiency of dynamo-machines is highest when the external resistance is double the internal resistance. The following gives the internal resistance of various machines:—

	Armature. Ohms.	F. Magnets. Ohms.	Total Ohms.
Bürgin (3-arc lights)	1·6	1·2	2·8
"A" Gramme......	·35	·64	·99
Siemens (Medium) .	—	—	·75
Brush (16-lighter)..	5·0	6 0	11·0

12. In the Siemens and Weston machines, the armature is a hollow wrought-iron cylinder on which the wire is wound from end to end along the outside of the cylinder only. The hollow cylinder is clasped by the poles of the electro-magnets. In the Gramme and Maxim machines, the armature is a ring; in the former constructed of soft-iron wire, in the latter of a series of fluted discs laid together. The surface of the ring inside and outside is covered with copper wire, all the coils being coupled up in series. The greatest dimension of the cross section of the rings lies parallel to the axle. The Bürgin machine armature consists of eight hexagonal rings formed of soft-iron wire, and wound somewhat like the Gramme armature. The armature of the Brush machine consists of a cast-iron ring, with eight coils coupled up in pairs, and so arranged that the pairs are thrown out of circuit in succession. Three pairs of coils are always in the circuit, two being connected through the commutator in multiple arc. The Schuckert machine has a ring armature somewhat like the Gramme, but formed of a series of wrought-iron discs insulated from one another. The greatest dimension of the cross section of the ring lies perpendicularly to the axle; the coils or sections are all connected in series.

13. The shunt dynamo gives a far steadier current under varying resistances than the ordinary dynamo. This at once constitutes its advantage and defect, for the current, although very steady, cannot be increased to any great extent.

14. To produce a field which is less likely to vary with every slight change in the current, cast iron has been employed for the cores of the field-magnets. Although, weight for weight, the current obtained with cast-iron cores is not so great as with wrought-iron, the current is much steadier under a varying resistance. **E.**

DYNAMO MACHINES.

[19985.]—I am sorry to say I cannot give "H." (letter 19929) all the particulars he requires, as I have not yet constructed my machine. I only put it forth as an idea, and certainly did not expect to get into such a hornet's nest. My position reminds me of that of the "Light Brigade"—"Cannon to right of them, cannon to left of them, cannon in front of them," &c.

I should have liked to have replied at length to "E.," "Humble Bee," "Sigma," and "LL.B.A.," but have not time to do so. "E." (19895) says nothing worth notice. "Humble Bee's" letter contains some useful information, together with the very absurd statement that a current can be induced in a conductor moving in one direction, in a magnetic field of uniform intensity. It is something to know this, for we need not run our armatures at all now this wonderful principle is brought to light. If only the above conditions are fulfilled, the magnetic state of the armature will never change, and if it will give current without any such change of magnetism, we may let the armature stand at rest, and get just as strong a current as when it revolves.

"Sigma" very rightly says just the reverse, that "the secret of getting current out of magnetism is to make the greatest changes possible." I must confess after having read "Sigma's" letter that I partly forgot this principle while designing my machine, and only aimed at making a variation in the intensity of the field during the entire revolution, in which at least I succeeded. Both "Sigma" and "Humble Bee" question whether I know if the opposing poles of the Brush field-magnets are similar. Where they got the idea that I did not, I cannot think. If on one side of the ring we place a N. pole and on the other a S. pole, it is very evident that the currents induced in the wire on opposite sides of the ring will be in opposite directions, and will neutralise each other.

I fully appreciate the kindly spirit in which "LL.B.A." criticises my unlucky machine, which suppose is a failure as it stands; but I am still going on with the subject, and hope to produce something which will not meet so hard a fate. I see several correspondents inquiring for a good, cheap, simple electro-motor. I have designed and constructed one which is likely to suit them, and will describe it shortly.

In conclusion, there is one good result which follows my describing my ideal dynamo. If the machine itself is of no use, the letters which its defects have provoked are. **Conrad.**

THORNBERRY'S (?) TELEPHONE RECEIVER.

[19986.]—The telephone-receiver, a description of which is quoted by you (p. 145) from the *Scientific American*, and which is stated by that paper to be the invention of Mr. H. S. Thornberry, is not altogether novel, as will appear from the following extract from a letter by Prof. G. Johnstone Stoney in *Nature* of Nov. 28, 1878:—

"A steel spiral . . . . was placed inside a coil of copper wire in circuit with a battery and the line. The spiral . . . . was fixed at one end, and kept tightly stretched by a string connecting its other end to a drum-head. In this arrangement no current passes through the spiral, but it is the core of an electro-magnet, and becomes magnetised in a degree which changes with the alterations in the intensity of the line-current. This causes the spires to attract one another with varying intensity, and the tremulous motion so produced is propagated by the string to the parchment. By this arrangement singing, whistling, &c., were heard when a Reiss transmitter was used. Probably a soft iron coil would have been better than the steel spring I used, and the apparatus is susceptible of other obvious improvements which would add to its sensitiveness."

Alfred W. Soward.

THE NEW TELEPHONE RECEIVER.

[19987.]—On page 145, No. 7, Vol. XXXV., you gave us a description of a *new* telephone receiver—another American invention.

I beg to inform you that the spiral core I invented and used in November, 1880; it was surrounded by a coil in precisely the same manner as the engraving shows it. Another modification of it: I used three coils, one connected to a few cells to magnetise the spiral, and the other two to receive the induced, or the current from the microphone direct. I also connected the two coils to the cells, and the centre coil to line. Again, I dispensed with the coils altogether, and passed the current through the spiral core, which I tried in copper, iron, steel, platinum: once more, I used a strained wire in place of spiral, with fair results. None of the experiments were so good as with a Bell telephone, whether through my unwilling attendant or not I cannot say. Not being satisfied, I placed them aside, where they still remain. I have not sent this as a boast or claim, but to show how it is possible for two men to invent the same thing, separated by thousands of miles.

George Tolman.

SEEING BY ELECTRICITY.

[19988.]—"W. L." (letter 19941, p. 151) is not quite right in supposing that no method has been suggested for forming an image in light and shade at the receiving station of the telectroscope. Professors Ayrton and Perry have devised a means of doing so. They say (*Nature*, April 22, 1880):—"Our receiver at the distant station was, in our original plan, a collection of magnetic needles, the position of each of which . . . . was controlled by the electric current passing through the particular telegraph wire with which it was connected. Each magnet, by its movement, closed or opened an aperture through which light passed to illuminate the back of a small square of frosted glass. There were, of course, as many of these illuminated squares as of selenium squares, and it is quite evident that since the illumination of each square depends on the strength of the current in its circuit, and this current depends on the illumination of the selenium at the other end of the wire, the image of a distant object would in this way be transmitted as a mosaic of electricity." The plan was a suggestion merely.

Alfred W. Soward.

ETHOXO-HYDROGEN LIMELIGHT.

[19989.]—In answer to Mr. Broughton's letter, No. 19900 in your issue of April 7th, in which he leads our readers to suppose that I have copied his apparatus, and that I am suffering from an explosion caused by limelight apparatus; now, as regards the latter, I was busy at work in my upper workshop, when an explosion occurred behind me, tearing up the floors, &c., and injuring myself, but not in the least damaging the work upon which I was engaged—viz., finishing off an ether generator ready to send away the following morning. In answer to the first part, I frankly acknowledge Mr. Broughton to have been the first to introduce the use of ether vapour instead of hydrogen gas from a bag under pressure; but, at the same time, allow me to assure him that I was not aware of the fact until last January, when a friend of mine lent me the *British Journal of Photography* of February 25th, 1881, containing a full description of his automatic limelight apparatus; but, had I seen the account of it before, I should not have been tempted to copy so complicated an affair as that. Since I made my first mixed jet (now about 12 years ago), it has been my study to improve the oxy-hydrogen apparatus: (1) by doing away with all superfluous accessories, and, if possible, to make it perfectly safe to anyone using it with ordinary care. I soon found the mixing chamber of the jet, packed with 30 thicknesses of fine gauze wire placed one-sixteenth of an inch apart, was useless for safety, as the flame would pass back through the whole without being extinguished. (2) That by placing both gas-bags in one pair of pressure boards, and using from 1½cwt. to 3cwt. pressure, according to the size disc required, and with the plain mixed jet—*i.e.*, the O and H tube joining as close as possible to the point of igniting without packing—there is not the least danger; in fact, the flame itself can only burn at its greatest brilliancy when the gases are properly mixed, and the taps themselves are the parts to regulate. Again, I have more often than not used bags of different sizes—viz., hydrogen bag 36in. by 30in. by 24in., and oxygen 36in. by 24in. by 24in., and have never once had the least mishap. I tried spirit vapour in lieu of pure hydrogen by passing a stream of oxygen under pressure through a generator containing cotton wool, lamp cotton, &c., &c., saturated with spirits; also the wash-bottle principle, as described by Mr. Broughton; but these I discarded as worthless, as I found the oxygen did not take up sufficient vapour to render it impossible for the flame to light back, for on turning off the hydrogen tap, or even in dissolving the gas remaining in, the tubes would explode with a nasty snap, and sometimes blow off the indiarubber tubes, but nothing more serious. It was not until last December that I was able to overcome these difficulties, and to offer a most safe, simple, and inexpensive generator to the public. I have used it with Chadwick's Oxygen Generator, both with the blow-through and mixed jet, using my usual 6-way dissolving tap, regulating the hydrogen flame with the by-pass to the lantern not in use, always with the greatest of success and superior results, to that obtained by the ordinary hydrogen. For public exhibitions I should prefer using a gasbag, especially if the disc required was from 20ft. to 30ft. in diameter; for that purpose a bag of oxygen 36in. by 30in. by 24in., and with 3cwt. pressure, would contain ample oxygen for a biunial or triple lantern for an exhibition of two hours. Mr. Broughton speaks of safety-valves; allow me to inform him that a townsman of his, Mr. Chadwick, has made a valve which he says he has tried under severe tests without lighting back, which I firmly believe; although by using my simple generator and jet, I defy any person to cause my generator to explode through any way it may be used for the oxyhydrogen light, and not using any more care than any ordinary gas-burner would require, and unless wilfully done. Any of your readers requiring information regarding the ether-hydrogen light, I shall be most pleased to give it to them.

Fredk. Fisher.

RAILWAY BRAKES.

[19990.]—I can confirm, from personal experience, the statement made by "C. E. S." this week, in letter 19962, with reference to small ejectors using a very large quantity of steam, and seriously detracting from the steaming powers of locomotives. From my experience, I estimate that the ejectors use about 2lb. of coal per mile. Now, Sir, I should be very much obliged if any of your correspondents could tell me the amount of steam required to actuate a pump to perform the same work, because I believe that a pump would be better and cheaper. I was much interested to notice that there exists a Westinghouse automatic *vacuum* brake. Will some reader furnish me with the details of this brake? It is satisfactory to find that the railway companies are fitting a large proportion of rolling stock with brakes which at least *appear* to be efficient. But I shall be glad to know the opinion of your readers with regard to the vacuum brake now used on the Midland. Is the statement correct that it cannot be applied to engines and tenders, and that the power leaks away in two minutes? If so, does it fulfil the Board of Trade conditions?

A Railway Servant.

Erratum.—Observations of Known Double Stars.—In letter 19937 there is a mistake I wish to correct in my observations. For ρ Cancri put ζ Cancri.—W. H. Gage, Eastbourne, April 29.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[45892.]—**Calorific Intensity (U.Q.)**—Errata.—Page 133, col. 2, line 25, for "(3·14 × 1·29)," read "3·14 + 1·29"; line 48, for "1,000 / 15·96," read "12,000 / 15·96; in formula at bottom of col., "*c*," read "*c*."—Alfred W. Soward.

[45923.]—**Brazing Bicycle Forks.**—To make a good job of this you want to be very careful, and if you know nothing about brazing, there is no doubt that you will make a mess of it the first trial; but practice makes perfect. Now, if you have a forge, take and clean and fit the joints, and drill a small hole in fork near the end of shank, towards the inside. This will allow the brass to run round the end of shank and make a solid joint, instead of a good many joints that we get with our machines; just the butted crevice filled with brass instead of a good solid joint, which ought to be where the strength is wanted. Now, considering that the fork will expand from the shank when placed in the forge, and get loose, you had better put a small pin through both, so as to keep steady while brazed. You will have to damp with water and put some powder borax in joint, place the joint together, and put pin through. Now place in a clear fire, but don't blow until you think the shank is as hot as the fork, as the fork will soon burn, being so thin. When hot, place some small pieces of sheet brass or spelter on the butted crevice, and the small hole that I have mentioned above. Now start blowing steadily, and keep adding a little borax, and keep the forge shovel over the joint, so as to beat the flames on to spelter. This will make a good strong joint if done right.—Jumbo.

[46069.]—**Automatic Arrangement.**—I know no reason why the arrangement described by "S. W. M." should not work well; the divisions would, of course, all be of one width; depth, of course, would be immaterial. I should prefer a continuous motion to the drum, and in fact the drum could have a pointer and a dial outside its circumference, so that the drum would, at the same time, indicate the time for the three hours during which it would work.—W. J. Lancaster.

[46221.]—**Clock and Watch Trains.**—There is a most excellent manual or handbook for clock and watchmakers, by Mr. F. J. Britten, the well-known secretary of the British Horological Institute, Northampton-square. There are 172 pages, octavo, and amply and indeed well illustrated by drawings of tools, and 'scapements and keyless work for watches, as well as plenty about clocks. There are tables of watch, clock, and marine chronometer trains, and others for various purposes belonging to such work. The book comes down to the latest date, having been published only in January last. It contains the cream of the richest horological milk in Clerkenwell, and that is saying something. No student of the art, whether amateur or otherwise, ought to be without it. It is to be had at the Institute, and is a fitting companion to Nellthrop.—C. S. M.

[46227.]—**Ground Pipeclay.**—In answer to "A Machine Tenter," I may inform him that ground pipeclay has for the past seven months been used by some of the largest calico printers in place of flour, gum, or other expensive substances, for the thickening of colour. It is a splendid article for this purpose, and is ground by a patented process, and sent out in bags as fine as flour. I do not know of any manufacturer except one at Bacup, who supplies all we use, the name of the firm being Preston and Co. As to the quantities used, it varies with the kind of colours or paste required, but if "A Machine Tenter" will state the particular shade and kind of colours, I will give him further information on his inserting a fresh query. The article is not as white as china-clay, but has far superior thickening qualities, and for all kinds of block printing on textile fabrics is an indispensable article and one that is slowly but surely making its way in the printing trade.—Practical Colourmaker.

[46296.]—**Harmonium or Organ.**—In case any of your readers should be misled by the statement of Mr. G. Fryer on p. 157, permit me to say that "any person at all acquainted with the interior construction of the American organ," provided he wanted tubes as shown by "Joiner," on p. 66, would plant them with just the same aspect as that gentleman has done. If the mouths of the tubes had faced the back, the reeds might perhaps have been removed a little more easily—say two or three minutes' quicker for the whole row; but "Joiner" has placed them with their mouths towards the inside for a purpose which evidently has not entered into the imagination of his critic. The reason that no one—save Mr. Fryer—has pointed out this "objection," is simply because it exists only in his imagination; there is no difficulty whatever in removing reeds placed as shown by "Joiner" on p. 66.—Organon.

[46355.] — **Photo. Enlargement.** — To Mr. Lancaster.—You can enlarge splendidly with an ordinary magic-lantern, and your achromatic lens; in place of the front belonging to your friend's magic-lantern, have the quarter plate lens fitted to the lantern; then cover all other parts of the lantern, so that no light can get on to screen beside that which goes through the lens. Now put the negative into the lantern, and on a card, same size as you want to enlarge, carefully focus the image; then put on cap, having sensitive paper on card, or drawn tight on a frame; then expose, afterwards developing as per the instructions sent out with the paper.—W. J. Lancaster.

[46371.]—**Barlow Lens.**—The plano-convex is crown, and the double concave is flint. I described this a fortnight back. The plane surface towards object-glass is the better way to use it.—W. J. Lancaster.

[46377.]— **Electro-motor for Tricycle.**— Nothing of the kind has yet been made to my knowledge. I have been for some time experimenting in this direction, but not with secondary cells. I have a simple form of an ordinary battery that gives ample current. It is the reduction of weight one has to work so much for; but even this will become possible.—W. J. Lancaster.

[46379.] — **Gramme Dynamo - Machines** — You evidently require someone to look after the machines. Too hard pressure of the brushes has nothing to do with it. They should press hard enough to make good contact, and the surfaces should be kept clean. The fire is caused by sparks jumping across from the divisions of the commutator as they come near the brush—*i.e.*, the current won't wait until it reaches the proper place to be taken off. Probably that is due to some faulty joints in the leads, or to driving so fast that more current is produced than is required.—T. P.

[46381.]—**Three-Legged Gravity Escapements.**—To E. H. Nelson.—You may, or may not, be perfectly correct in your statements concerning the above. As regards paragraph 14, I am not prepared to argue the point with you. For the benefit of the querist who addressed himself to me, I sent what was, as I said, an almost literal transcript from Benson's book. The particular paragraph, also all to which numbers are prefixed, are Benson's own. There are, I think, few more reliable authorities upon clockwork than Benson; so I think such a statement would not have been published to the world without proof being at hand. I may say that the book is about seven years old, so, possibly, Benson's ideas have since been improved upon. Should these letters meet his eye, one and all will, I am sure, be benefited by a few words from him in explanation.—Alfojoe.

[46388.]—**Plaster-Blocks.**—Alum will help to make plaster hard, but it also delays the setting. Lime-water prevents it cracking. I think if "Ladle" tries a little sulphuric acid in the water he mixes the plaster with, he may find the best remedy.—Nun. Dor.

[46392.]—**Froth.**—Froth is simply in this case a number of soap-bubbles, produced by air being driven in when agitating the solution, which, being of a slightly viscous nature, forms a more or less durable envelope. Hard water hinders the formation of the froth, simply because it hinders the solution of the soap.—T. P.

[46393.]— **Soap.** — I would suggest that this query could be answered by a few experiments. —T. P.

[46399.]—**Small Quantity Battery.**—As you want one to stand "turning upside-down," I am afraid you will find some difficulty; but, perhaps the lime chromate would be best.—S. E.

[46399.]—**Small Quantity Battery.**—To Mr. Lancaster.—I do not know of a cell that would do what you want, and to have its elements left in the liquid all the while. The bichromate is one of the most easily-worked cells you can have, and it would be an easy matter to so make the cell that the zinc should draw out, and a small valve close over it and keep cell watertight; the rod carrying zinc can also be hinged to fold down on the top of all.—W. J. Lancaster.

[46404.]—**Medical Battery.**—I cannot find any answer to your query in recent numbers, and if not too late I shall be pleased to give you all the directions you require. Insert another query, saying whether you wish to make a medical battery only or a coil and cells.—W. J. Lancaster.

[46413.]—**Bamboo Whistle.**—I would suggest that you copy the flute for position and size of holes, and also for the bore; but bamboo is not a suitable wood.—Nun. Dor.

[46414.]—**Electric Engine.**—Electric engines for driving tricycles may be "coming"; but at present they would involve a considerable weight in themselves, and a heavy load in the shape of battery, the cost of which for zinc and acid would add materially to the "disadvantage" side of the question. For information on carbonic acid engines see Brunel's "Life" (Longmans), and look through the records of the papers read at the Royal Institution by Faraday, in 1823. Sir Isambard started the experiments which were carried on by Mr. Brunel with all the assistance to be gained from constant intercourse with Faraday, and the result was that the carbonic-acid engine was relegated to the limbo of failures as of not sufficient account.—Nun. Dor.

[46414.]—**Electric Engine.**—To Mr. Lancaster.—I am sorry I have been unable to write an answer before, but it has been impossible (much to my regret) for me to keep up my correspondence. The causes are too many to mention, but one was due to falling off my tricycle and sustaining a severe sprain of my right thumb, which has prevented my holding a pen for any lengthened period of time. I found that with the pen holder strapped to my forefinger I could write slowly for an hour; then having a rest, I could go on again, but of course I only wrote what was absolutely necessary, and even now, while I am writing, it is very painful to hold the pen for any length of time, but I cannot longer forego the pleasure of doing what little I can to assist the readers of the Mechanic. As to the motor, I have been unable to continue my experiments, but I hope soon to be able to do so, and I will at once communicate anything worth knowing.—W. J. Lancaster.

[46424.]—**Circular Saw.**—I am much obliged to "Pattern Maker" for his advice in reference to this query, viz., "to send the saw to a saw-fettler's and get him to hammer it." No doubt that would be a good plan; and, of course, a good plan is what I wanted. But as I do not know of any saw-fettler in my neighbourhood, and as, more particularly, the object in asking questions in this journal is to elicit information by which querists may *themselves* do what is wanted, I again ask some practical correspondent to look at my original query (46424, page 44, March 17, 1882), and kindly tell me how to make my saw flat and in good working order without taking it to a saw-fettler or anyone else.—Circular Saw.

[46435.] — **Magnetic Bell Hammers.** — I cannot quite understand the form of bell hammer you have which you call a "wheel-revolving magnetic bell-hammer." Let me know something more about its construction, and I will do my best to advise you correctly.—W. J. Lancaster.

[46452.]—**To "Finem Respice."**—I am obliged to "Finem Respice" for his reference to my quarter view lens, sold at 5s. I need hardly say in the pages of the Mechanic that the lens "Finem Respice" refers to does work as well as lenses costing ten times the money—there are so many of "our" readers who have them, and who have sent to me charming prints and equally charming letters about these lenses. It is always a pleasure to me to put scientific apparatus in the hands of every amateur at the lowest possible cost; there is much more gratification to me in doing this than there would be in charging exorbitant prices.—W. J. Lancaster.

[46457.]—**Battery.**—Half a dozen Fuller's cells ought to do the work you require. You, of course, know their build: if not, I shall be very pleased to give you full instructions for fitting them up, &c.—W. J. Lancaster.

[46472.] — **Magneto-Electric Machine.** — A machine to do the work you want it to do would be past your hand. You can buy a machine that will do it well, but as to making one, that is out of the question. You could not depend upon a small machine to equal a couple of Daniells; better go on quietly with your present cells than bring upon your head a heap of troubles.—W. J. Lancaster.

[46481.]—**Boiler-Pump.**—I am sorry to say that I cannot give "Slocum Podger" any given rule for finding how full the pump is; the only guide, to my knowledge, being the speed and condition of pump. If the pump be running very fast, then the full stroke will not be delivered, as the barrel does not get time to fill. When the water is driven out again, or if any of the valves are not air-tight, the vacuum will be partially destroyed, and consequently the pump will not deliver the full stroke. Being only a "younker," I would like very much to hear from any of the "old hands" if there is any correct way of finding this out.—Was-heil.

[46489.]—**Bicycle Making.**—To "Sunlight." —In reply to your inquiry, my lathe is a 5in. centre, single geared, having only hand-rest. I shall feel grateful for the promised instructions as to making drilling-spindle, and if you could also set me right as to the following, you will confer a further boon. Has front wheel spindle and back wheel cone to be case-hardened before brazing the hubs thereto or after? If the former, will not the heat caused by brazing tend to soften them? and if the latter, will not the heating of spindle and cone for the purpose of hardening melt the brazing?—An Amateur.

[46491.]—**Telescope.**—To Mr Lancaster.— The eye-lens of eyepiece in your telescope is too near to your eye when using the telescope. If you could alter the cap over eye-lens so that the lens might be a good ¾in. away from your eye, then the telescope would work well; generally the cap is a distance above front of eye-lens; then the glare is not apparent.—W. J. Lancaster.

[46492.]—**Horizontal Winding Engines.**— As I have not yet seen this query replied to, perhaps I may be allowed to state my views on the subject. To begin with: for engines of the size given, I would recommend drop valves (called by different names in different parts of the country, such as stamper valves, equilibrium drop valves, &c). With these valves there is less friction than any other; they can be placed closer to the cylinder, and so save long steam-passages. You will require four valves (two at each end of cylinder), one steam, and one exhaust. They are best worked by a lay shaft driven from crank shaft by mitre gearing, and the valve levers worked either by tappets or eccentrics. The reversing is similar to a slide-valve, but easier as a rule. The first cost of an engine with drop-valve is greater than the cost of one with plain slide-valves, but the difference is amply returned by the lessened cost of working.—Labor Omnia Vincit.

[46497.] — **Fortified British Cities.** — The subject mooted by "Antiquary" is an interesting one to all readers, as the existence of such fortified places is instructive as to the condition of this land in early times. No doubt members of the Archæological Society, who have access to all documents relating to this subject, are well up in the matter, and if one of them would condescend to give a little information to the readers of "ours," it would be conferring a boon on many who have not the opportunities they have. I understand Oswestry was anciently a fortified town, had strong walls, and four gates. The gates existed up to 1783: remains of the walls are still to be seen in various places.—Curious.

[46503.]—**Jamming of Tapered Journals.**— Many thanks to "J. J. A.," Liverpool, for his communication; but if he will refer again to p. 31 he will see that it is hardly an answer to my question. What I want to know is what slant to give the sides of a cone (I merely gave the sketch as an example for convenience of reference), in order that it may be theoretically on the point of jamming when fitted into a similar female cone. I am aware that the taper shown is far too "quick" for an actual lathe, but it was necessary in order to get the sketch into the space allotted to it, and at the same time to give my meaning clearly. If "J. J. A., Liverpool," will answer my query in the precise terms of the original, using the same letters, he will be doing me a great favour. Perhaps

"Tubal Kain" or "Sunlight" will give the required information?—GLATTON.

[46517.]—**Preserving Wood Troughs**.—Procure a few sheets of laminated lead and a small quantity of copper tacks; line the troughs with the same, and the desired end will be obtained.—A. MANOCK.

[46518.]—**Cotton Wadding**.—I should imagine the necessary machinery to make a single sheet of wadding would cost several hundred pounds. The cotton, after it has been "ginned" to free it from husk, &c., is passed through the "carding" engine, which delivers it in a thin, wide sheet, or film; and I believe "wadding" is a number of these sheets laid one on the other, and finally gummed on one side. I hoped someone better qualified would answer this. Would anyone remind me of the precise uses of the "slubbing frame" and roving engine?—MURANO.

[46526.]—**Removing Spots from Telescope-Glass**.—Do not attempt to remove the spots yourself, or you will most probably destroy the lens altogether. You might send it to any good optician, who would do it for you without at all damaging the lens. A Darlot lens is generally a good one, and should never be tampered with.—W. J. LANCASTER.

[46531.] — **Yacht - Deck**. — I fully endorse "J. J. A.'s" correction of my reply. I had overlooked the size of 20 tons, and was thinking of one that I was once part happy owner of, and about 12 ton size.—WORKING TOM.

[46537.]—**Miniature Spectroscope**.—To MR LANCASTER.—You had better purchase the five prisms already cemented, then build them in a tube with an adjustable slit at one end and an eyepiece at the other end—by which the slit can be accurately focussed. The prisms are difficult to make, and I would not advise you to attempt them. Canada balsam would not at all answer the purpose.—W. J. LANCASTER.

[46552.]—**Loosening Green Baize**.—The best method for "G." to adopt will be to get a pail of hot water and a sponge. Afterwards damp the green baize for about five minutes, and it will become quite loosened. Then, taking a chisel, scrape off the baize as required, and our querist will find that a very neat and satisfactory finish will be the result.—A. MANOCK.

[46556.]—**Skin-Disease**.—If "A Sufferer" will try the following, I think he will find a benefit. Half lard without salt in it, and half Stockholm tar melted together, and a little rubbed in at night and washed off in the morning.—J. COLLINS.

[46575.]—**Photo-Lenses**.—To MR. LANCASTER.—To begin with, see that the lenses are placed in their cells correctly. Thus, the front lens should have its convex surface outwards, then the back combination should be put into cell as follows: the crossed convex lens should be put into cell with the weakest convex down, the deeper surface being upwards; then a ring of tube ¼in. deep should be put on to lens, and the concave surface of the concavo-convex put down upon the ring, and the counter-cell screwed in its place; and lastly, screw the two cells into the tube, so that the two inside lenses should be 3in. apart. The lens will work then at its best.—W. J. LANCASTER.

[46583.]—**Small-Quantity Battery**.—If a bichromate cell would suit your purpose, make one with a water-tight lid; have the carbon and zinc plates long enough to reach half-way down the cell; then add sufficient solution to be within ¼in. of the plates, and by turning the battery upside down, the action would commence. The lid should be hollow, so that you could pour some melted paraffin to cover the connecting brackets, &c. You cannot have a dry battery at present. Would a small dynamo suit you?—GEORGE TOLMAN.

[46587.]—**Dynamo-Machine**.—Let us know a little of the construction of it, and I will soon set you right.—GEORGE TOLMAN.

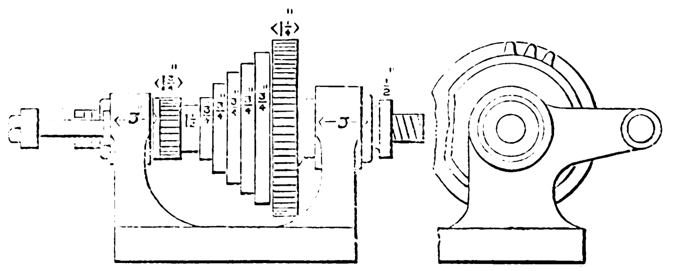
[46594.] — **Heating Water**. — To "LABOR OMNIA VINCIT."—Many thanks for your answer on p. 137. I will explain a little better about the tank if possible. We have 5in. pipes from our boiler carried many hundred feet for heating purposes. About one hundred feet from the boiler my water-tank is fixed and supplied with water independant of the boiler. The water is required boiling all day long, and to feed with cold when any is drawn. We have a cold-water cistern to feed the tank, and all goes on well enough until the water boils back into the cold supply pipe, then it overflows the cistern and tank gets nearly empty. I have heated the water as you see with the steam rushing into it, and as soon as it boils the waste of steam goes on through my air or vent-pipe. The tank is below or under the 5in. pipe the steam is taken from.—JEFF.

[46599.] — **Photographic Portrait-Lens**. — Read my answer 46575, and if your lenses are put together correctly as there described, let me know something more about its construction and size, and I will do what I can to help you.—W. J. LANCASTER.

[46603.]—**Induction-Coil Failure**.—I think the fault is in the cell. If you will have a bichromate battery, then wind your primary to suit it. Two layers of 20 would have been better; as it is, two layers of 16 offers about 0·1 ohm. resistance; this would soon take all the pluck out of the cell. You had better, now the coil is wound, use a 6in. Bunsen or more cells. The varnished paper will do for insulation. Test the secondary again, and place the galvanometer several feet from the coil. Let me know result.—GEORGE TOLMAN.

[46605.] — **Dynamo-Machines Sparking**. — This is sometimes due to a little oil being on commutator, or brush a little behind time.—GEORGE TOLMAN.

[46606.]—**Headstock**.—To "SUNLIGHT."—The time at my disposal is so very limited that the sketch I send you is a very rough one, but it will perhaps give you some idea in conjunction with the description. First let me say that the main casting looks somewhat heavy, but I am strongly opposed to flimsy castings in any tool, and I therefore sketch such proportions as I should use myself. You will note that the mandrel is made with double cones, the back one sliding on a feather and set up with lock-nuts. For a 5in. headstock I should use a thread on the nose 1in. diam. and 8 threads to the inch; let the screw be 1¾in. long, total length of mandrel, 19in, bearings to be 3in. long each. The gears must be according to what patterns you can get, except you buy them ready cast of the correct size and pitch. The gears you had better let me know as to whether you can get patterns or not. There should be the two large wheels, about 7in. diam., 1¼ wide and about ⅜in. or ½in. pitch; the back gear shaft is carried on arms cast in one with the headstock, as shown. The other details will, I fancy, best be got at by your asking me questions, but I would strongly advise you to make a scale drawing before you attempt a start.—SUNLIGHT.



[46607.]—**Fuller's Battery**.—It is not suitable for your purpose, unless your apparatus is made for it.—GEORGE TOLMAN.

[46607.]—**Fuller's Battery**.—I have had large numbers of these at work, and at one time had them in circuit for months at a time. They are a fairly constant form; but the great thing is that they are practically powerless. I had a variety of forms, to arrive at (if possible) the best form; the result being I classified them into two forms—one for the maximum of constancy, and the other for maximum power, the time in action being a secondary point. If the utmost power be wished for a limited time only, say a week or two, then I found a cast-zinc plate in a flat porous cell the best form; if for constancy, then a star-shaped zinc in a No. 5 round porous cell—the carbon element being the same in both cases: viz., a plate of carbon 7in. by 3½in. It is really a double fluid bichromate form. You would require a containing-pot, either flat or round, as the case may be, a porous cell the same, a plate of carbon the size I name, and the plate or "star" of zinc. A sketch of the zinc star will be found in Vol. XXXII. or XXXIII. I think. I write this away from home, or would refer you to the exact page. The carbon needs, however, careful preparation. First melt some paraffin wax, make the carbon plate hot also, and dip it endways into the melted wax for the first 2½in., and thoroughly soak the wax in with heat. When cold, with a Bunsen flame and the blowpipe, drive the wax back from the extreme end for say 1in. towards the centre, so that a band or zone of wax is left in the pores of the carbon, say 1½in. wide. To the top 1in. of the carbon the binding-screw is fixed. I always prefer to electrotype this part with copper. It is a very little trouble, and you then solder the binding-screw on, and get a connection far superior to anything else that can be got. The zinc plate or star must also have its binding-screw fixed to it, preferably either cast in or else soldered on. Now, we place the carbon plate in the containing pot, whether flat or circular, then the porous pot in that, and the zinc element inside the porous jar. The zinc should be just dipped in fairly strong acid and water to clean the surface. To charge the battery, into the porous pot place 1oz. of mercury, and fill up to within an inch of the top with pure water. In the outer pot pour water saturated with bichromate of potash, and then add crystals of same, 2oz.; sulphuric acid, 6oz, and the battery is ready. It will not work for a few hours, as the acid needs to penetrate the porous cell. If the porous pot is too soft the battery gives a good strong current, but does not last. If too hard, is very constant, but does not give the power. The mean is what you want. Exhaustion of the bichromate solution is evinced by its turning purple, whilst the current being found slow, can be remedied by taking out some of the water from the porous pot and replacing with pure water, as it becomes saturated with the salts of zinc. You can use it for almost any electrical purpose, not forgetting that it will not give the current of the Bunsen, and that, therefore, many more cells are requisite to do the same work. I have repeatedly used it for driving induction coils, as it was constant and fumeless.—SUNLIGHT.

[46608.]—**Strength of Battery Current**.—This is alternating (the coil) current. I have not seen anything for testing it.—GEORGE TOLMAN.

[46615.]—**French Express Locomotives**.—A reply to this query appears among the letters.—ED. GOBERT.

[46616.]—**Leclanche Battery**.—Perhaps some of the zincs were amalgamated: that is no detriment; the cells will work.—GEORGE TOLMAN.

[46616.]—**Leclanche Battery**.—Many thanks to "Kappa" and A. W. Soward, for noticing my query. By copper pole, I mean free carbon of battery. My cells are connected thus: zinc of No. 1 with wire from bell-carbon with zinc of No. 2, carbon of No. 2 with zinc of No. 3, carbon of No. 3 with wire to push. The zinc in No. 3 turns quite black, the others remain bright. I obtained the water from a small stream, the sal-ammoniac was sent with cells. I have examined wire to push, and believe insulation to be perfect.—ODDFELLOW.

[46617.]—**Sewer - Gas**.—Stop all the proper openings to the drain, and burn some sulphur in the drain in the lowest position accessible, in an iron vessel into which some burning coal has first been put.—C. S.

[46621.]—**Dynamo Machine**.—I do not like the ring of iron wire unless it is cotton covered, and the ends perfectly insulated. Are the coils all in one direction? Can you test for any leakage between wire and ring? The coils must be insulated from ring. Annealed cast iron is best for ring.—GEORGE TOLMAN.

[46627.]—**Watch Escapement**.—You can examine roller and lever contact in the following way:—Move balance round till tooth drops off pallet on to other pallet, locking face. When that takes place, hold balance still, take hold of lever-tail and try if there be shake: there should be just a little corner shake of lever on pin, so that pin can pass out free, when wheel tooth drops; if it does not, corner of lever wants shortening until there is corner shake of lever. Also when guard-pin is pressed against roller the pin should pass free into lever-notch; if not guard-pin must be brought nearer to roller and banking-pins opened. There are lots of causes of watches setting, i.e., motive force not sufficient, balance-spring not pinned in right, pallets out of angle. It is difficult to tell without seeing your watch.—WORKING BLACKSMITH.

[46634.]—**Fixing Electric Wires**.—1. They are not strained, merely stapled. 2. Candle and blowpipe, rosin, solder, experience. 3. Some bells will ring through half-mile, others fifty yards, according to purpose they are made for.—GEORGE TOLMAN.

[46634.]—**Fixing Electric Wires**.—To "SUNLIGHT."—Thanks for answer; but my query referred to how to strain and fix wires on posts and insulators, or rather to outdoor walls and insulators. Will you, therefore, kindly further answer? Longest distance between insulators about 50 yards. Please also say the nearest distance the copper wires may be to a damp wall so as not to leak.—Meme.

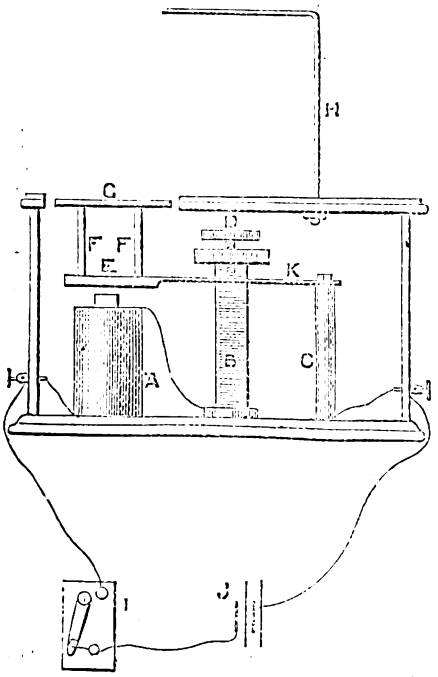
[46635.]—**Fixing Electric Wires.**—(1) Wires for domestic telegraphs or bells do not require any straining up; they should simply be laid along, either under flooring or close to ceilings. As they are insulated and covered in different colours, they may match the general colour of wall-papers, and any straining would certainly injure the insulation. Ordinary bell-staples should be used to keep wires in position, but must not be driven home tight. (2) All joints should be soldered; but in places where this is very inconvenient, the ends should be well cleaned and twisted together, and covered with indiarubber tissue, sold for that purpose. This readily melts, and should be well pressed round joint with wet fingers, so as to exclude the air. (3) The length of wire through which two Léclanche cells would work a bell depends on size of wire used, as the resistance is in proportion to the sectional area. If No. 14 B.W.G. copper wire were used, a mile or mile and a half would not be too long; but for work in a house, No. 18 insulated wire is large enough.—Philolektron.

[46636.]—**American Cloth.**—If "B.'s" table is covered with what is called bright-grain American cloth, and in a warm room, we are not surprised at his papers adhering to it. We would advise that the table be covered with dull grain American cloth, and then washed over two or three times with milk.—A. Manock.

[46637.]—**Mount-Cutting.**—May I supplement my letter upon page 160 by stating that a retired carver and gilder informs me that he resided next door to a mount-cutter for some years, and that his gear consisted of a beech cutting-board, one or two stones for sharpening the knife, and the knife itself was merely a shoemaker's old knife, which was covered with guttapercha, within ½in. of the point, so as to obtain a very short hold of it, with the requisite steadiness of cut, and that having pencilled out the desired oval or square, on the cardboard (by means of trammels and straight edge, &c.), he whipped the knife round with amazing dexterity and celerity to any desired bevel, using his thumb as a fulcrum. Then, taking a thin stip of gold paper, which had been previously prepared with size; drawing this across his mouth, he applied it to the said bevelled edge. J. J. A., Liverpool.

[46640.]—**Electric Dancing Figure.**—What kind of figure? If a light one, the bell-fittings you have would do it, with three cells.—George Tolman.

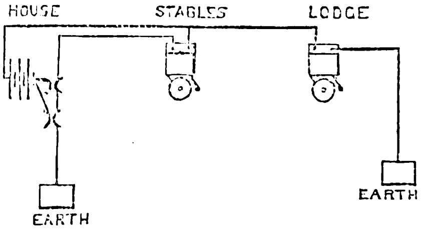
[46640.]—**Electric Dancing or Working Figure.**—The following description is of an electric dancing figure which I have myself constructed and found to work extremely well. I do not think a very long description is needed, as the querist will see from my drawing how to set about constructing it. A is an electro-magnet, horse-shoe shape, wound with about ¾lb. of No. 18 cotton-covered wire. The poles are about 3in. long and the same distance apart, and ½in. diam. B is a brass standard with a thumb-screw, D; C is a brass pillar for supporting the spring K, made of rather stiff steel (clockspring), carrying the round iron plate E, 2in. diam. and ⅜in. thick; FF are two brass rods about ¼in. diam. for supporting the brass plate G, upon which the figure stands; H is a wire for supporting the figure. It should be supported by the wire so that its feet only just touch the brass plate G; I is an ordinary switch, and J is the battery. I have never seen or heard of Mr. Bennett's battery, having only just commenced to take the "E. M.," but my machine would work for two hours at a stretch with a bichromate battery of two elements, 6in. by 2in., just giving the solution a stir up now and then. The whole machine is inclosed in a mahogany case, so that only the figure and binding screws are seen.—Grapho.



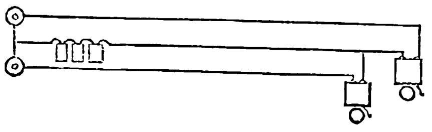
[46641.]—**Electric Bells to Connect.**—You may use one battery to ring any number of bells, provided it is strong enough. You had better run one additional wire from the house to the lodge, and another from the lodge to the stables, joining one of the wires already laid anywhere between the stable-bell and the house. You might use the earth for the return current; but I think the cost of two large copper plates would exceed that of the insulated wire for so short a distance.—Tortoise.

[46641.]—**Electric Bells.**—Your best way is to use one direct wire to either place; then use either an earth connection, or else carry the return wires to the nearest point, and then, by one main wire, to the battery. Or, to put it plainer—You need to carry one wire from the house to stable, and another wire to the lodge. As the lodge is but 200 yards from the stable, I should run the return-wire from the lodge on to the stable's return-wire. You then need only the new length of wire to reach from house to lodge by shortest route, and from thence to stable for the return.—Sunlight.

[46641.]—**Electric Bells to Connect.**—This is a very easy affair. You will have to make earth at house and at lodge-gates. The sketch I send will explain.—George Tolman.



[46641.]—**Electric Bells to Connect.**—You can make use of both your present wires, extending them from the poles of the existing bell to the new bell; but in such case both bells will ring simultaneously. If you wish to ring them separately, you can use your present battery-wire as far as it goes, connecting the new push to one end of it, and the new bell to the other end, so as to include the battery between the connections; but you must run a separate wire from the push to the bell, as shown in the diagram above.—R. T. Lewis.



[46644.]—**Painting.**—There is a kind of paint called flatting, which would probably answer "Cambridgeshire Boy's" purpose, as it has both a dead appearance and takes the varnish well, the same as he speaks of. It is mixed with turpentine instead of oil.—A. Manock.

[46649.]—**Mounting Micro. Lenses.**—There is no standard for the microscope threads used other than the universal thread and gauge for the objectives. These can be obtained at the Micro Society's office, I believe, at King's College. The threads used for the other parts are the usual and various threads used by mathematical instrument-makers, opticians, &c. Now, as to mounting the lenses: The eyepiece lenses are at once the simplest, and the objectives the most difficult lenses to mount possible. For the e.p. it is necessary to turn a shoulder with a rim or, as it is called, a bezzle standing up just high enough to turn over, say, a 1-50in. above the glass. The glass is held in lightly with one finger of the left hand, while the cell is on the lathe; then, by bringing a small steel burnisher to bear with slight pressure against the bezzle, it is pressed neatly over the lens while the lathe is slowly revolving. The left hand finger in use soon feels when the glass is fast. It is essential not to use too much pressure in burnishing, or the glass will break. Also, that the bezzle must be thin, say as thin as notepaper. As to the objectives, the mode I adopt will be explained in the construction of achromatic e.p., which I intend to bring forward as soon as the specula is treated of. I dare say "Micro." will not mind waiting, unless some of "ours" give their procedure. This will be be better. "Micro." may then choose if the modes differ.—Prismatique.

[46654.]—**Storage Battery.**—"Dix-huit" will find Sutton's Storage Battery as easy to make as any. The following is the inventor's description:—"The cell is composed of a sheet of lead cleaned with dilute sulphuric acid, and amalgamated thoroughly with mercury, and a sheet of thin copper a little shorter; the two sheets are perforated with a number of holes, and then rolled in a spiral, separated by rubber bands cut every five inches, the holes in plates and cuts in rubber bands being to allow free circulation of the solution (the short plate being uppermost before rolling). This combination is immersed in a solution of cupric sulphate [to which, in a later paper, Mr. Sutton recommends the addition of one-twelfth of sulphuric acid], and the amalgamated lead plate made the positive electrode of a suitable source of electricity. The chemical action being, the oxygen of the decomposed solution combines with the lead, forming a perfectly even coating of the insoluble peroxide, the hydrogen replacing the copper of the solution, the copper being deposited in the metallic state on the negative electrode. As the decomposition of the cupric sulphate proceeds, it gradually loses its azure blue colour, becoming more acid, and finally, when the whole of the copper is deposited, we have the solution colourless, and transformed into hydric sulphate and water, the positive electrode peroxidised, and copper deposited on negative electrode. During discharge, the peroxide is reduced and the copper element oxidised, the oxide combining with the acid and forming cupric sulphate, the solution returning to its original colour. This change of colour forms a beautiful means of telling when the cell is charged." The strip of lead may be about 4in. wide by 30in. long, and the copper the same width, but about 6in. shorter. One or two Bunsens may be used to charge the battery.—Alfred W. Soward.

[46655.]—**Astatic Galvanometer.**—The needles must be as near astatic (i.e., of equal power) as possible without completely overcoming the directive action of the earth upon the system, so that, when no current passes, the index will remain at zero.—J. M. Stocks.

[46655.]—**Astatic Galvanometer.**—Both statements are correct. The needles being equal in power a perfect astatic system would result, moving with infinitesimal action. But there must be some resistance to bring the indicator to zero, and it is convenient to leave one needle rather more powerful than the other.—Sigma.

[46655.]—**Astatic Needles.**—When the needles are equal in strength, and their magnetic axes are in the same vertical plane, the system will be perfectly astatic, and will set in the direction determined by the torsion of the suspending fibre. When the needles are equal in strength, but their magnetic axes are not in the same vertical plane, the system will set at right angles to the magnetic meridian. When the needles are of unequal strength, the system will set *in* the magnetic meridian. In constructing a galvanometer, it is generally sufficient to make the needles approximately equal; but where very great delicacy is required, they should be exactly equal. Owing to the practical impossibility of fixing the needles in the same vertical plane, they will always point either north and south, or east and west.—Alfred W. Soward.

[46655.]—**Astatic Galvanometer.**—Quite so. As far as practicable the needles should be of equal power, so that one would balance the other in relation to the tendency to point north and south. But it is an impossibility, almost, to get the magnetic power the same in both. Hence, one needle is a little more powerful than the other. Therefore the strongest magnet of the two controls the stationary direction. As far as the quotation goes it is correct: that is, that if the one needle is much stronger than the other, there is less oscillation, and after a deflection, a state of rest is again arrived at sooner. But as far as extreme accuracy goes, the more accurately the one magnet balances the other, the more precisely exact is the indication. The question may be thus put: an unmagnetised needle would be not deflectable, therefore, to make it so, we need to give it magnetic power. When this is done, we also find that the property so given it, holds it, as it were, against a force which should tend to deflect it. Therefore, the inherent power must first be overcome before any deflection is obtained. Hence, the astatic form, in which also we have imparted to a needle the magnetic pole-seeking property; by the addition of the second needle we counterbalance, to a very large degree, the previous inherent resistance that it interposes to being deflected by a test current. Therefore, for extreme delicacy, the needles should as far as possible, balance one another; whilst, at the sacrifice of some delicacy, we get a steadier deflection, and a state of rest is sooner arrived at. —SUNLIGHT.

[46657.]—**Turkish Bath.**—Remedy: Pipe C should enter at the bottom at one end, and pipe D should come from out of the top at the other end, also pipe D should be considerably larger than pipe C. Also there should be divisions on the inside of chamber A to prevent the cold air rushing through before thoroughly warmed.—WORKING TOM.

[46657.]—**Turkish Bath.**—If the relative positions of the heater to the bath-room be as shown in sketch, then there is but little wonder. The bath-chamber E must be at a higher level than the heater A B. Then the pipe C should be carried to the lowest joint and coolest part of A B; whilst D should be taken from the top of the heater. Then you also need a valve to allow the hot air to displace the cold air in E at starting, and you would not be troubled with the flow being the wrong way. —SUNLIGHT.

[46657.]—**Turkish Bath.**—The reason why the hot air will not pass into the room seems to be because the two pipes are on the same level. The cold-air pipe should be very much lower than the hot-air pipe. Perhaps the defect may be remedied by bending the end of the cold-air pipe down. If this is not sufficient the hot-air pipe must be removed to the top of the heating-chamber. The hot-supply pipe should on no account dip downwards, as the heated air ascends. If the two pipes are re-fitted so that there is a perfectly direct rise from the mouth of the cold-air pipe to the entrance into the room, there will not be any more trouble. —EAST MEDINA.

[46658.]—**Date-Mark.**—The oldest date-mark known is in the reign of Henry VI. The cycle began in 1438, and the mark is a Lombardic letter. It appeared as an *h* in 1445. The next letter was in 1481, Henry VII., and was a D. The next was in 1498, Henry VIII., when a small Lombardic *b* was used. A good many gaps occurred during that king's time, but not so much as previously, and six "cycles" of the Goldsmith's Company had gone by. It was not until the era of Elizabeth, 1558, that yearly date-marks commenced for continuity. This mark was the black letter, small *a*, inclosed like the Lombardians. The mark for 1796 mentioned by "Alpha" was the Roman capital A inclosed in line. See Chaffers's "Hall Marks."—C. S. M.

[46659.]—**Spongy Platinum.**—Did "G. F." use chloride of sodium instead of chloride of ammonium? Even the ammonium precipitate is slightly soluble, and only requires a slight washing to reduce the fumes given off when heated.—SIGMA.

[46659.]—**Spongy Platinum.**—If you evaporate the solution and ignite the residue, your Pt will be left in the spongy state. In future, prepare the chloride, precipitate, evaporate, ignite, and wash at the finish if necessary.—J. M. STOCKS.

[46659.]—**Spongy Platinum.**—A solution of ammonic chloride produces with platinic chloride a yellow precipitate of ammonic platinic chloride ($2\,NH_4ClPtCl_4$), which is soluble in much water. Hence, "G. F." has redissolved his precipitate on washing; but on evaporating the yellow solution to dryness over a water-bath ammonic platinic chloride will be again obtained, and on heating to redness, by which means ammonia and chlorine are expelled, leaving only spongy platinum.—L. HEAP.

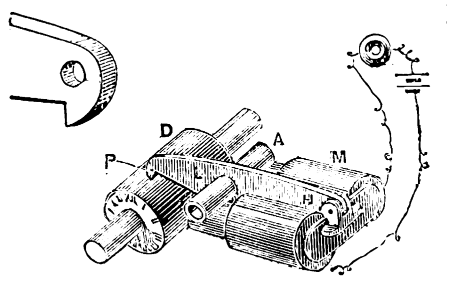
[46659.] — **Spongy Platinum.** — Evaporate your solution of double chloride to dryness, and then ignite the residue at a dull red heat. Be very careful not to raise the temperature higher than is necessary for the decomposition of the double salt, as the lower the temperature at which the decomposition is effected the more spongy is the metal obtained. Assuming that your platinic chloride and ammonic chloride were pure, there was no necessity to wash your precipitate. Certainly you should not have added sufficient wash-water to dissolve it.—ALFRED W. SOWARD.

[46660.]—**Sutton's Secondary Battery.**—Mr. Sutton, in his supplementary paper read before the Royal Society, says that the addition to the solution of culpric sulphate of one-twelfth of sulphuric acid "improves the cell at once." Mr. Stutchbury might try the effect of adding a quarter of a pint of sulphuric acid to his sulphate solution. —ALFRED W. SOWARD.

[46661.]—**Watch-Balance Springs.**—You can get pendulum-springs at almost any price from 2s. a gross to 2s. 6d. each. I use Lutz's springs, at 5s. 6d. per dozen, best quality, and I believe they are generally used. The secret make I have not used. For verge work, I generally make my own. I will give a description of tool if you like.—WORKING BLACKSMITH.

[46661.] —**Watch Balance-Springs.** —The most costly watch balance springs that I know of are from Switzerland, I believe they are called "Hillgren's springs," and the flat ones with overcoil are 2s. 6d. each to the trade. They won the gold medal of the Horological Section of the Society of Arts, Geneva, and are making a high reputation in this country. They are only used for first-class watches, unless by special request. Mr. W. G. Schoof, of the British Horological Institute, Northampton-square, can give every information about them, and is the only person in England though whom they can be obtained. Mr. Schoof has tried these springs extensively, and as he is an experimental horologist as well as a practical watchmaker, his opinion about their merits will be conclusive. I have long thought of testing one or two myself. —C. S. M.

[46662.]—**Electric Tell-Tale Clock.**—A drum carries a strip of paper which is wound upon it. The surface has grooves cut in it, either circular or (if to indicate for more than 12 hours without attention) spiral. In the latter case, one end of axis of drum is cut with a screw of the same pitch as the grooves on the drum, and works in a fixed nut, so that when rotated the drum travels along an axial line at such a rate that the grooves retain the same relative position to a fixed point, such as the indenting point, presently to be described. The drum has the hours engraved at one end, and is made to rotate once in 12 hours. A spring (not shown) holds the cylindrical armature off the face of electro-magnet (*m*) until a current passes, when the lever is drawn down, and the point (*p*) makes a puncture in the paper. The position of this puncture relatively to lines drawn from the figures on end of drum along the paper in direction of drum's length will indicate the time at which current passes. A simple contact spring, such as is used for ringing electric bells, is pushed by the watchman, when making his rounds, and a record is made on the paper. If this is not sufficient please write again.—GLATTON.



[46663.]—**A Street Nuisance.**—Any person collecting a crowd in a public thoroughfare, to the annoyance of the inhabitants or passers-by, is undoubtedly guilty of committing a nuisance, and he can be proceeded against criminally by indictment and civilly by an action for damages. But though this is the law, I am well aware that its application is a troublesome and expensive matter. There is also the remedy under the Police Acts for causing an obstruction in the highway; and the police ought to interfere, but it seems that they refuse. The only advice I can give "Ajax" is to get his neighbours to unite with him in bringing an action for damages against the leaders of that branch of the Salvation Army by which the meetings are organised, and thus raise the question, and I believe they would succeed.—FRED. WETHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall.

[46664.]—**Resistance of Electric Lamps.**—"Nun. Dor" is informed that connecting up lamps in multiple arc does not reduce their resistance, it only reduces the resistance of the total circuit to one fourth of what it would be if joined up in series. The lamps must always remain the same, although the current has one fourth the distance to pass through.—GEORGE TOLMAN.

[46664.]—**Resistance of Electric Lamps.**—Taking the resistance of a Swan lamp as 50 ohms, the resistance of four ranged in series would be 200 ohms, as stated; but if the four are arranged in multiple arc, the resistance will be 12·5 ohms, not for each lamp, but for the four together. There are four pathways open to the current, each as large as the original pathway, and the total resistance of the four lamps is, therefore, just one-fourth of the resistance of the single lamp. If 50 lamps were arranged in multiple arc the total resistance would be one-fiftieth that of a single lamp, that is 1 ohm.—ALFRED W. SOWARD.

[46664.]—**Resistance of Electric Lamps.**—Does not "Nun. Dor." see that the resistance of 12·5 ohms is the resistance of the whole four lamps together—not of each? The resistance of each lamp never changes. When the lamps are joined in series, the current passes through all in succession, and the resistance is quadrupled. When arranged in multiple arc, the current divides and passes equally along all the resistances. The four are, in fact, equal to one of one-fourth the resistance of one lamp. The four carbon loops are equal to one loop of four times the sectional area of one. Hence it is plain that the resistance of 50 lamps in multiple arc would be 50 / 50 ohms = 1 ohm.—W. H. L. H.

[46664.]—**Resistance of Electric Lamps.**—The resistance of each lamp is not altered by any arrangement; but if we give the current four equal paths, of course fourfold current will pass if the source can supply it; and this is expressed as being due to diminished resistance, though it is truly due to increased conducting capacity. When circuits are arranged in multiple arc—that is, as concurrent conductors, the resistance to the current, that is the total resistance of the combined circuits, is diminished in the ratio of their number, while if placed in series it increases in that ratio. But this in no way affects the separate resistances.—SIGMA.

[46664.]—**Resistance of Electric Lamps.**—The resistance of a lamp cannot be changed by changing from series to multiple arc, as "Nun. Dor." presumes, but the total resistance in circuit can thus:—

Let R = Resistance of circuit.
„ r = „ 1 lamp.
„ n = Number of lamps.

Then, if several equal resistances (lamps) are in series, then $R = r \times n$, thus $50 \times 4 = 200$ ohms; or, if several unequal resistances are in series, then R = their sum; thus $100 + 50 = 150$. If several equal resistances are joined in multiple arc, then $R = r / n$, thus $50/4 = 12{\cdot}5$ ohms; or, if several unequal resistances are in multiple arc, then, as the conducting power of a conductor varies as $1 / r$, and the total conducting power is the sum of all the conducting powers, thus:—$1 / 100 + 1/50 = 3 / 100$ is the total conducting power, and the total resistance is $100 / 3 = 33{\cdot}33$. The total resistance of conductors in multiple arc must always be less than the resistance of the conductor of least resistance in circuit. Upon this rests the fact that Holborn is lit by a current which (it is said) cannot traverse the human body.—J. M. STOCKS.

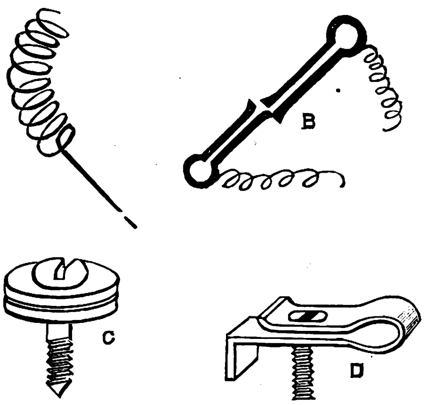
[46664.]—**Resistance of Electric Lamps.**—The resistance of each lamp is a constant. Perhaps an analogous illustration with water would help you. Suppose you have a syringe full of water, and that by applying a given weight to the top of the piston-rod you empty it through a single hole in the bottom in one minute. Now make another hole of the same size. The same weight which was used before will now empty the syringe in half a minute about; that is, the water meets with only half the resistance to its flow which it did before. If three holes are made, the resistance will become ⅓rd of that in the first instance, and so on. Now, each hole offered the same resistance per unit of water passing. Now, it is clear the greater the number of holes the less the total resistance, although each hole offers a fixed resistance to a fixed rate of flow. The syringe must be filled more often than before—i.e., will use a greater quantity of water per minute with a large number of holes; but the weight does not need to be increased to maintain the same rate of flow in each hole. Now, for the syringe substitute a dynamo-machine, let the holes be each replaced by an electric lamp, the weight will become electromotive force, and the quantity of water used per minute by the syringe will be represented by the current flowing from the dynamo-machine. As before, the resistance is diminished, and the capacity for current increased by increasing number of lamps, so that instead of altering construction of dynamo—i.e., putting more weight on piston of syringe, we need only drive it faster. Fifty lamps would together (not singly) offer a resistance = 1-50th of a single one—i.e., 1 ohm, and would require 50 times the amount of current.—GLATTON.

[46665.] — **Discolouration of Paint.** —The question of the discolouration of paint containing zinc-white as a basis, has been investigated by Dr. Phipson; who arrives at the conclusion that the discolouration is due to the presence of an hitherto unnoticed metal, which he calls actinium, whose sulphide has the property of darkening in the light and of regaining its colour in the dark. He states that such paints can be protected from the action of light by thin plates of glass, but this does not seem to agree with "Achromatic's" experience.—ALFRED W. SOWARD.

[46666.]—**Organ.**—American organs, which all work on the suction principle, have swells which are practically identical with the venetian swell of the harmonium. The difference is this: In the A.O. the reeds are exposed to the atmosphere, and each row (or, to be more accurate, each side of the tubeboard) has a swell shutter—that is, there might be two rows, one over the other, when one swell shutter does for both. In the harmonium the reeds are inclosed in the well, and it is the pallets that are boxed up in a chamber fitted with venetian shutters. The effect can be produced by varying the air supply; but all decent American organs are fitted with swells. The fact is, the reeds speak with so little wind that it is difficult to keep at pianissimo by mere regulation of the blowing, for you are liable to get no speech at all from want of wind, so gently must it be done.—Organon.

[46672.]—**Binding Screws.**—"Crux" evidently goes to Bond-street to make his purchases. They are sold elsewhere at from 1s. 6d. per dozen; that is cheap enough.—George Tolman.

[46672.]—**Binding Screws.**—I send sketch of a few substitutes. A is a bit of wire twisted into a spiral and bent as shown. It is held straight while end of wire to be connected is inserted, and on being released tries to resume its former shape. B represents two bits of stiff wire. They are bent as shown, and connected by being slid together—one of the best connections I know for temporary work. C, two brass plates with a wood screw, screwing into woodwork of instrument to which it is attached. The lower plate is soldered to one wire, the other wire being pinched between the two plates. D scarcely needs any explanation. The screw may be dispensed with.—Glatton.



[46672.]—**Substitute for Binding Screws.**—To join two wires without the aid of a binding-screw, proceed thus:—Clean the ends; amalgamate them by aid of a mixture of tallow and mercury spread on chamois leather: bend an inch of the end of one wire back on itself, forming a V-shaped bend; twist the end of the other wire into a small spiral that will fit spring-tight upon the V; dip both into mercury, and press the V into the spiral. In joining up batteries, solder wires to the plates wherever possible, and join these as above, being careful to make all battery wires terminate in V's, and not in spirals, as the former are more easy to clean and re-amalgamate than the latter. Two V-wires may be joined together by a single spiral. Thus, platinum and zinc of a Grove's battery may be held together by an American paper-clip (price one halfpenny.) If the spring is not strong enough to give good contact, press a small wooden wedge between the open jaws, and so force the jaws holding the plates more closely together.—Alfred W. Soward.

[46674.]—**Telephone.**—"Crux" can make an induction coil for 2s. Surely that is not expensive. The use of the coil cuts off a lot of the jarring noise, so the current must be evidently weaker.—George Tolman.

[46674.]—**Telephone.**—The induced current will go through a greater resistance than the simple battery current. The cost of making induction coil need not necessarily be large.—Glatton.

[46675.]—**G.N. Engine, No. 48.**—No. 48 is one of the 8-footers. Cylinders 18 by 28. I will not give more particulars, as your correspondent will find all the dimensions, as well as other particulars, in back volumes (XXVI.-XXVIII.). The engine was built at Doncaster, in 1875, and was in the Abbotts Ripton accident. No. 48 was not at Darlington, the engine sent by the G.N. Co. was No. 47 of a similar class. With regard to query 46612, "N.L. Engines," addressed to me, I wish to state that I have no particulars of either of the newest types of these engines.—Meteor.

[46677.]—**Musical-Box.**—The defect is probably caused by the comb not being screwed down tight. In such a case, the remedy, of course, is simple. The comb being anyways loose, will produce a similar noise as described in the query.—G. Fryer.

[46680.]—**Horizontal Escapement.**—To put in beat, notice three dots on plate near rim of balance, and one on the edge on balance rim. Put bristle from brush in escape-wheel, to keep it from moving, and pin pendulum-spring in so that the dot in balance stands in a line with centre dot on plate.—Working Blacksmith.

[46682.]—**Hydrometers.**—The values of the degree of Baumé's scale for heavy liquids are as follows:—

B.	Sp. Gr.	B.	Sp. Gr.	B.	Sp. Gr.
0 =	1·000	25 =	1·210	50 =	1·532
5 =	1·036	30 =	1·263	55 –	1·618
10 =	1·075	35 =	1·321	60 =	1·714
15 =	1·116	40 =	1·385	65 =	1·823
20 =	1·161	45 =	1·454	70 =	1·946

To convert Baumé's degrees into Twaddell's, find the specific gravity by the above table, subtract 1 from that figure, and divide the remainder by ·005. Thus, a liquid is of the specific gravity of 10 according to Baumé; what is it according to Twaddell? 10° B = 1·075 (where water = 1·000), 1·075 – 1·000 = ·75. ·075 / ·005 = 15 = specific gravity according to Twaddell.—Alfred W. Soward.

[46684.]—**Photo. Background.**—There is no difficulty in obtaining a dead surface with either distemper or oil-colour, the latter being mixed with an excess of turps; but the defect complained of is probably owing to some irregularity of surface reflecting light into the camera. Try the effect of leaning the background forward a little.—W. Robinson, Jun.

[46685.]—**Piston.**—Either the engine has been standing some time, and the piston is rusted fast, or you have run a long time without cleaning it. You must now take out the broken eye-bolt and get another made. Let the cylinder be warm to begin with, and run plenty of petroleum round the piston cover, pouring some in through the bolt holes of cover as well. Let it have time to soak through, and try again, gently tapping the cover with a hand-hammer. If it will not come off this way, then the quickest way will be to take piston out of cylinder whole, and get the cover off by heating it with pieces of hot iron, keeping the block cool at same time by waste dipped in cold water frequently renewed. This last job requires care and judgment, and if you have never had such a job it would be well to get someone to assist you. But any advice I can give I will with pleasure.—Labor Omnia Vincit.

[46686.]—**Organ Reeds.**—It is not to be wondered at that the querist is at his wits' end after interfering with his organ in the way he has. It is impossible for any correspondent to advise with any degree of success in such a case as this, as it is, beyond doubt, one requiring personal inspection by an organ-builder. No person can form any idea of the cause of the defects mentioned in the query, without examining the organ in question. The best advice that can be given through the columns of the "E. M." is that the querist should consult an organ-builder, who will, no doubt, give his advice gratis, if he thinks he is likely to have the job to put it right again, which I must assure the querist will undoubtedly be an exceedingly troublesome one. The querist asks for a few hints on what he terms "the mysterious subject of reed-voicing." As he is evidently ignorant of the difficulty in the art of voicing reeds, he had better scout the idea of attempting it, as it is an art requiring considerable practice and skill. My advice to "Wits' End" is (with regard to voicing reeds), that he had better not attempt it. I can furnish him with a few hints on the subject, but without practice and skill they would be of no practical use to him.—G. Fryer.

[46688.]—**Intensity and Quantity of Current.**—The words "intensity" and "quantity," as applied to a current of electricity, really have the same meaning. Given a certain number of voltaic cells, it will entirely depend upon the resistance of the circuit whether the most intense current (i.e., the current of greatest quantity) would be obtained by joining them up in series, or in multiple arc, or partly in one way, partly in the other. The current is strongest when the cells are so arranged that their combined resistance is equal to that of the remainder of the circuit.—Alfred W. Soward.

[46688.]—**Quantity and Intensity.**—These terms are often confusing. To give you a rough idea, take a Bunsen cell, and try what length of platinum wire it will heat to redness. Connect a couple of such cells in multiple arc; you will find that you cannot heat a much greater length of the wire, simply because it is now as one large cell; but connect the cells in series, and it will heat twice the length, because you have the electromotive force of two powerful cells. Four Leclanché cells in series will not charge an electro-magnet wound with 2½lb. of 16 wire (at least it will only support a few ounces); in multiple arc it will sustain many pounds—now we have the quantity of four weak cells arranged as one large cell.—George Tolman.

[46688.]—**Intensity and Quantity.**—When "intensity" is used now it means the quantity of electricity which flows through a section of the circuit in unit time. The term "strength" is used oftener, and means the same. If the electromotive force of one cell equal E equal 2, and the resistance of one cell equal R equal 3, and the resistance of the external circuit equal r equal 3, and the strength of current equal C, then $C = E/R + r$, and if you join six cells, as you say, for quantity, then $C = E/1\text{-}6\,R + r = {\cdot}571$; or, if you join six cells, as you say, for intensity, then $C = 6\,E/6\,R + r = {\cdot}571$; so that, if there is any difference, they are both alike, and which gives which "B. H." may settle if he can, as he does not say what was meant by "intensity" and "quantity" in his electrical days.—J. M. Stocks.

[46689.]—**Focal Length of Photo. Lenses.**—Yes, the figure referred to on p. 124 should be F / 16 and not F / 14. The principal or solar focus of a lens is the point at which all objects beyond a certain distance are sharply defined. As this distance is lessened the focal point gradually recedes; but except in copying or enlarging, it will seldom happen that this has any material influence upon the length of the exposure.—W. Robinson, Jun.

[46690.]—**Waterproof Cloth.**—Procure sufficient unbleached calico, or still better Drogheda linen, cut to shape and sew into form, give it a coat of size, and, when dry, one or two coats of boiled linseed-oil.—J. J. A., Liverpool.

[46690.]—**Waterproof Cloth.**—A sailor once informed me the only thing he could get waterproof was silk, boiled in linseed oil in which the whites of eggs had been mixed. I could not say the proportion.—Working Tom.

[46691.]—**Retouching Photos.**—"F. C." will find some useful information on re-touching in Vol. XXXI., p. 366, Vol. XXXIII., p. 496. Spots and streaks on negatives may frequently be filled in with pencil; but if not sufficiently opaque, a little black varnish should be used, the resulting white spots and marks on prints being afterwards touched out with colour. Of course this sort of patch-work should not be pushed too far. Better take a fresh negative, if practicable.—W. Robinson, Jun.

[46692.]—**Scotch Bagpipes.**—The usual hideous and monotonous sounds of the bagpipes, with which we are often favoured in our streets, will not present much difficulty in learning; but if "Cosmo" desires to learn to do anything decent with the bagpipes, he will find that it requires some little study and practice. You can obtain suitable music for the bagpipes from G. Butler, Haymarket, London. I have no doubt but that he can supply you with an instruction book also, if you write to him.—G. Fryer.

[46693.]—**Staves.**—I do not see how there can be any difficulty in reducing Baltic staves to Petersburg standards. If "H." will give an example with which he finds a difficulty, I shall be pleased to help him if I can.—G. W. B., 27, Wilbury-road, Hove.

[46696.]—**Bichromate Battery and Intensity-Coil.**—Make a fresh solution. What do you mean by an intensity-coil equal to 60 cells of this battery? J. M. Stocks.

[46696.]—**Bichromate Battery and Intensity Coil.**—These cells are not fit for electric lighting, as it means short-circuiting of the cells, which these will not bear. I have not been able to gain on the cells by the use of a coil; have tried a quantity coil, with 30lb. wire, but with no better results.—George Tolman.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

46062. Fireclay, p. 578.
46078. Shrink on Yarn, 578.
46079. Oiled Cloth, 578.
46086. Midland Railway, 578.
46102. Facing Plates, 578.
46105. Power from Falling Weight, 578.
46112. Percussion Action, 579.
46123. Electric Engine, 579.
46131. Sails for Fishing Boats, 579.
46134. Ladd's Dynamo-Machine, 579.

46378. Bevel Wheels, p. 43.
46383. H.P. of Locomotives, 43.
46385. American Birch Stain, 43.
46394. Timing French or Other Pendulums, 44.
46398. L. and N.W. Engines, 44.
46403. Cottage Building, 44.
46418. Photography, 44.
46421. Boat-Building, 44.

QUERIES.

[46697.]—**Railway Grease.**—Will some of "ours" inform me of the composition of the railway grease at present in use for lubricating trucks and carriages? Does soap ever find its way into the mixture?—Inquisitive.

[46698.]—**Fatty Anhydrides.**—Will Mr. Allen or some other kind reader inform me of the difference between fatty acids and fatty anhydrides in soap analyses? As some chemists estimate the amount of fat as fatty acids, and others as fatty anhydrides. Which is correct? And is there any rule by which one can be converted into the other?—Ignoramus.

[46699.]—**Shellac Cement.**—In back vols. recipes have been given for repairing broken glass by heating the glass, then sprinkling powdered shellac over the heated surfaces—join, and you will have, in a few moments, a joint so firm that it will bear a greater strain than any other part of the glass. Now I have attempted this mode of repairing glass articles over and over again, but invariably have failed. Will some kind reader assist either by pointing out my error in working, or by giving some recipe in which success is nearer certain?—Unfortunate.

[46700.]—**Intensity Coil.**—To Mr. Lancaster.—I have just completed an intensity coil of the following dimensions, viz.: core 3½in. long by ⅝in. dia. of No. 16 iron wire; primary, two layers No. 16 cotton-covered, with two ounces No. 36 silk-covered for secondary. When connected to a bichromate cell, gives a very small spark at the "breaker," which however, does not appear to vibrate. When the condenser (40 sheets tinfoil) is attached, the hammer sticks to the core. Will you kindly say where the fault is?—Bronte.

[46701.]—**Moment of Inertia.**—Would someone help me to an answer to the following?—1. The moment of inertia of a uniform rod with respect to an axis at right angles to its length passing through one end is $\frac{1}{3}$ (mass) × (length)^2. Show that when the rod coincides with one edge of a cube its moment of inertia, with respect to another edge which neither meets, nor is parallel to that edge, is $4/3$ mass × length^2. (2) Find moment of inertia—first, with respect to one edge; second, with respect to a diagonal.—Inertia.

[46702.]—**Drills.**—What is the difference between drills for iron and brass, and how should I set and harden them?—Tinker.

[46703.]—**Mounting Oleographs.**—In mounting oleographs on holland, does the latter, when on stretcher, require any preparation before putting on the oleograph? After mounting, and previous to varnishing, should the picture be sized? and if so, what can I use instead of parchment size?—An Amateur M.

[46704.]—**Blake Transmitter.**—Would Mr. Lancaster or other competent reader kindly tell me in what manner the carbon is fixed to the iron diaphragm so as to insure electrical connection in the Blake transmitter? A small sketch, with advice as to best means of making one of above, would be greatly esteemed by—Practical Amateur.

[46705.]—**Cart-Axle Grease.**—How is it that no axle grease is made in this country to correspond or rival American Frazer's? The common grease found in oil and colour stores is adulterated with powder of some sort, and is altogether bad stuff. I am anxious to prepare, on a commercial scale, a good, pure, cheap grease. I have made very good grease from rosin oil and milk of lime. This will not crust on the axle, and is very smooth; but it is too troublesome and too expensive in consequence of the water not combining, and having to be worked out. Will someone suggest a remedy or propose a different method of preparing a good cheap grease?—Mathew.

[46706.]—**Bleaching Palm-Oil.**—I have tried several times to bleach palm-oil by Watts' bichromate of potash process, but never with satisfactory results. Once, indeed, the bleaching was accomplished, but the oil had acquired a soapy consistence, which no amount of sulph. or hydrochl. acid would alter. I tried these acids separately, and together with bichromate of potash; but the soapy compound of a greenish colour always resulted. I used the exact proportions recommended, and carefully watched the temperature. I think the recipe is incorrect in one particular, as at 130° Fahr. (the temperature given for the chemical change to take place) I could see no change; but about 180° F., froth appeared, and changed colours just as expected at 130°. Will someone kindly say if this recipe can be used practically, and if so, give me the necessary specific directions?—Mathew.

[46707.]—**Scrofula.**—To Dr. Edmunds.—If you have not already treated on the above subject in these columns, I should be very grateful for a few remarks from your able pen that would guide me as to treatment and diet to keep the disease down (I am doubtful as to its cure). I am now about 22 years of age. Its first appearance was when a child in the form of a nub in the glands of the neck. Since that time it has broken and gradually spread year by year until it now extends from ear to chin. About February in each year for the last six years there is an excess of humour, which causes much pain until it is discharged, otherwise, I suffer no pain whatever. The natural skin appears to be eaten away, leaving a smooth red skin, which would bleed profusely if punctured in the slightest way. All round the edges a dry scurf-like substance forms, which is easily removed by a little vaseline being applied to it. I am a life abstainer and a non-smoker. I have tried a diet of vegetables for 10 and 12 months,—but am not doing so at present. It did not appear to affect me one way or the other. I naturally prefer living without meat. I get plenty of exercise and bathing in the season, and enjoy very good health as a rule.—"What Can't be Cured Must be Endured."

[46708.]—**Rain-Water Tanks.**—Will some of your correspondents kindly inform me what will be the best and cheapest material for a tank 11ft. × 6ft. × 3ft. deep, so that the water will keep sweet and good? Will it be necessary for bottom of tank, if of iron, to rest on a plain floor, or will three supports, one at each end and one in the middle, be sufficient? Would frost be likely to injure a tank of this size exposed to all weathers? Any hints will be thankfully received.—W. L. P. P.

[46709.]—**Mildew on Composition Statues.**—I have two very handsome composition statues very much stained by mildew. They will not take paint until the mildew is removed. What is best to be done?—Blackwater.

[46710.]—**Depositing Trough.**—Can an experienced electroplater inform me what "varnish" I should use to make a wooden trough impervious to the solution? I am depositing silver.—Electric Light.

[46711.]—**Terra-Cotta.**—Having seen some plaster busts and medallions that were coloured in imitation of terra-cotta, and having a few that I wish to do myself, would some correspondent kindly tell me what colours to mix, and how to produce that dead or flat appearance?—An Amateur M.

[46712.]—**Yacht.**—I am desirous of making a small yacht to carry one person comfortably, or two squeezed up. As the draught must not exceed 24in., and the boat cannot remain in the water, but be taken out and home when done sailing, it is necessary she should be as small and light as is safe. Where I want to sail is a very large shallow pond. If any of our kind readers could tell me the length, beam, and weight of ballast on the keel, and give as many hints as to building and rigging as they might consider useful, they would greatly oblige—Minim.

[46713.]—**Bleaching Clothes.**—I should be much obliged if you or one of your correspondents would let me know the proper way to use chloride of lime for bleaching linen and cotton things which have a bad colour through bad management and indifferent accommodation for washing on board ship during a long sea-voyage?—A Captain's Wife.

[46714.]—**Power of Engine.**—Would some reader kindly state the actual power of steam engine? Stroke, 4⅝in. × 3in., steam-pressure, 50lb. to the sq. in. Also, rule for finding same? and oblige—A. B. D.

[46715.]—**Photographic.**—1. How are opal plates got ready for painting on? Please explain the whole manipulation, how sensitised, &c. 2. I have made a camera after my own idea, which works remarkably well except in the bellows body. Would anyone please say how I might make a cloth body cheaply, what sort of cloth, and how to fold, &c.? Any hints on above will greatly oblige—Semper Fidelis.

[46716.]—**Sound in Pipe.**—Thanks to "Sunlight" for answering my query. I am afraid I did not give it quite clearly enough. But what I want is to prevent the water-pipe conveying the sound from tank to bed-rooms and let steam-pipe remain as it is. The steam-pipe is carried over top of tank, then down, and perforated pipe across bottom. This pipe has been the same as now for many years, but noise never heard in bed-rooms until water-pipe was laid to bath-rooms.—Anxious.

[46717.]—**Gas-Engine.**—To "Sunlight." — Will "Sunlight" kindly help me out of a difficulty?—I have made a model gas-engine, somewhat similar to the "Otto," which I cannot get to work. The reason, I think, is in the lighting arrangement, which I have made according to an illustration in the Mechanic of October, 1880, which does not give the means by which the gas reaches the slide-light; which, and the means taken to prevent the light blowing out too soon, are what I require to know. This is referred to in Crossley's specification, where it says that the lighting port is opened out towards the cylinder port to prevent the sudden pressure forcing the light back up the supply-pipe. I have cut a channel in the slide in the way I understand this to mean; but it will not do. So kindly explain the actual meaning of this passage in the specification. Also, when is the gas to the slide-light cut off? It seems to me that the mixture in the cylinder should begin to pass into the cavity in the slide as soon as compression begins, and therefore the gas should be cut off just before that. Is this correct? The slide cuts off the air supply to the cylinder about ⅛in. before the gas. Is this correct, or does it interfere with the lighting? A sketch of slide and cover would much oblige. May I ask "Sunlight" what gearing he used in his gas launch, as I have seen a steam winch with the engine constantly going, the barrel being connected to it by grooved friction-wheels, which appeared to be connected and disconnected with very little shock. Would not such means do well for a launch?—A. M. G.

[46718.]—**Varnish for Venetian Blinds.**—What is the best clear varnish for pine venetian-blind laths, mode of application, and price?—M. C. H.

[46719.]—**Reading-Lamp.**—The overflow of colza oil from a Queen's reading lamp is now and then so excessive as to fill the waste reservoir in two hours. This does not occur every night. The oil, wick, &c., are at all times precisely the same. Can anyone explain and give a cure?—M. C. H.

[46720.]—**Pitch of Cogs.**—Please to tell me the way to measure and strike out the pitch of cogs, gear, &c.—Jaff.

[46721.]—**Rights of Way.**—(1) Have Highway Boards power to come to an agreement between themselves and a landowner, or (2) tenant to stop a footpath? If not, what means are required to stop a footpath? (3) Also, what constitutes a right of way?—Q.

[46722.]—**Clockmaker's Lathe.**—Will some clockmaker or mechanic kindly give drawings and particulars of a clockmaker's lathe? as I am desirous of making one for myself.—Amateur.

[46723.]—**Marbling Chimneypiece.**—My chimneypiece is painted dark brown. Would some reader oblige by saying how I could imitate marbling or graniting? I may say I have a fair knowledge of common painting.—House Proud.

[46724.]—**Concrete Walls.**—What proportions of cement or ground lime mixed with broken stones (Portland) for walls of basement-floor about 8ft. high and 1ft. 6in. thick, the stones from an old building. Would they require washing? Which makes the best and cheapest work, cement or ground lime?—W. L. P. P.

[46725.]—**Plumbers in Paris.**—Would some reader of the "E. M" kindly oblige me by stating what prospects there are for English plumbers seeking employment in Paris or any part of France?—Shavehook.

[46726.]—**Paints, &c., for Steel Spanners.**—Will any of our readers kindly inform me the best way of getting up spanners in steel after cast and filed up? I mean what mixtures of paints to apply? And also, how to get that dark black oily surface which is usually on small steelwork? Also, the best mode and how to get a japanned surface on? At the same time, none of these mixtures to stick to the hands or come off when the article is being used.—Steel.

[46727.]—**Firing Loose Gunpowder by Electricity.**—Will any brother-reader tell me how to fire loose gunpowder by electricity? What strength and kind of battery (small as possible)? Will an induction coil be necessary. If so, what price?—Experiment.

[46728.]—**Ferrules.**—How do makers of ferrules for fishing-rods make the brass ferrules a steel or bronze colour?—Koptica.

[46729.]—**Vegetable Ivory.**—Will any of our readers kindly give us some recipes for preparing above? —Practical Colour Maker.

[46730.]—**Cheap Oils.**—I lately saw an advertisement in a newspaper stating that a good lubricating oil could be made at twopence per gallon. Would any of our readers who have such a receipt kindly give it for the benefit of ourselves?—P. C. M.

[46731.]—**Moulder's Blacking.**—I wish to make some of this. How is it made?—P. C. M.

[46732.—**Microscopic Fungi.**—Would some of your numerous readers say the best medium in which to mount microscopic fungi for the microscope.—L. L.

[46733.]—**Screw Propellers.**—Will any reader of "ours" kindly answer the following?—What is the diameter and pitch of the best known propellers?—Enquirer.

[46734.]—**Midland Engines.**—Can any reader give me the dates and principal dimensions of the following engines?—510, 481, 431, 429, 406, 395, 291, 274, 271, and 270.—C. H.

[46735.]—**"Eames" Locomotive.**—Would some correspondent give a sketch of the above engine, lately tried on the L. & Y.R.? The dimensions have already been given in the "E. M." It would be of great interest to know what trials are going to take place with it. —Tyre.

[46736.]—**Deliquescence of Salts.**—I observed—I believe correctly—that potassium nitrate in an anhydrous state refuses to absorb water from an ordinary saturated atmosphere. But when a fair quantity of water is first added to the salt, it goes on absorbing more water regularly from the air. Is this known? If so, are there other salts that act likewise? What explanation can be given of the experiment?—Kerux.

[46737.]—**Wild's Anemometer.**—Could Mr. Lancaster, or any other meteorologist, kindly give full description of the above with diagrams, if possible, and say how effective it is for measuring the strength of the wind? What ought to be the size of the swinging iron plate—what weight? What design could be adopted for keeping the plate always towards the wind? Could a curved piece of an iron strip graduated be placed in the direction of the plate's movement with an indicator to slide freely that way, but not back till again set by hand, so as to mark the force of wind? And if so, how, or what rule should be observed in graduating this? Full particulars will greatly oblige an amateur.—S. R. C.

[46738.]—**Universal Brake Couplings.**—Will any correspondent kindly furnish details of the Midland universal vacuum brake coupling selected at Euston, and also of the Westinghouse universal coupling, which, it appears, is likely to supersede it? Also, of any details being published relating to the construction of the vacuum brake being tried on the L. & N.W.R.? It is reported that the East Coast, West Coast, and Midland joint stock carriages are all to be fitted complete with two brake systems—air and vacuum—in order to avoid the present difficulty of interchanging vehicles. I notice that some carriages are already so fitted with duplicate gear. I shall be glad to receive any further information on the subject. Can any reader give me the date when a railway brake was first used or tried which worked through the compression of the spring-buffers? What line was it tried upon, and what was the reason of the idea being abandoned?—A Railway Servant.

[46739.]—**Nitro-Glucose.**—Can anyone give instructions for making nitro-glucose?—G. Thomas.

[46740.]—**Tests for 3in. Telescope.**—Will anyone give a few double stars, &c., with which I might test the powers of a 3in. astronomical telescope? Let them be such as I can find without the use of a star-map.—Wykehamist.

[46741.]—**Landscape Photography and Dry Plates.**—I have a pocket camera with a number of dark slides. I wish to take some views of landscapes, and will be thankful for information on this subject. The gelatine plates which I can buy are very quick. This would be of no advantage to me, as it matters not if I take the landscape in two seconds or in half a minute, and these very sensitive plates require manipulation in inconveniently dark non-actinic light. There may be a method of gelatine which is not more rapid than ordinary wet collodion and of good keeping properties both before and after exposure. If not gelatine, what is best for my purpose? Gelatine is wonderful for instantaneous work, but for landscape, where we can afford plenty of time, we want something more easily handled, at least, in the dark closet.—Holiday Work.

[46742.]—**Daniell Batteries.**—Why does the copper find its way into the porous cell? It becomes deposited on the zinc itself. I believe I always keep the sulphuric acid solution quite up to the level of the sulphate one. I am told that Daniell cells are very constant with the porous cell charged with plain water. Would not that increase the difficulty of the copper penetrating, owing to the greater specific gravity of the sulphate solution?—J. E. A.

[46743.]—**Microscope and Magic-Lantern.**—I have a good lantern for 10ft. disc; also a £5 microscope, and I want to know (they were purchased independently) whether I can adapt the microscope for use with lantern without damaging its proper uses. If so, how, and what parts thereof, and in which way to be attached?—Meme.

[46744.]—**Marble.**—Of what colours are Bethersden and Purbeck marbles, and is marble found anywhere but at Bethersden in the six "home" counties? Are there any books on marble?—describing the different varieties and giving a list of quarries in the United Kingdom.—Murano.

[46745.]—**Stopping for Decayed Teeth.**—I have been recommended to use cotton-wool, saturated with collodion and carbolic acid, "finishing off" with mastic. Is this good? Filling a hollow tooth with metal seems to me likely to make it ache—and that would be worse than hollowness. Would some of "ours" kindly give their experience of this interesting subject? I could not get the cotton-wool and collodion to harden or stick in the least; and everything I eat was flavoured with carbolic acid for three days.—Murano.

[46746.]—**Balmer's and Phillip's Gas-Stoves.**—A month or two ago someone advised me to alter one of Belmer's stoves to Phillip's plan. Would they kindly say what the latter is? Is a Mead's patent gasmeter likely to be in order that has been in use 18 years? It makes a peculiar squeaking.—Murano.

[46747.]—**Rapid Drying-Box.**—To "Gelatino Bromide."—Referring to your letter (19958), I, for one, should be glad to have, through the columns of "ours," a description of a good drying-box for an amateur.—R. T. B.

[46748.]—**Sharpening Carpenter's Saws.**—Will "Jack of All Trades" (see reply 46559) kindly go into this more fully, and say whether only one side of a single tooth should be filed at a time, whether all the teeth, whether set from or to you, should be filed with the saw in one position, and what the meaning of "buckle" is? I hope that he will forgive the ignorance of—Tiro Tironum.

[46749.]—**Hay.**—New hay, after being stacked a short time becomes heated by the chemical action of the various constituents of the grasses. In the case of hay not seasoned properly, the heat developed is often sufficient to char the hay and cause it to burst into flame. Can any of your correspondents give me any particulars as to the degree of temperature which is natural, and beyond which point the temperature acts injuriously on the hay? Also, what would be the probable degree of heat which would cause the hay to char or blacken, as seen in the case of many stacks after being cut?—Farmer.

[46750.]—**Tricycles.**—It would be very acceptable information to myself and to many other if some obliging correspondent versed in tricycle matters would kindly give the dimensions of some of the best-known machines. The important question is, what width opening the various kinds will pass through? The majority of those I have seen will not go through an ordinary doorway, and the trouble and expense of stabling make many would-be bicyclists afraid of investing in a machine. What I wish for is a table showing width of opening each will pass through, height, length, and approximate weight?—R. Smith.

[46751.]—**Windmill.**—To "T. N. C."—I should be glad if you would give us some more information about the windmill you mention on p. 525, No. 880. What is the use of the second set of sails? A sketch would greatly oblige. I should be obliged to anyone who would give a design for a turntable for windmill top that would be good and easy to make.—Samothes.

[46752.]—**Windmill.**—To Mr. Vallance.—I should be greatly obliged if you would give us a sketch and description of your horizontal windmill. I think it would be interesting to many beside—Samothes.

[46753.]—**A Water-Closet Nuisance.**—I have a water-closet in my house having the usual cistern supplied by a ball-tap from the main. The flush is excellent, and every time the closet is used the cistern is emptied, or nearly so, at the option of the user. But in the act of refilling by the action of the ball-tap, and just before the ball closes the tap, a very disagreeable loud hissing noise is made, ending in a loud whistle, sounding all over the house, and lasting for nearly a minute. I had the tap changed, but it was much worse, and had the old one put on again. Perhaps some of your readers or Mr. Davies (who has supplied those excellent articles on plumbing) will be able to suggest a means of remedy? I may say that the tap used is called a silent tap. I have two other ball-taps in the house not silent taps, which are perfectly silent. My plumber cannot effect a cure.—Silence.

[46754.]—**Repairing Watch.**—To "Alfojoe."—I cleaned my lever watch according to your instructions, and have it now going in perfect order with the exception of the stopwork, as I have broken the fusee chain several times, and have now to look at the barrel every time when winding, so as not to wind too far, or the chain would fly off. If you would kindly inform me how to remedy this I would be greatly obliged; and please accept my best thanks for your valuable instructions on how to clean a lever watch, which appeared some time ago. Also, how could I fasten the 'scape-wheel of a verge watch?—Country.

[46755.]—**Enlargements and Developing Tins.**—I have seen in some book that an enlargement can be made on bromo-gelatine paper by a French lens. I have a 2in. plate portrait lens. Would someone say how I can do it without a lantern?—giving full details, or recommend a cheap book with it in. I have made some tin developing dishes. What can I coat them with so that the pyro-alum or hypo will not affect them? Shall I paint and varnish, or coat with Brunswick black, or with shellac varnish—or what?—H. C. F.

[45756.]—**Bookbinding.**—I want a glue with which to attach sheets of paper in a block bound only at one end to the binding paper, such that any sheet can be removed at pleasure without loosening others. I have seen small note-books so bound. Can anyone tell me what ingredients to use?—X.

[46757.]—**Emery Wheels.**—To "Sunlight."—I have a small grindstone mounted in my lathe, but find that it is a slow and laborious way of doing the work I principally put to it, which is making tools for turning metal out of old files. I have heard that emery-wheels are much quicker in their action, but that they are required to be run at a high speed. Will you kindly give the following information respecting them: What sized pulleys and wheels shall I use on the overhead and spindle of emery-wheel to obtain the necessary speed?—the driving-wheel of lathe being 28in. dia.? Also, what thickness and dia. should the emery-wheel be, and is it to be used dry?—F. E.

[46758.]—**Bicycle Varnish.**—Can any reader kindly oblige with a formula or the kind of varnish for coating bicycle spokes to keep them bright?—one that will stand damp and exposure to air, &c.—Bicyclist.

[46759.]—**G.W. Goods Engines.**—Can any reader give description and dimensions (with a small sketch) of the leading types of G. Western goods engines? Are they double or single framed, and by whom are they built? Have the company any broad-gauge goods engines running?—Meteor.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or requies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6 Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, April 26, and unacknowledged elsewhere:—

Barnett Son and Forster.—W. C. Hughes.—K. M. Cunningham.—D. A.—Rev. S. R. Craig.—G. R. Miles.—N. G. Numsen.—R. Reyburn.—T.—Rivetter.—J. C. King.—A Fellow of the Royal Astronomical Society.—B. M.—R. A. V.—H. C. F.—Milford.—F. W. G.—One Leg.—R. D. D. M.—N. W. S.—J. S. B.—Invincible.—Aspirant.—Chemist No. 50.—Summit of England.—J. H. Huxley.—H. T. Barnett.—Sharples.—F. C. Putley.—W. H. S. W.—Dix.—Foundry.—Ascalon.—Teddy.—Douglas.—W. G. E—C. B. A.—Fellow Workman.—H. R.—Maj.-Gen. Cunningham.—A. Surridge.—J. Hezmalhalch.—Queensland.—Scotus.—Penuria.—Long Tom.—H. C. Sutton.—E. B. F.—D. Brown.—A. B. C. Pargo.—Cinquanta.—Brake Block.—Civis.—Pholas.—Cat's Tail.—Jumbo.—A. E. Harris.—R. D. T.—Carstairs.—T. J. C.—T. M. Hewetson.—G. Pinnington.—W. Worley.—A Canadian Subscriber.—Swan.—Screw Propeller.—David.—H. A. Wassell.

David Carson. (Several blowpipes of the kind in back volumes. See p. 146, No. 838, for instance. For colouring gold, refer to pp. 45, 93, 116, 165, 297, Vol. XXIX. The solder is made of gold, silver, and copper; but without knowing what it is wanted for, no one can give proportionate parts. As a rule, the solder should be the hardest it is possible to use.)—Three Legs. (Will not the article, "How to Make a Camera-Stand," on p. 445, No. 877, suit?)—One Interested. (You are bound to pay the House Duty, but are entitled to deduct it from the next rent paid to your landlord.)—A. H. K. (There is probably nothing very serious the matter with your wife, beyond the ailments for which she has been treated, but no advice worth giving could be had without personal examination. Why not consult a physician, or take her to Dr. Edmunds, at the London Temperance Hospital?)—Bradfordian. (See the announcements respecting steamers in Bradshaw's "Railway Guide.")—Roko. (If described in our columns, it would certainly invalidate a subsequent patent.)—Moahak, Paterson, N. J. (They are 7s. each in England, but we do not know what the U.S. duty is. Order them through Willmer and Rogers, or any respectable American bookseller)—G. W. (Simply add any bitters you fancy to the spirit.)—W. E. K. (We think not, but an inquiry at the Admiralty would settle the question. We do not know where photos of the ships in question can be obtained, but good illustrations of most of them are given in Vol. I. of Sir T. Brassey's "British Navy," which we reviewed on p. 557, last Vol. The book is published by Longmans.)—G. W. Dunn. (You will find a table on p. 336, No. 872, giving particulars of various sizes; but you will have to use enough battery-power.)—J. Main. (It would simply not be so powerful, as the larger sized wire would make fewer coils. Read what has been written recently, or study the principles as given in Sprague's book.)—Delta. (We have described M. Faure's battery many times, and plain directions for making have been given by correspondents. See p. 258, No. 869, and the indices of the last two volumes.)—W. Newbould. (Buy the double salt ready prepared. What has "nickel silver" to do with it?)—F. W. D. (Canada balsam is the short answer, if we understand you; but the varnish is applied after the painting is done. See p. 25, No. 782, for an article on lantern transparencies, and the index of Vol. XXXI. for references to an exhaustive discussion on the subject.)—G. Pinnington. (You will find accounts of the experiments of M. Lodyguine in serial publications, and in the *Transactions* of the St. Petersburg Academy of Sciences, by which society he was awarded an important prize in 1874 for an incandescent lamp, subsequently improved by Messrs Konn and Bouliguine. Lodyguine inclosed carbon in a glass vessel from which the oxygen was expelled. Several notes on his lamp in back volumes.)—A. H. K. (The core is magnetised by the passage of the current. When the circuit is broken the current ceases to flow, and the core ceases to be magnetised, or is said to be de-magnetised.)—Semper Fidelis. (If wanted for a short time only, the bichromate battery is the cheapest and best; but if required for hours the Bunsen is best. See recent back numbers.)—Cousin Dobbin. (On p. 336, No. 872, you will find a table giving dimensions of electro-magnets of various sizes. On p. 414, No. 876, you will find that the lead plate is connected to the positive electrode of the generator, and becomes coated with insoluble peroxide.)—H. (The connections are practically the same in any system. See p. 87, for instance, and other recent numbers.)—Wiseaf. (We do not know the process named; but see the indices under head of Lantern Transparencies, Photo. Transparencies, and Colouring Photographs)—A. L. Houston. (There is nothing better than aniline dyes. The sprigs take the dye best after being dried.)—F. B. (Hot fomentations to draw out inflammation. Certainly not a "magnetic" knee-cap, though one of scarlet wool might be useful. 2. A saturated solution: until the paraffin has soaked thoroughly into it.)—E. M. (If you know number, year, and price, send stamps to Mr. H. R. Lack, Sale Office for Specifications, Cursitor-street, E.C., with extra stamps for postage. If over one shilling, send postal order.)—Labor Omnia Vincit. (We do not remember any book or even a paper on the subject. Probably it is looked upon as a trade secret. Perhaps in some of the German technical journals there may be a paper in which the question is treated.)—Pro Bono Publico. (Several recipes in back volumes, but possibly the best is good glue, to which a little tannin is added. 2. See pp. 192, 236, last volume, for microscopical and chemical tests for silk.)—Dundonian. (See p. 538, Vol. XXI., and p. 153, Vol. XXII. 2. The simplest fountain is made by connecting the jet with a water tank some feet above it. 3. What part of a dwelling-house do you want to keep animals in? As to plants, geraniums, fuchsias, coleus, &c. 4. No, zinc does not injure them.)—An Amateur Photographer. (See p. 424, last volume, and the indices of recent volumes.) B. M. (In the ordinary pattern, the reeds are reached by removing the fretted slip just below the keys for the front set, and the back of the case for the other set. With the knee lever pressed over and the stop drawn, you should be able to see the reeds. See a diagram on p. 117, No. 655, or p. 605, No. 518.)—Mirror. (You proceeded quite correctly, but did not use enough mercury, and did not slide the plate on, so as to exclude air. In Ure's Dictionary (art. Mirrors) you will find the process given with much detail, also in back volumes. See, for instance, p. 354, No. 716. The process is a difficult one until practice has made the operator skilful, and we think amateurs will always find better results by depositing a film of pure silver by one of the wet processes, for which see almost any back volume. The previous answer contains all the principal parts of the mercury process, but makers use so much quicksilver that their tables have a trough to catch it as it is driven off by the advancing edge of the plate. If you try again, be sure that you get *tin*-foil, not composition. The mercury should appear to eat it up.)—W. Johnstone. (See previous answer, and the reference given. It is not an easy matter to resilver a looking-glass, and if time is of any value, is a costly experiment.)—Robt. Muirhead. (We do not know of any book specially devoted to the electric light which we can recommend; but if you will make up your mind to study the principles you can have no better book than Sprague's "Electricity," published by Spons. Look through our recent back volumes for many papers on the subject. You can procure lamps of the Swan Electric Lighting Co., Mosley-street, Newcastle-on-Tyne.)—M. W. D. (Copying-ink can be made by adding moist sugar to any good writing-ink in the proportion of about 1oz. to a pint.)—Tormented One. (Many plans suggested in back volumes; but if you run coal-tar into their holes once a week for, say, a month, you will effectually disgust them.)—Steam. (No; the remedy is either ventilation or inclosing air-tight.)—E. R. M. (We do not think there are any assisted passages to Australia now; but you can ascertain by applying to the agents-general of the respective colonies, whose addresses you will find in the Directory. You might possibly, by applying to some of the shipping companies, get a chance of working your passage out.)—Ego. (No, we know it would not—there is no thinking about it)—T. P. N. (Use methylated spirit and loose cotton wick; the benzoline fires because the heat vaporises it. On the bottom, because it has the weight of water plus the same pressure as the top.)—Ino. (You used too much. Rub the ink into the lines, and then clean the surface of the plate with a leather or cloth rubbed on a piece of whiting or chalk. As you proceed you will find that once the lines are filled with ink they readily take a supply from the roller while the rest of the plate is scarcely soiled. You can print from your monogram in the same way, but to do it properly you should have a counterpart to force the paper into the lines.)—A. B. (A crane, but it can be done with a differential pulley.)—Tinker. (Your second question was answered by "Alfojoe," on p. 113. See also his papers in the preceding volume. The professional painters usually lick the surface with the tongue; but perhaps you will prefer to wash the photo with solution of ox-gall.)—Phono. (If you want to make one, see p. 157, No. 683. There is no book on the subject, but you will find several articles in back volumes.)—W. J. B. (A description of Sutton's battery is given in the Replies (46654) in this number.)—Fred. Wooton. (Ask for caustic potash or, preferably, caustic soda, or refer to recent letters on the subject, and you will learn how to prepare it.)—Cheap Battery. (The porous pot ought to be a little above the outer jar. 2. Half full will do. 3. Not necessarily. 4. Yes, saturated solution with one-twelfth sulphuric acid.)—

The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, MAY 5, 1882.

TELEPHONIC COMMUNICATION.

ALTHOUGH six years have elapsed since the invention of the telephone in its practically useful form, it has not, so far as this country is concerned, at least, taken the position which it ought to occupy. There are several reasons for this apparent neglect of a really useful invention, the most important of which is probably the action of the Post Office, though the difficulty of determining the rights of the holders of the patents has had something to do with the delay. No doubt, too, there is some natural hesitation on the part of would-be users, who, judging by their experience of other inventions, are, perhaps, justified in looking for improvements which will supersede the instruments at present employed. The telephone as devised by Bell, though still holding the first place as the receiving instrument, is rarely employed for transmitting purposes—the instruments in which carbon contacts are used being preferred for the reason that they allow of stronger undulatory currents being sent than are possible where a magnet alone is available. Of these instruments there are several seeking the public favour, some having many carbon contacts, as the Ader, the Crossley, and Wollaston, while others have only one, as the pantelephone. The fact that among such well-known forms as the Edison, Blake, and Hunnings so great a difference in the number of contact points is found, leads Col. Webber, the president of the Society of Telegraph Engineers and Electricians, who read a paper on the subject last week before the Society of Arts, to the conclusion that we are still a long way from comprehending the true meaning of the work performed by the pressure of the carbon. So many minds have however in the last two or three years been devoted to the study of the telephone, that we may safely assume no radical change of any importance will be made in its construction, and those who can find a use for it may instal it with the certainty that it will answer its purposes even if something better is found next year. The history of the telephone affords an instance of the difficulty of introducing even a meritorious invention; for although six years have passed since it was patented, it cannot yet be said to be so widely used as it deserves to be. It is true that in this country the application of the telephone has been delayed owing to the existence of rival companies, partly, but mainly in consequence of the action of the Post Office, which, according to the law courts, is entitled to the monopoly it has claimed. The merits of the new method of transmitting messages are, however, now fully appreciated, and there is no lack of subscribers whenever it is proposed to establish an "Exchange." In Germany, in France, in Belgium, in Italy, and in other countries on the Continent the exchange system of telephoning is in full work. In Berlin, for instance, it has reached that degree of perfection which is indicated by the fact that any person can have five minutes' conversation with any of the subscribers to the exchange by the expenditure of 50 pfennigs (about 5½d.) in the purchase of a list of subscribers, and in this country exchanges are already in existence, which cost the members about one penny per message. In the United States telephonic communication has reached its highest development, for in New York alone there are 5,000 subscribers divided into about fifteen exchanges, besides 1,500 private telephone lines. It is no secret that the arrangements of these exchanges, admirable as they are, considering the absence of experience, are not altogether satisfactory, for besides the objectionable network of wires with their supporting masts, there is also considerable carelessness or want of thought on the part of the subscribers, which has led, in some cases, to the adoption of a rigid time-limit during which a given wire can be at any member's disposal. The necessity for this rule arises from the fact that subscribers frequently neglect to "ring off" when they have finished their conversation, and the attendant at the central office is thus induced to keep others waiting unless he adopts a plan which, probably, he does not care to practise, and which might not be agreeable to the members concerned. That is known as "listening off"—viz., listening to the speaker, and waiting until the hanging up of his telephone is heard. According to Colonel Webber, in practice it is found that 20 per cent. of the subscribers forget to "ring off" when the exchange is first established, but improvement follows with a little practice; still the neglect is so serious that means of doing it automatically have been devised, notably by Mr. Johnson, one of Mr. Edison's assistants, who utilises the action of hanging up the telephone to slowly depress a lever, which causes a current to be sent to the subscriber's instrument for several seconds. A further improvement devised by the same inventor consists in making a distinction between the call of the subscriber for his correspondent and for the exchange. That is done by sending the battery current continuously or intermittently, the change being effected by the movement of a little handle. The bells at the out-stations are "chatterers," and act under the influence of a continuous current, but not when subjected to an intermittent current. The annunciator at the Exchange, on the contrary, acts under the influence of an intermittent current, and slightly vibrates only when a continuous one is passing. Possibly, however, until some undreamt-of automatic appliance is invented, the time-limit will be enforced on busy exchanges, for it is not difficult to conceive that a subscriber having been put into communication with his correspondent might lay the telephone down to look for some paper or other reference to refresh his memory, and his search might occupy a much longer time than would be altogether convenient to his brother members. It is not easy to suggest an automatic arrangement which will meet all cases, and we suspect that on busy lines it will be necessary to enforce the time-limit with a certain allowance at the discretion of the attendant, or switch-clerk, as he is called. If no calls await attention, there will be no advantage in cutting out the subscriber who has the line; but if others are ringing to be connected up the time-limit must be enforced. The question of overhead wires is not so easily settled as Col. Webber seems to imagine, and whoever he may mean by "the mouthpiece of what should be the highest authority in the land on such matters," we cannot agree that he has full justification in stating that overhead telegraph lines need never be an eyesore or a nuisance. The question is not so much whether they are eyesores or nuisances, as whether they are dangerous and subject to frequent accident. We pass aside the hint that the "clamour" is more or less encouraged by the cable and guttapercha interests, in view of the obvious facts that wires stretched across from the tops of houses are not easily placed in position, are not readily repaired, and are subjected to the effects of acid and other vapours, besides the often destructive action of the wind. It may be, as Col. Webber says, that in by far the largest number of cases, the line wires "have been put up unmechanically, and are in consequence dangerous and unsightly," but if erected by those who are now supposed to understand the business, they would be all that could be desired. That is scarcely the question—the public can judge only by experience, and at least in Germany and Paris the authorities do not seem to have much faith in the technical skill of the overhead erectors. Mr. Graves, the Engineer-in-Chief of the Postal Telegraphs, in the course of the discussion, pointed out that the Post Office had many overhead wires, and must continue them in certain districts, the business of which would not pay for an underground system; but wherever wires were massed in large numbers there was first the difficulty of finding room for them on the tops of houses, and, secondly, the weight became a source of danger. Further, oxidation is a serious evil, for unless the wires are carefully and continuously inspected, corrosion goes on unsuspected, and there is that source of danger added to those of frosts and high winds. Mr. Graves is clearly of opinion that wherever the collection of wires becomes heavy, they should be put underground. The wires in the neighbourhood of a telephone exchange will, of necessity, be numerous, and, consequently, heavy, and though the cost of insulation may be very great, it is almost imperative that they should be placed beneath the roadway; and looking at the constantly recurring expense of repairs, which are not easily made when the wires are carried on poles fixed upon the tops of houses, it is conceivable that, in the long run, it would be more economical to put all wires—in towns at least—beneath the footpaths.

As to the cost to subscribers, the rates charged at present are confessedly high; but while there are so many applicants, and the difficulty of obtaining permission to erect fresh wires increases, there is small likelihood of the rate being lowered. Even as it is, with the charge fixed at £20 a year, many customers pay only one penny per message, and some only one farthing. That, however, arises from the fact that they make as much use as they can of the facilities afforded, and if every subscriber did the same, it is clear a great many more wires would be needed to carry on the business. It would seem, therefore, that before long it will become necessary to have a graduated scale of charges—subscribers paying to a certain extent in accordance with the use they make of the lines. In the United States the tariff ranges from £6 to £9 10s. on small social exchanges; but on the commercial and business lines it ranges from £10 to £21. In Paris, as in Germany, the uniform tariff is about £20. As at present arranged, an exchange system can be worked most economically when it is on the large scale, requiring the use of several switch-boards, so that subscribers can be classified, and those most frequently corresponding amongst themselves placed in one group; but in the case of large switch-boards there is much liability to confusion and delay. The smaller exchanges, though more expensive in first cost proportionally, are more easily worked, and could undoubtedly be carried on for very much less than is now demanded, if the subscribers were left to themselves to provide the lines and the instruments free from any royalties. Whether these telephone exchanges are to be created and controlled by a number of companies, or whether the Post-office is to take the work in hand and carry it on as a monopoly, is a question that is coming up for settlement shortly. One thing at least

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is certain, that the telephone exchange is a growing innovation which will ultimately absorb much of the business that is now done by telegraph, especially local messages, for there are several reasons why those who desire to send them would prefer to speak direct to their correspondents instead of writing the words on a form, and would also prefer to receive the answer in a voice that can be recognised instead of on one of the familiar forms. It will be difficult to make general arrangements of the nature of the existing telephone exchanges, but it is satisfactory to learn that the Post-office is prepared to extend existing facilities whenever the public demands warrant the requisite expenditure.

CART AND WHEEL-MAKING.—XV.

(*Continued from page 609, Vol. XXXIV.*)

By J. Charles King.

In the course of cart-making, much of the painting may be done as soon as the body is finished. In the trade, the body is often finished painting while the carriage and wheels are being got on with; this expedites work, and as the body has so much contact with the cushions and the hands, in the riders getting in and out, it is the best course to have the body finished first. It will be useful to describe at once the process of carriage-painting as followed in the best English shops. I, therefore, proceed to give full working details of painting as applied to carriages, with a few hints of what you must avoid doing. You may have perfect confidence in your successful completion of the job in a short time if the directions are followed; the main requisites being cleanliness, method, and flexible dexterity of wrist and fingers.

Before commencing to paint, be sure you have a shop secure from currents of fine dust, and be careful to get your body and carriage free from dust, especially in the corners, and the wood free from glue, grease marks, or smoke, from any part of the wood having been scorched by the hot ironwork. Should any be on, scrape and wash off with turpentine.

The colours, as the liquid pigments are termed, are the priming colour for first, second, and third coats of paint. The preparing colours first, second, and third coats. The fancy colour, and the relief of "striping," or "picking-out," by some different colour, to be finished by varnish on the fancy colour, and japan on the ironwork, and black paint where wanted. "Filling-up" an intermediate coat of paint between the third priming-coat of paint, and the first preparing coat of paint is not termed colour, and is a special mixture. How to mix these colours in proper proportions of ingredients will be fully explained, and it will be seen it is the simplest part of the process of painting. To lay on the paint, and "flat-down" between the drying of each coat, requires the care of forethought, and sensitive dexterity of touch.

To give confidence to anyone disposed to try his hand at painting, I may mention that I had to appoint a painter to do the work on a large estate near London. In chosing a suitable man out of several who wanted the job, I rejected several who had done painting before, and selected a farm-labourer who had never done such work; within a week's time he could mix properly any colour he wanted, and had finished a first-rate oak-graining job, with a flowing coat of varnish. His success was due to cleanliness, forethought, method, and a critical sense of touch in handling a brush.

As briefly as possible I proceed to tell how to mix the various paints, "lay-on" and flat-off for varnishing. Priming colour is made of white-lead (as sold ground in oil) 2lb.; linseed oil, $\frac{1}{4}$ pint, thoroughly well mixed, then add turpentine, $\frac{1}{2}$ pint. This makes cream-colour, to darken to lead colour of any shade, add lamp-black, and stir up till of the consistency of milk; to insure quick drying, add to this mixture 2oz. of "dryers"—this is sold ready for use.

I am obliged to remark now that as much of your cart as can be taken easily apart, must be done so, before beginning to paint.

The body should be upside down on tressels, the springs resting on the top of a stool or tub, or hung up on one end, the scroll-irons apart. The dashiron, wings, and body-rail all off, the back-door off at the hinges; in fact, only the steps need be fixed to bar and shafts. Begin this upside down and turnover as you go on. Begin always at the under sides or inner angles of your parts, working the first coat of priming with a rather stumpy worn brush, so as to force the colour thoroughly into the grain of the wood and crevices of the ironwork; let this coat of paint be put on in fair quantity, but thoroughly laid-off so that outer projections have as much as inner angles; leave it 24 hours to dry; then give another coat with a longer haired brush, using both hands; thus, work the brush with the right or left hand, and with the other have a small tool to wipe off any extra quantity of colour likely to run into a bead or angle; where it would remain wet paint while the adjacent surface was dry; in another 24 hours it will be dry.

The third coat of priming is put on with care to cover every part with a level coat. On this depends good work.

I must remind a learner that paint, being compounded of materials of such different densities, the mineral portions sink to the bottom of the paint-pot—so that the colour must be stirred frequently with a small bat-shaped stick; avoid wiping your brush on the edge of the pot, to regulate the amount of colour in your brush—the edge of the piece of wood, or a bit of wire stretched over the pot will serve better. With practice, you will not need to use either, but dip out, with brush or tool, only just as much as you want to use each time. Cover up your paint-pot with a sheet of card or leather when not using it, to preserve your colour from dust; let the paint-brush handles project through the cover.

If your paint stands by, it becomes thick—the turpentine has evaporated, and requires renewing. If dust gets on your work, be sure to dust off before you begin to paint again.

The axle may be fixed to the springs after the first coat of priming; you are then sure all the bearings have paint under them.

Now comes the puttying-up of holes, joints, and uneven places, with putty and "hard-stopper." I must again pause to explain that putty may be many weeks getting hard if not properly made, and that hard-stopper may get hard almost before you can use it all up on the job, in a few minutes. I describe how to make both, and how to keep hard-stopper soft for use while the job lasts.

Putty of any colour is made in a very simple manner by mixing thoroughly linseed-oil and whiting together, beating it up and kneading it. Usually a piece of sugar of lead the size of a small walnut is used with a 2lb. cake of whiting; this forces the drying and hardening of the putty. It may be darkened to any shade by the addition of lampblack, mixed up with the putty in making. Thus, this crevice and hole-filling material is distinctly different from hard-stopper used for the body, and has to be differently treated in use, being pressed and worked well in — level and smooth — with adjacent surfaces; while hard-stopper, which is used in a softer state, must be dexterously pressed into the hole to be stopped with the stopping-knife, and left to stand up above the surface in all cases, as it shrinks in the course of drying, and if not prominent would leave a hollow place at every stopped hole or joint. But well made putty, which alone is used for the wheels and under-carriage, does not shrink. Hard-stopper is kept in a gallipot, which, when not in use, must be turned upside down in a saucer. This causes the residuum of oil to filter to the under-surface of the hard-stopper, and keeps it from hardening and spoiling, which would be the case if the stopper got at all hard before using it. A careful workman knows success depends upon keeping his materials as well as tools in a state fit for immediate use. The following is the way to make hard-stopper and to use it:—Mix up on a stone slab or hard smooth board, dry white-lead $\frac{1}{2}$lb., and tub lead (as lead ground in oil is called), well worked up with gold-size into an adhesive putty; this is done with a stiff-bladed putty-knife, till the "stopper" is of the consistency of soft cheese. As most carriages are painted dark colours, the stopper should be darkened with a little lamp-black; not ivory-black. It is pressed into every pin-hole, screw-hole, or flaw that is visible on the surface of the body with a knife. Don't attempt to level it. The body may now be "filled-up," as it is termed; that is, painted with colour, having a large amount of silica in it, which has the effect of hermetically sealing up all the previous coats of paint and grain of the wood with a surface resembling stone, which has to be made level and smooth by facing-off with hard pumice-stone and water. This process is termed "rubbing-down."

Filling-up is made thus: 2lb. of coarse brown ochre, and $\frac{1}{2}$lb. of spruce ochre ground in turpentine, to which is added $\frac{1}{4}$lb. of ground white-lead; this softens the brittleness of the ochre, and gives a denser surface to the filling-up when rubbed down; the filling-up must be of the consistency of cream; to this is added $\frac{1}{2}$ pint of carriage-varnish to give toughness, adhesion, and elasticity to the filling-up, preventing it from chipping off when knocked, and making it less absorbent of water under the action of rubbing-down; this coat dries quickly—ten minutes after it is laid on. If it does not soil the hand when passed over it, it is dry, and may be followed up by a second and third coat rapidly; but the first coat is better for a night's drying. Filling-up must be laid on quickly with the firmness of an experienced hand, not timidly or daubed on; the use of a stiff brush will equalise the coat, and a small brush or tool will level corners of panels and on mouldings, which must never be daubed up, nor left bare at sharp angles. Thus a body may have three coats of filling-up in six hours, if urgent. If the filling-up gets thick it must not be thinned by adding turpentine, or bad results will follow in cracks and other annoyances in after-painting.

The thinning of filling-up must always be with the same material. When making the filling-up, carriage-varnish dregs may be used if strained warm through a sieve. The thorough cleansing out of a varnish-can may be effected by putting a little turpentine in the can to be cleaned and drained, and letting it stand near the hot stove-pipe for a few hours. In a small shop this is a matter of economy, not so likely to be omitted as in a large shop. The filling-up coat having stood 24 hours in summer, or 48 hours in winter, will be ready for rubbing down. This is effected with pumice-stone and water. The pumice-stone has a grain like wood, the end grain is the proper rubbing surface—it cuts down the filling-up quicker, and does not crumble away at risk of scoring the surface with little pieces under the pressure of rubbing. Plenty of clean water should be used, and the pumice-stone allowed to float in the water to cleanse, not laid on steps or the floor, by chance to pick up grit by contact.

It is as well to remark on the plan of some painters who employ incompetent men to rub down, for them to give the filling-up coat an overcoat of lamp-black and turpentine as a guide to the rubber-down of how much he is to rub off, that is, all this black coat, and then calling the job finished; this is just the way bad workmen are made, and kept so; moreover, the turpentine acts prejudicially on the filling up. The hand of the painter, as well as his eye, should be used to judge the levelness of rubbing down. It does not matter how much or how little of the filling-up is rubbed through. So critical does the sense of touch of the painter's hand become, that he tests the accuracy of surface, and level, by the hand being passed carefully over the panels he has done to try them. In rubbing-down, a facing-stone is used for cleaning and levelling the pumice-stone upon.

Washing-off should follow immediately, as the process of rubbing down goes on, and plenty of clean water and a clean wash-leather with sponge should be used, or a piece of linen or calico rag will do even better than wash-leather, as it does not clog like the leather does, and is more easily rinsed out and wrung dry for use.

From the preceding remarks, it will be seen that from the commencement of a piece of work with the priming coat, to the finish of the rubbing down, occupies from seven to fourteen days, according to the season of the year, the dryness of atmosphere, and the emergency of the work; it need hardly be said that the longer paint has to dry the better. The same processes modified, and material made up for quick-drying, may be carried out so as to complete a repairing job in twenty-four hours; as a new panel, or boot side. Before concluding these remarks upon filling-up, it cannot be too forcibly urged that while the paint is laid on copiously, and all projecting parts well covered, the inner angles of mouldings, quirks, and corners need hardly have any more than a light coat of the paint. It is a common practice of careless painters to daub over the bodies, filling up the angles and corners, using twice as much stuff over these parts as is needed. This is the starting of defective work which follows. What has been put in the angles and corners of mouldings has to be got out. In the attempt to do this the prominent parts are cut through to the wood, and yet the corners remain daubed up. Time is then wasted looking at it, talking about it, perhaps, and then making a botch of colouring over the bare places, waiting for it to dry, flatting off, or perhaps, as is mostly the case, it is considered a trifle. This, and the bare wood and thick plaster of filling-up, are painted with a preparing coat, just as if it was the proper thing for those parts of a body, the most exposed, to be barely painted, and other parts, not exposed, to receive a needless amount of paint. It may happen, however, that a joint will rise, or a screw-point bulge a part of the surface to be painted, and escape the notice of the body-maker in cleaning off, and if noticed by the painter in priming over, allowed to pass. It often happens in large shops that workmen of one branch resent interference from another about trifles, as these would be called. When it so happens, there is no alternative but to rub through to the wood. Do it boldly, as follows:—If there is not time to paint over again with "filling-up stuff," when the wood is dry (and it ought to be dried quickly so as to dry the wet out of the grain before it can soak deeply in), rub the wood with a piece of rag, having on it a mixture of three parts of linseed oil, two of turpentine and dryers, or sulphate of copper; for a quart, as much driers or sulphate as will be as large as a walnut. Indeed, this mixture in the hands of an intelligent painter is a valuable surface mixture or dressing to stop the too rapid absorption by the filling up of the preparing coat of paint which follows the rubbing-down process. This coat is not put on with a brush, but rubbed on in a small quantity at a time with a rag. It has the additional beneficial effect of killing the damp that may be left in the filling-up coat, after rubbing-down. Where a body has been rubbed through the filling-up, in parts, into the primary colour, this dressing, carefully rubbed in, equalises the action of the absorbing surfaces, and favours the laying on of the first preparing coat of colour, so as to prevent an unequal drying and sinking-in of following coats of paint, which will otherwise be manifest even through successive coats of paint and varnish by surface cracking, or mottled and cloudy dimness of lustre.

We will suppose the carriage and wheels to have been put through the usual course of three priming coats at the same time as the body with its extra coats of filling-up; and flaws, unequal joints, surfaces, and screw-heads have been duly stopped, filling-up rubbed down, third coat of priming glass-papered to get smooth and level, then comes the three courses of preparing colour. This paint is made of white-lead, linseed-oil, and lamp-black, just as the priming colour was, except the proportions of oil and turpentine are altered for preparing colour, the oil being diminished by one half and the turpentine being doubled in quantity. The painter's object now is to fill up thoroughly the absorbent pores of the filling-up surface stuff with preparing colour, just as he had done the grain of the wood with the priming colour before the filling-up was laid on. When much oil is used in the preparing colour, the filling-up surface will not absorb it at once, as it should do; it will be simply glazed over and slowly and unequally absorbed, according to the variable thickness of the coat of filling-up, or to the chance of being laid on well or badly by the painter that does this part of the work, which is one of the most critical coats of paint that is laid on. With the last coat of some delicate glaze colour, the eye will aid the painter in his operation; but for this first preparing coat the experience of judgment, to which vision lends little help, is essential for putting on plenty of paint, and also for *laying it off level*, so that there is not a superfluity, and in the rapid manipulation and watchful attention to the absorption of colour, as it is laid off, so that the saturation of the filling-up base is thoroughly effected.

The first coat of preparing colour will be dry in twenty-four hours, and may be faced-off with pumice-stone. This produces what is known as eggshell dulness of surface, and levelness of parts, or fine glass-paper may be used for the same purpose; though for well-done work a lump of crisp, curled horsehair will serve for the purpose. To the young hand it may help him to explain why it is requisite that this first coat of preparing colour must be faced-off. The different degrees of absorption of the under coat of filling-up produces an uneven surface, and any little "nibs" or projections of paint, unless levelled off, become doubled in size by the addition of the next coat of paint. To face off the next coat of paint, instead of the first, would be to rub through two coats of paint instead of one at some parts, and by that, laying bare in invisible specks the filling-up, which would not fail to show in some way its effects on the next coat, even to the varnish. It may not be amiss to remark upon the liquids that form the vehicle, for the flow of colour which is when used, in a few hours to become a dry, hard-surfaced paint. Linseed-oil gives to almost any pigment it may be mixed with, the tenacity of leather when dry. Turpentine, which also contains oil as well as spirit, does the same to a very slight degree; the greater fluidity of turpentine, and the ready absorption of its spirit by any porous matter it is laid on, insures its penetration into the filling-up, even right through it to the priming colour, in places where, if the priming coats have been made with red-lead, or contained any boiled-oil, or similar objectionable substances, an action analogous to fermentation takes place which, reacting on the overlying paint, causes flaking, blistering, cracking, pin-holes, sweating, dead or cloudy surfaces, &c., to show up through the varnish. This, of which we hear so much complaint in American painting, and note it in their imported carriages, is almost unknown either in Britain, or with the best work on the Continent. Of course other fluid vehicles for pigments may be, as they have been, used; but the two named are proved to be the best yet known, and the best dryers for preparing colour are sugar of lead, and sulphate of copper; this last certainly preferable.

After this long digression, intended to save workmen from the annoyance of failure and hap-hazard processes, we now proceed to explain that the second and third coats of preparing colour, if intended for final colours—as lake, vermilion, ultra-marine, verdigris-green, canary-yellow, or lighter shades of colour, should have the preparing colour made of correspondingly lighter shades, and also where glazed-colours are used; or, if it be thought desirable, some of the final colour may be mixed with the preparing coats. These coats may be "flatted"—*i.e.*, made dead, or of dull surface, by pumice-stone dust and water being rubbed over them; this dull surface insuring the more thorough cohesion of coat upon coat of paint. Having followed up the courses of painting as far as the finish of the third preparing coat, duly flatted down, on all the panels and mouldings, and on the carriage and iron work, glass-papered smooth and level, the carriage is ready for the coats of final or fancy colours.

I will leave, for the present, the description of the various pigments, of which these colours are composed, and describe their mixing and manipulation by the carriage-painter. The fancy colour for the first coat is made by grinding the dry pigment with linseed-oil till it becomes of the consistency of cream. This may be done in a paint-mill worked by hand or steam, or from an engine worked by gas, or by the ordinary "muller" and paint-stone. This latter operation requires not only a critical sense of touch to know when the paint is ground fine enough; but the sense of hearing, as well as vision, aids in the perfect manipulation of the paints. As the successive coats of paint already laid on have sealed the grain of the wood, and levelled the surfaces of the ironwork, a small quantity of fancy colour will cover a large extent of the surface of a carriage. Assuming that a quantity equal to a gill measure of the fancy colour in oil has been ground to the consistency of cream, it has to be thinned by adding turpentine, to make it equal in measure to three-quarters of a pint; this must be well stirred in a large paint-pot with a brush, which is repeatedly drawn over the edge of a stout-bladed pallet-knife held over the paint-pot to insure thorough mixing. This, though so thin and liquid a paint, has a veritable body for covering work thoroughly; but it must be strained through a fine wire or gauze-sieve, or a "Stapfer" filter. It is now thickened to its proper consistency for use by the addition of about a gill of the best body-varnish; the purpose of this varnish is not to give lustre, that being just the reverse of what is wanted, but to give thickness and fulness to the paint in working, and a hard texture of surface when dry that will bear "flatting." Many other fluid materials may be used instead of varnish, but none are known to serve the desired purpose so well. In mixing this varnish with thin paint, it is best to have the varnish already measured into a paint-pot, and to pour the paint into it, stirring it with the brush thoroughly. In painting, there are two technical phrases, "laying-on" and "laying-off" the colours—the latter phrase simply means spreading it, i.e., painting. This is just the trained manipulation which, by its effectiveness, constitutes the workman who commands a high wage, and a leading position in his craft.

In laying-on the first coat of the fancy colour, the judgment soon aids the workman. It now depends upon himself entirely if he is to turn out good or bad work; that is, when finished, with a perfectly level glassy surface of japan or varnish, or with a streaky, silky, or ropy unevenness to mar his work. These are not frequent faults in English coach-painting. But they are about the only ones that are conspicuous with some second-rate work. They are invariably ascribed to a defect in the japan or varnish, which is so erroneous a notion, that we affirm that the very worst japan or varnish could not be made to assume ropy or streaky lines without the mechanical action of the brush and laying-off the previous coats of paint had laid the lines for the flow of the varnish to follow into. In fact, the manufacture of English varnish and japan has been brought to such perfection that painters have long since ceased to find fault with it to excuse their own errors. Laying-off colour on carriage-panels is to carriage painting what "stippling" is to artistic colouring and finish of art painting. This process of laying-off colour marks the highest mechanical qualification of a painter; the accurate conjunction of the action of the eye and hand determines it simply by the DEGREE OF ANGLE from the surface at which the brush is held in working the final strokes. If the brush be held too upright, or at a slight angle from the surface, streaky or ropy lines on the surface are certain. The points of the bristles act mechanically, and rake the paint into lines or ridges; these become enlarged by each subsequent coat of paint, and show glaringly in the varnished or japanned coats.

The highest grade in the craft of coach-making is that of the "picker-out," as that workman is called who lays on the relief lines and ornamentation to the body, mouldings, wheels, and carriage parts. These are done in one or more colours, different to the fancy colour of the panels and under-carriage. The widths of the reliefs vary from 1in. to 1-32in. The wide lines are called "bands," and are mostly the width of the body mouldings, or of the carved beadings of the carriage parts, if from $\frac{1}{2}$in. to [illegible]in. wide. The next narrower lines are called "stripes," and are used mostly for centring lines, either on the "bands" or on the fancy colour. These vary in width from [illegible]in. to [illegible]in. wide.

(To be continued).

WATCH-CLEANING AND REPAIRING.

By "A FELLOW-WORKMAN."

(Continued from page 166.)

PIVOTING.—The top pivot of the verge often gets broken, and I think you will find it easier to repivot than fit a new verge.

First make a hollow drill (Figs. 39 and 40). This is done by drilling a hole in the end of a piece of steel wire, a little larger than the body of the verge, and about 1-16in. deep, and turn it down, as shown in sketch, Fig. 39, so that it will cut away enough brass to make room for a plug, but not to loosen balance on its arbor; now make an arbor of a pivot drill and slip a piece of brass on it, as shown Fig. 37; you should file this arbor quite as small as the body of the verge, so as to be able to get a substantial plug. Now turn this plug so that it will enter about ⅔ into the hole made with the hollow drill (I forgot to mention that the piece of the verge body left in by the hollow drill can easily be removed by trying to bend it); now put plug back on to arbor and cut off as shown in Fig. 38, leaving a little piece of arbor protruding at bottom to act as a wedge to the plug when it is being driven home. Now put your verge on the "verge riveting stake"; put Fig. 38 in the hole and with spring punch, Fig. 42, drive the plug home; keep working the punch round while driving—you will feel when it is home, and then you must leave it alone, for if you drive after the plug has reached the bottom you will be upsetting it, and your job will be spoiled. Fig. 41 is a section of the plug after it has been driven; now put it in your calipers, and if balance runs true you can make your pivot, but if you find that in driving the plug it has got a little out of true, then you must make a true male centre, put it in the turns and turn pivot true before filing.

FIG. 37.

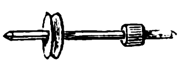


FIG. 38.

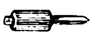


FIG. 39

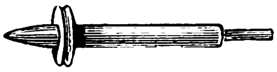


FIG. 40.

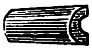


FIG. 41.

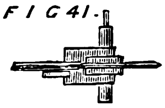


FIG. 43.

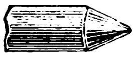


FIG. 44.

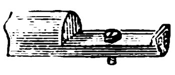


FIG. 45

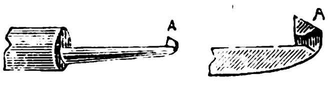


FIG. 46

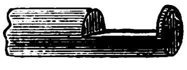


FIG. 47.

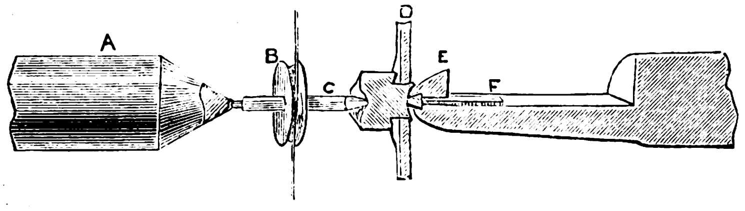


FIG. 42.

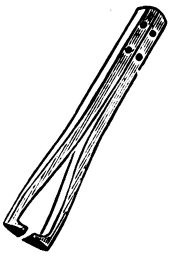
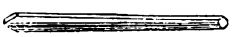


FIG. 49



Using the graver is got by practice. The following may help you: always cut above the centre, keep your rest as near your object as possible; *cut*, but don't *scrape*. Don't press on your graver: feel it cut, the same as you would a diamond; wet the graver with your tongue for brass, use oil for steel, turn very steadily, and hold your bow lightly; use a diamond-shaped graver, get up your graver with care. There is more practice required for sharping, or getting up, your graver, than there is to use it.

Fitting a new pivot to a pinion is very simple; it only requires patience, and may be learnt in an hour or two by anyone who has had any experience with watches, supposing the bottom (pillar plate) pivot is broken off. A 3rd wheel. You must drill a hole in the centre of pinion, fit in a steel plug, so as to get a new pivot. Now the following is a very simple plan, and will turn out a better job than many of the "pivoting turns," and it is not necessary to remove the wheel. Get two pieces of steel wire that will fit in your bench turns; make one end of one piece as shown Fig. 43, the other end as Fig. 44. Take the other piece of steel wire, make one end as Fig. 45, the other end as Fig. 46. Now place third wheel between the centres (43 and 45), as shown Fig. 47. A is Fig. 43, B is a rose or head, taken from a pivot drill (the hole is broached large to fit pinion). C is pinion, D wheel, E is A, in Fig. 45, F is a piece of broach, Fig. 48. It does not require any previous centring; simply place it as described (Fig. 47). Now put Fig. 48 in at the back of E, Fig. 47, and push it through until it touches the root of the pinion. Now, while you turn your pinion, you must press Fig. 48, which will find its own centre, and also make a hole for the plug, and the best tool in the world cannot do it more true. Now, having made your hole, make a plug out of a pivot-drill and drive it in; leave about enough for pivot. Now remove Fig. 45, and put Fig. 44 in its place; put face of Fig. 44 up against the root or shoulder of old pinion, so that the piece of plug left for pivot rests in a slot made for that purpose. Now take pivot file, and with the old shoulder as your guide, make pivot to size required, and polish as described in previous number. Now remove Fig. 44, and put in Fig. 46, and round off. It is not absolutely necessary to round off, but it looks better.

I do not think it is necessary to say any more about the verge watch. I will, if requested, go on with the horizontal escapement, unless some other correspondent would like to take it up, in which case I will stand over. I quite agree with "Tempus" that the best use should be made of the space, which is so generously given us by the Editor. That is one reason why I made my articles as short as possible. Hair-springs will come in best with the horizontal movement.

(*To be continued.*)

APPLICATION OF OZONISED OXYGEN FOR BLEACHING.

On p. 126 of the last volume we gave an account of the process, amongst others, of preparing oxygen, adopted by the firm of Brin Brothers, of Passy. The inventors have recently taken out a patent in this country for the production and application of ozonised oxygen for bleaching and other purposes, which may perhaps be taken as conclusive evidence of the commercial success of the baryta method of preparing oxygen. It is well known that ozone partakes of all the properties of oxygen, and that it possesses them in a more active and powerful degree; also that endeavours have been made a long time for the production of ozone. The present laboratory process consists in submitting oxygen to the action of the electric spark, or rather the efflux of a continuous current. The feeble production of ozone obtained by this method does not amount to more than a small per cent. of oxygen transformed into ozone. The reason of the non-success is that oxygen is a bad conductor of electricity at ordinary pressure, and resists its absorption; the electricity therefore escapes therefrom to a very large extent. It is not so with dilated oxygen. As the pressure diminishes, its conductivity increases: and if electric sparks are made to pass into a glass tube in communication with an oxygen reservoir it will be seen that the sparks become elongated and more powerful when the density of the oxygen is diminished; when this density falls to one-tenth, one-fifteenth, or one-twentieth of that of the atmosphere, the length of the sparks, which was originally respectively about three-eighths, three-fourths, and one and one-eighth inches, increases rapidly to 19, 28, and 38in. In this state the fluid is more quickly and completely electrified. In the manufacture of oxygen, according to the patent of the Messrs. Brin (1880, No. 1416), the oxygen is drawn from a retort containing barytes under a pressure of about one-twelfth to one-twentieth atmosphere. It is under these conditions that the inventors have observed the aforesaid phenomena of sensitiveness as regards electrification, and have been enabled thoroughly to investigate this state. According to the present invention cold oxygen is attenuated to a density about, at, or below a column of 4in. of mercury In this state the oxygen is passed through a circuit of electricity, which it closes, the current being in the form of sparks or continuous efflux. The oxygen may be made to enter a vacuous vessel, where it expands as required, and is exposed to the aforesaid electrical action. The oxygen is by preference, by an ordinary suction pump, or by a jet pump, or by any other suitable exhausting apparatus, made to pass through a cooling apparatus having, for instance, a coil for the oxygen and a continuous circulation of cold water around the same; it is then passed through the ozonising apparatus in an attenuated condition. The ozonising apparatus may be arranged as a vessel containing acidulated water, and having a series or system of tubular or other passages or chambers arranged with corresponding interior or intermediate tubular or other passages containing acidulated water. One pole of the battery or other source of electricity is connected to the water in the latter passages, and the opposite pole to the outer acidulated water, and the oxygen passing between them closes the circuit and becomes electrified, that is, ozonised, more or less as desired or required. The oxonised oxygen thus prepared—in the specification (No. 3728, 1881) the patentees show suitable plant—is of considerable use for many purposes in the arts, as it exercises a very powerful bleaching effect on organic and other soluble and insoluble substances in a very short time: for instance linen, cotton, jute, &c., saccharine liquids of all kinds, oils, &c. The process of preparing the oxygen was so fully described at the place cited that we need not recapitulate; it must suffice to say that, made on the large scale, its cost is said to be not more than 4s. per 1,000 cubic feet, to which of course must be added the expenses of the processes above described to arrive at the cost of the ozonised oxygen.

LUBRICATING BEARINGS.*

It is impossible for a bearing to run cool until the high places are reduced, so that there will be a uniform film of unguent between the two surfaces. It is a custom for purchasing agents, and in some cases for practical men, when ordering oil, to mention simply "lubricating oil," without specifying the kind of bearings for which it is to be used. The latter is a very essential point. Frequently, when the oil is received, it is found to give poor satisfaction, and some of the bearings are found to run hot. Under these circumstances, the oil is generally charged with the fault, when, in reality, the fault has been in giving the order. A good lubricant for small, close fitting, fast-running bearings must be of a very fine quality, and have a light body in order to distribute itself between the close-fitting surfaces. Such a lubricant is entirely unfit for large bearings, where more body is required to carry the heavy weight which is placed upon them. It is the practice in most shops to use the same kind of lubricating oil for all the machinery, which, when properly considered, is both unreasonable and extravagant, for the reason that a bearing, when imperfectly lubricated, is worn away much faster it than would otherwise be, and on fine machinery the lost motion in the bearings requires frequent attention.

Experiments are constantly being made with a view of producing a cheaper lubricant than the best oils now known, and which shall possess all their desirable qualities as lubricators. For heavy shafting the journals are generally lubricated either by means of oil boxes or cavities in the upper part of the cap of the journal, so that tallow, grease, oil or other lubricant may be placed therein. The old way was to fill the oil-box with tallow, leaving a small space for oil; and, in case the box should heat, the tallow would melt and run down over the journal.

I remember some years ago in a mill, there was a wall box supporting a five-inch shaft which would get hot and remain so in spite of all the efforts made to cool it. Oil, sulphur and tallow, water, were each used in great abundance, but still the journal refused to surrender. Finally, one night I raised the shaft and removed the composition box,, and had it carefully cleaned. The shaft having also been cleaned, a very light film of lamp black was applied to the shaft, after which the box was gently rubbed over it. This test revealed the fact that the bearing was all right so far as fitting was concerned, but the surfaces of both the shaft and box were rough, and the skin of the metal disturbed. The load upon the bearing being heavy, it was sure to heat. I obtained some pure flake graphite, and having melted a pot of pure tallow, I stirred in a liberal dose of the graphite. The box having been replaced, both bearing surfaces were covered with the mixture of graphite and tallow, and the shaft lowered to its place. In the morning when the machinery was started the box warmed up to about a blood heat and remained so for several hours, after which it cooled down and gave no more trouble. In a few days it was examined, when the surfaces were found polished like a looking glass. The graphite had become imbedded in the pores of the metal and formed a very fine wearing surface which ran with very little friction. I have since made use of this mixture for cooling heavy journals and have always found it successful. I have also used graphite mixed with oil for lubricating purposes, but have experienced difficulty from the graphite separating from the oil. I understand, however, that quite recent experiments have resulted in a chemical combination of oil with pure graphite, so perfectly that they fail to separate after standing quietly in a vessel for months.

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* By L. F. Lyne, in *American Machinist*.

In using oil for lubricating a line shaft I prefer to use automatic oil cups, except in cases where self-oiling boxes are used. I believe the latter plan to be the most economical. The boxes should have wipers so as to exclude every particle of dust which mingles with the lubricant and scratches the surfaces of the journals. The great cause of the journal bearings upon railway cars being worn away is the fact that dust is freely admitted to the bearings, mixes with the oil and destroys the journal. I have known absolutely tight boxes to run until the wheels had to be renewed, simply by the addition of a little pure oil occasionally.

With automatic oil cups I have known journals to run with from 35 to 40 drops of oil per week, and have all the lubrication required. In many shops a "doper" is required to oil up the shafting every other day, and, as a rule, each time he oils up more than as much oil is wasted as would be required to run a month. The best oil judiciously used will in every case prove the cheapest and most economical in the end.

RECENT IMPROVEMENTS IN THE MECHANICAL ARTS.*

A NOVEL invention, which has for its object the automatic setting out of the packing rings of a piston-head within the cylinder, has been devised by the Master Mechanic of the Pennsylvania R.R. Co., and will be adopted by that company for use on their locomotives. The improvement consists of a solid piston-head suitably cored out for the reception of the packing rings and their actuating levers, as also for the two adjustable bolts which centre the piston and provide the bearings against which the weight of the piston exerts itself to set the packing out automatically. The two operating levers are each fulcrumed in a block resting on the packing rings at the bottom of the piston and extend, one on each side, into the upper circumference of the head, where they rest against other blocks having their bearings on the packing rings and constituting the resistance of the levers. The power is applied through the two threaded bolts referred to and which work adjustably in screw bearings in the solid head. These bolts are each arranged on an angle of 30°. Thus, it will be seen that the whole weight of the piston rests upon these two bolts, which, in turn, bear respectively against their levers, whose fulcrums are in the bottom of the piston and whose resistances or operating ends are in the upper part of the piston, whereby the weight of the same is utilised, through said levers, to bear directly against the upper circumference of the packing rings to expand the same in the upper part of the cylinder.

A recent improvement, tending to increased safety in railroad travel, consists of a frangible tube projecting from the cab of a locomotive and communicating with the brake-pipe of the Eames or Westinghouse system of air-brake apparatus. A switch, drawbridge, &c., have wires or ropes attached to them which lead to semaphore arms arranged at a distant point on each side of the switch or draw. These semaphore arms are so arranged that when a switch is misplaced the arms will lie across the path of the frangible tube on the locomotive, whereby said tube will be shattered and the brakes instantaneously applied. In the Eames improved system, a constant vacuum is maintained in the brake-pipes, the brakes being set up by the destruction of the vacuum, which has the effect of opening up the vacuum power of auxiliary reservoirs located under each car; thus, it will be observed that the breaking of this frangible tube will destroy the vacuum in the brake-pipe. In like manner, in the Westinghouse system, a continuous pressure of air is kept up in the main brake-pipe, the reduction of which opens up secondary reservoirs under each car, which operates the pistons of the brake apparatus.

A late invention provides means for extinguishing fires in the stoves of passenger cars should they, by any accident, upset. For this purpose an elongated water reservoir is suspended along the side of the car. Cords, attached to the stove and to valves which normally close outlets in the reservoir, serve to operate said valves when the stove is upset, and allow the water, through a perforated distributor, to flow into the fire.

A new staple of manufacture consists of the fibre of the stalks of cotton plants. The stalk is disintegrated and the fibre separated from the rest of the stalk, preserved and prepared according to the following method: First separating the fibre from the stalk by passing through rollers or by retting, then drying, then scutching or breaking, and then carding or hackling the same, thus producing a staple of the fibre alone. It is proposed to manufacture from this staple woven fabrics by spinning it and converting it into twine, cordage and yarns, wadding, packing, calking, and paper.

ELEMENTARY LESSONS IN DRY-PLATE PHOTOGRAPHY—VIII.*

Third Lesson in Development.

IN considering the subject of exposure in a former lesson, we assumed that correct exposure is a fixed point, and that any deviation from it would give imperfect results. This is not the case, however, for there is a certain "latitude," which is due to two causes: first, a certain latitude of effect is permissible. Thus, if the plate be a little under-exposed, there will be somewhat less detail in the resulting picture than is visible to the eye, but this need not spoil the effect. Again, if the plate be somewhat over-exposed, the effect will be a slight fog or want of transparency in the shadows of the negative; but the only result of this will be that what is called a "slow printing negative" will be produced. The latitude in effect is not great, however. It may be said that if two seconds be the best exposure, anything between one and a-half and four seconds will give good results. We have, however, a second method of gaining latitude, and this is by means of the treatment with the developing solutions. Thus, simply by leaving the plate for a longer or shorter time in the developer, we can compensate to a certain extent for under or over-exposure. It is, however, by varying the proportions of the ingredients of the alkaline developer that we gain the greatest latitude. We must enumerate the chemicals used in this developer, and try to make clear what are the properties of each.

The essentials are as follows: First, pyrogallic acid, or more properly, pyrogallol; second, liquor of ammonia, or occasionally some other alkali; third, a soluble bromide, usually bromide of ammonium or of potassium. The pyro. is the true developer, and acts very energetically when rendered alkaline. The stronger the developer is in pyro., the denser will be the negative; but the effect of increasing the pyro. is to "restrain" devolopment—that is, to make it take a longer time, and to prevent a certain amount of detail from appearing. The ammonia is used to render the developer alkaline, and the greater the quantity in the solution the more energetic the action. The effect of increasing the ammonia is to shorten greatly the time of development, to increase to a slight extent the amount of detail, and to increase the density. A point is reached, however, where the action is so energetic as to reduce or blacken even those parts of the plate which have not been acted on by light, and fog is the result. Some plates will stand much more ammonia than others. The use of the bromide is to retard development—to make it slower, so that it may be more under control. Without it the development is very rapid, and unless the quantity of ammonia be very small, it is difficult to avoid fog. The result of increasing the bromide is to make the developer much slower, to keep back a little of the detail, and to increase ultimate density greatly.

A little consideration of what we have said will show that by varying the proportions of the constituents we have enumerated we have the power of greatly modifying the resulting negative, and have a power of compensating to a great extent for error in exposure. This is especially the case for over-exposure. It is true that in the case of under-exposure we can correct to a certain extent by using an increased quantity of ammonia; but the fog point is soon reached, and thus it is only to a small extent that we can correct in this direction. In the case of over-exposure, however, it is different. Either pyro. or bromide may be increased indefinitely. The latter is the best to increase, as it is the cheaper. By largely increasing the quantity of bromide the development is rendered slow as regards the appearance of detail, but less so as regards the increase of density. It is thus possible to stop the process in the case of an over-exposed plate before the shadows veil over, and yet to have a sufficiently dense negative.

We have said that it is right, in using any particular make of plates, to use the developer given in the "instructions;" but it is by no means necessary to mix the "stock solutions" exactly as directed.

We recommend that the solutions be mixed in the following manner:— Dissolve quarter of an ounce of citric acid in eight ounces of water. Add this to one ounce of pyro. Make the whole up to ten ounces, and label "Pyro solution."

Take once ounce of bromide of ammonia and make up with water to ten ounces. Label, "Ten per cent. bromide solution." Take one ounce ammonia, strength ·80, or two ounces of the ammonia diluted with an equal amount of water as recommended before, and make up with water to ten ounces. Label "Ammonia 10 per cent. solution."

There is no developer which is suitable for all subjects. Those given in instructions can only be taken as typical. If the photographer expects to excel, he must vary his developer to suit his subject. Thus, when the contrasts are very strong—say in the case of an interior with white columns and deep shadows—he must reduce the amount of pyro, or he will have a negative giving a "chalky" print. If the contrasts are naturally weak, as is sometimes the case in open landscape, he must increase the quantity of all the ingredients, but specially of the pyro and bromide. If he knows that he has under-exposed, he must increase the ammonia. If he knows that he has over-exposed, he must increase the bromide.

The following we have found to be a good developer for general purposes:—

Pyro....................	from 1 to 2 grains
Ammonia........................	3 minims
Bromide	1½ grain

To each ounce of developer.

This is a more restrained developer than is usually recommended. We find, however, that the increase of the bromide beyond that commonly used does not necessitate an appreciable increase in exposure, whilst it gives a better quality of negative, and permits of a considerable latitude in exposure simply by allowing the plate to be a longer or shorter time in the developer.

We shall now tell how the best result can be got from a plate when there is uncertainty as to whether or not it has had the correct exposure.

A developer made as follows should be flowed over the plate:—

Pyro......	1 to 2 grains according to subject
Ammonia	2 minims
Bromide	1½ minims

To each ounce of developer.

This is a very slow developer, and even if the plate be much over-exposed the image will not appear for some time. A little experiment will enable the photographer to know whether the plate has been over-exposed, correctly exposed, or under-exposed by the length of time which elapses between the time of pouring on the developer and the appearanceof the image. If the exposure appear to be correct, let one minim of ammonia be added to bring the strength up to that recommended. If it appear to be over-exposed, let development proceed, or even add more bromide. If the image be very long of appearing, showing that there has been under-exposure, ammonia may be added to any amount short of that which will produce fog. Good plates should stand ten minims of ammonia with one and a-half grains of bromide. The greater the quantity of bromide, the larger the amount of ammonia that may be used; but the quantity of ammonia permissible is not proportionate to the bromide used. Doubling the quantity of bromide will not permit double the quantity of ammonia to be added. With the ferrous oxalate developer, under-exposure and over-exposure may be corrected to a certain extent, but not so greatly as with the alkaline developer. The developer may be acclerated by the addition of any quantity up to ten minims of a 1 per cent. solution of hyposulphite of soda to each ounce of developer, or retarded by the increase of bromide. It is commonly said that there is difficulty with gelatine plates in getting a sufficiently dense image. Such a difficulty results from inorance of the principles of development. The secret of getting "plucky" negatives lies in using in alkaline developer strong in all the constituents, but specially so in bromide, and, if necessary, giving a slightly longer exposure than might otherwise be thought necessary. The real difficulty lies in judging when the density is sufficient.

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* By F. B. Brock, in the *Journal* of the Franklin Institute.

* Condensed from the *Photographic News*.

UTILISATION OF TIDAL ENERGY.

AT a meeting of the Society of Engineers, held on Monday evening last, a paper was read on "The Utilisation of Tidal Energy," by Mr. Arthur Oates. The author commenced by stating that the recent advance in the application of electricity to the storage and transmission of mechanical power has caused attention to be directed to economising our coal, by the employment of some of the inexhaustible sources of power, amongst which the tide takes the first rank in this country. After giving a table showing the power and value of the energy derivable from the rise and fall of tides, and explaining how they can be calculated, the means which could be employed in utilising the energy were stated to be almost innumerable. Of these, the tidal dam is by far the most important, therefore the rest of the paper was devoted to the consideration of it, illustrated by drawings showing the nature of the proposed dam. It would have to be constructed across an inlet, or in any position where it would inclose a portion of the sea, and would be provided with machinery to utilise the fall of the water into, and out of, the inclosure, near the times of high and low water respectively. The difficulties connected with this way of utilising, and the means of overcoming them, were then dealt with, and the various purposes for which the energy could be used, touched upon. After describing the principal modifications of the tidal dam, and the probable effect it would have on the currents and sea-bed in its neighbourhood, some of its structural details were considered, and the mode of constructing the class of dam illustrated, described. The author concluded by stating the physical and economic conditions necessary to render tide-utilising works an engineering and a financial success, and expressed a belief that in the future the design and construction of such works will form an important branch of civil engineering, and a remunerative field of investment to the capitalist.

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

The President's Address.*

AFTER reading a number of obituary notices relating to Fellows of the Society, the President referred to the report of the Council, as to the general prosperity of the Society, and then said:—

In no previous year, so far as I can gather from a reference to the printed records of the Society, has so much light been thrown upon subjects which are of the first importance in microscopy.

I propose, then, briefly to recall the evidences of progress in this part of our science, which the past year affords.

The Abbe Theory of Microscopical Vision.

As a notable feature may be mentioned the greatly increased interest which has been awakened in the important contribution to the theory of the microscope, originated by our illustrious Fellow, Professor Abbe. Although those views are now several years old, and were brought before the Society so long ago as 1877 by our then Treasurer, Mr. J. W. Stephenson, the recognition of the extraordinary nature of the experiments was until lately confined to a very small circle. Both in this country, and in Germany and America, however, the past year has seen a great extension in the number of those who have followed these experiments, and who have appreciated the important bearing which they have on microscopical vision.

I have used the term "extraordinary" because I think that everyone who has seen these experiments will readily agree that it is extraordinary, in every sense of the word, to find, that merely by excluding a greater or less number of the "diffraction" images found at the back of the objective, a great variety of entirely different appearances are presented by one and the same object—lines at a known distance apart doubled and quadrupled—or that objects in reality quite unlike can be made to seem identical—multi-sided figures giving images of squares. In short, the *same* objects may appear to be *different* in structure and *different* objects may seem to be *identical*, entirely according as their diffraction images are made dissimilar or similar by artificial appliances between the objective and eyepiece. The appearance of particular structure can even be "predicted" by the mathematician, before it has been actually seen by the microscopist.

The result of these experiments is to show that a distinction must be drawn between the vision of minute objects and what may be termed, for this purpose, "coarse" objects—*i.e.*, those which are considerable multiples of the wave-lengths.

The latter are imaged by the microscope, substantially in the same way as by the camera or the telescope, and their images correspond point for point with the object. We are, therefore, able to draw the same inferences as to the actual nature of such objects, as in the case of ordinary vision.

Minute objects, or parts of objects, only a few multiples of the wave-lengths, are, however, imagined in an entirely different way—viz., by the diffracted rays produced by the action of the minute structure. If *all* the diffracted rays from the object are reunited and reach the eye, an image of the real structure is obtained. If *some* only of the rays are transmitted, the image is no longer necessarily a true representation of the object, and the smaller the admitted portion the more incomplete and dissimilar the image. Now, as the objects become more and more minute, the diffracted rays are more widely spread, and fewer of them can be admitted by an objective even of largest aperture. The visible indications of structure in such images are not therefore necessarily conformable to the actual nature of the object under examination, and the only inference that we are entitled to draw from the image as presented to our eye, is the presence, in the object, of some of the many different structural peculiarities which are capable of producing the diffraction phenomena observed in the particular case.

Our veteran microscopist, Dr. Carpenter, C.B., has embodied, in the edition of his widely-known work published during 1881, a statement of the leading points of the diffraction theory, which is valuable as containing the results of his own matured views on the subject. He says (p. 187), "This doctrine, originally based on elaborate theoretical investigations in connection with the undulatory theory of light, has been so fully borne out by experimental inquiries instituted to test it, and is in such complete harmony with the most certain experiences of microscopists, that its truth scarcely admits of a doubt."

There are one or two points that require to be kept prominently in mind in regard to the diffraction phenomena in question; 1st, that they are not to be confounded with the so-called "diffraction band" observed round the outlines of objects illuminated by oblique light, nor with the "diffraction" rings displayed by brilliantly-illuminated globules; 2nd, that they are not confined to transparent objects illuminated by transmitted light, but are also produced by *opaque* objects; and 3rd, that they are not limited to lined or regular objects, but extend also to *irregular* structures or isolated elements of any shape; in fact, universally, to structures of all kinds, whenever the uniform propagation of the luminous waves is disturbed by the interposition either of opaque or semi-opaque elements, or of transparent elements of unequal refraction, which give rise to unequal retardations of the waves. They, therefore, apply not merely to the "resolving power" of objectives, but to their general *delineating power*—the power of the microscope to show things "*as they are.*"

The 3rd point is, I need hardly say, most important, and one which it will be very interesting to have more fully elucidated, having regard to Professor Abbe's statement that objects (such as the flagella of bacteria) which are only a fraction of a wave-length in diameter, will necessarily appear to us, not in their proper proportions, but with greatly *increased* diameters, and that very minute striations must appear as if the dark and bright interspaces were nearly of *equal* breadth, although in reality not so.

There are obviously many histological problems, such as the question of the structure of muscle, which a proper knowledge of this part of the subject may greatly help to elucidate.

The facts which we now have before us in regard to microscopical vision, are sufficient to justify the injunction of Prof. Abbe that "the very first step of every understanding of the microscope is to abandon the gratuitous assumption of our ancestors that microscopical vision is an imitation of macroscopical, and to become familiar with the idea that it is a thing *sui generis*, in regard to which nothing can be legitimately inferred from the optical phenomena connected with bodies of large size." That there must be a great deal more yet to be elaborated in regard to the origin and nature of the phenomena we have been considering, is obvious, and I hope that the attention of our own physicists and microscopists will be directed to a subject of such extensive practical bearing, not merely to the theoretical microscopist, but to the large class of practical histologists who are entirely dependent upon the microscope for the accuracy of their observatfons.

The Aperture of Objectives.

The "aperture question," as we all know, gave rise, several years ago, to a somewhat acrimonious controversy, not in the "Proceedings" of the Society, but in the unofficial section of its then *Journal*, and doubtless there were some Fellows who, at the beginning of last year, regarded with no little apprehension the prospect of a revival of that controversy. But, notwithstanding the warmth with which it was debated in its new form, no one will, I am sure, deny the very great value that the renewal of the discussion—between Mr. Crisp and Mr. Shadbolt—has been in bringing to the light what had previously been confined to a few. If any one does not now comprehend how an immersion objective can have an aperture greater than that of a dry objective of 180°, at least it cannot be any longer charged against this Society, that means have not been provided to enable him to do so.

The essential difference between the old and the new view of aperture is simply, that the former considered only the rays which *enter* the objective, while the latter deals with those which *emerge* from it.

The disadvantage of the former method, which estimated the incident pencils entirely by their angles, has been its inevitable tendency to give a fictitious importance to the angle of the entering pencil, which was supposed to have a special virtue of itself, in the delineation of objects. Naturally, therefore, the same angles, whether in air or any immersion fluid, were considered to produce an equal effect, and the advantage of immersion objectives was rested on minor points.

An estimation of the emergent beam, however, must obviously give the same result as one of the incident beam (assuming them both to be correctly made), it being of course impossible for anything to emerge that has not been first admitted. But to quote Mr. Crisp:—"The great and obvious advantage in dealing with the emergent pencil is that it is always in air, and so the perplexities are eliminated which have enveloped the consideration of the admitted pencil, which may be in air, water, oil, or other substances of various refractive indices."*

The subject of aperture is not, in reality, a difficult one, and any intricacy in which it may seem to be involved will be found to arise from the necessity of clearing away some of the old entanglements, such as the curious mistake involved in the "hemisphere puzzle" and similar matters. Looked at *de novo*, there are two simple stages in the aperture question.

(1) To appreciate that, in using the term "aperture," we use it not in any artificial sense, but as meaning opening and nothing else—defining, simply, the capacity of an objective for receiving rays from the object and transmitting them to the image.

(2) That the aperture (as so defined) of an objective is determined by the ratio between the diameter of the emergent beam and the focal length of the objective. According as this ratio is greater or less, so the objective will receive and transmit a larger or smaller portion of the total quantity of rays presented to it.

The emergent beam of an air objective of 180° angle cannot exceed in diameter twice the focal length; that of a similar water-immersion objective may be one-third larger, and of an oil-immersion half as large again, and the relative capacities of such objectives (with equal angles) to receive and transmit rays will always be as 1, 1⅓, and 1½.

It cannot be too carefully borne in mind that it is not a question of this or that theory, but the ordinary laws of geometrical optics, which determine that, all other things being equal, one objective will receive and transmit a greater quantity of light than another, and, therefore, has the larger or smaller aperture, according as the diameter of the beam emerging from it is greater or smaller.

As fellows of this Society we may, I think, be proud of the able communications, relating to this subject, which were published last year in the April and June numbers of the *Journal*.

Numerical Aperture.

The abandonment of the angular notation for aperture necessarily follows, as soon as the correct view of aperture is appreciated; for when we know that the apertures of three objectives are, for instance, as 98, 126, and 138, no one would insist that they should be designated 157°, 142°, and 130°. A notation can have no title to be considered a scientific one, which denotes things as the same when they are really different (60° in air and oil) or different when they are the same (180° in air and 82° in oil).

Until, however, the "law of aplanatic convergence" had been demonstrated by Prof. Abbe, no principle had been established by which the ratio between emergent beam and focal length could be conveniently denoted.

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*By Prof. P. MARTIN DUNCAN, M.B. Lond., F.R.S., &c. (Annual Meeting, 1882.)

* As pointed out by Mr. J. Mayall, jun., at the commencement of the discussion, if 180° in air is equivalent to 82° in glass, the 140° in glass of the immersion lens must represent something *more*. The fact is, however, so constantly misinterpreted, owing to the supposition that when the immersion fluid is introduced the effect is only that the 82° is no longer compressed by the action of the plane surface of the lens, but is allowed to expand to 140°. This is one only of the apparent difficulties that obscure the proper estimation of the incident pencil, and which are avoided in dealing with the emergent beam.

It would not be possible for me to condense, without a sacrifice of intelligibility, the steps by which he subsequently showed, in a very beautiful manner, that the ratio in question can be expressed by the product of the refractive index of the medium in front of the objective, and the sine of half the angle of aperture, that is by $n \sin u$.

Taking for our *unit* the capacity of an objective for collecting the whole hemisphere of rays from an object in air (i.e., the case of a dry objective of 180° angle) we obtain the "numerical" notation, which, commencing with the lowest numbers advances as far as 1·52 with oil-immersion objectives, and by the use of which not only are apertures compared in the same medium, but in different media also, and we see whether they are smaller or larger than the maximum of a dry objective.

It is gratifying to find that the reproach hitherto attaching to microscopists, for the use of a misleading notation, is, thanks to the efforts of this Society, being rapidly removed, and that the initials N.A. are no longer so mystic a symbol as they have been. I understand that many of the opticians have decided to use the numerical notation in future issues of their catalogues, which is a step in the right direction, which we shall hope to see generally followed.

Whilst on this subject I may point out how important it is that in observations with high-power objectives, their aperture as well as magnifying power should be stated. Whether a large or a small aperture has been used, may make a very material difference in the value to be attached to the results described.

The "Homogeneous Immersion" principle.

The utility of homogeneous immersion objectives being established beyond doubt by practical experience, it is interesting to note that the origin of the principle is very fully recognised by Prof. Abbe to be due to our esteemed Fellow Mr. J. W. Stephenson.

The two essential points in homogeneous immersion are, 1st, the increase in aperture obtained by the use of a fluid of high refractive index and, 2nd, the enhanced optical performance arising from the total suppression of spherical aberration in front of the objective. Prof. Abbe states that although Amici first applied oil immersion, he failed to recognise the specific advantage of an immersion fluid being as near as possible in refractive and dispersive powers to the crown-glass —*i.e.*, "homogeneous." He finished his lenses and then sought for oils and mixtures of oils of various refractive powers for obtaining the best correction. It was Mr. Stephenson who, in his first communications with me, expressed the opinion that doing away with the anterior aberration would improve the defining power, and especially would afford very favourable conditions for further increase of aperture."

The importance of this system will be appreciated when we remember, in regard to the first point (the increase of aperture), that the theoretical resolving power of an objective is thereby raised from 96,400 lines to an inch, which is the maximum of a dry objective, to 146,528 the maximum of an oil-immersion objective, the illuminating power being also increased from 1 to 2·25: while as regards the second point, we are able by the homogeneous-immersion method to reduce the problem of correcting a very wide-angled objective to the much less difficult one of correcting an objective of *moderate air angle*. Our lamented president, the Rev. J. B. Reade, declared in 1870 that "the ghost of aberration will never be entirely exorcised even by cold water." But there appears to be good ground for believing that oil has practically accomplished that object.

During the past year several kinds of fluids for homogeneous immersion have been brought before the society, such as chloral hydrate and glycerine, iodide of zinc and glycerine, and gum-dammar and cedar-oil. Two other vegetable products have also reached us, "tacamaque" and the gum-resin "oliban," or "incense," both dissolved in cedar-oil. While the dammar is claimed to be unchangeable, and to be in refractive and dispersive powers very near that ideal of a good immersion medium, "fluid crown-glass," there is evidently room for further research in this direction, particularly for a fluid which will not attack the various varnishes in ordinary use.

Lastly must be noted an important advance in practical manufacture by the construction, by Messrs. Powell and Lealand, of a homogeneous-immersion objective of the large aperture of 1·47 N.A. out of a possible 1·52. As long ago as 1850 one of my predecessors in this chair expressed the belief that objectives had then "nearly, if not quite, attained the limit of perfection," and whilst it will be prudent even at this much later date to avoid any assertion of finality in the present, or scepticism as to the possibilities of the future, it must be admitted that, so far as regards aperture and resolving power, we have arrived at a point beyond which it will, to all appearances, be difficult to advance, at any rate not without serious restrictions in the use of the objectives. Whilst it might be possible to work front lenses for objectives out of diamond, and so to increase the aperture to 2·5 N.A., and the resolving power to 241,000 lines to the inch, it must be remembered that it would be essential at the same time to provide an immersion fluid, slides, cover-glasses, and illuminators of the same refractive index as diamond also.

(*To be continued.*)

SCIENTIFIC NEWS.

THE approximate position of Comet Wells, on May 10 will be R.A. 23h. 33m., N.D. 74° 35' for Greenwich midnight.

Dr. J. Cossar Ewart, Professor of Natural History in the University of Aberdeen, has been appointed to the Chair of Natural History in the University of Edinburgh, vacated by Prof. Ray Lankester before he had actually entered upon the duties of the office. Prof. Cossar Ewart is an Edinburgh man, and for a few years held the post of Conservator of the Zoological and Anatomical Museums in University College, London. He organised the zoological station on the coast of Scotland, near Aberdeen.

Mr. Eugene Kästner, the inventor of the electrical thermophone, died recently at Strasburg, in the thirtieth year of his age.

The Select Committee of the House of Commons, having passed the Bill for the construction of an electrical railway under the Thames, between Charing-cross and the London and South-Western Railway, at Vine-street, Lambeth, there is a probability that we shall soon have another attempt to tunnel under the river in full swing. The subway was made at so small an outlay that the scheme for an electrical railway promises to be a success.

There seems small probability of the search parties finding Lieut. De Long and his section of the crew of the unfortunate *Jeannette* alive. The news of the burning of the *Rodgers* will help to discourage the old method of Arctic exploration, and draw attention to the plan of establishing depots and advancing by degrees.

One of Mr. Edison's assistants says that the large dynamo now running in London has a resistance of ·002 of an ohm, and that on this resistance Mr. Edison is able to convert 125 horse-power of energy into electricity with a minimum loss, and to avail himself of 97 per cent. of the electricity outside of the machine.

A new insulating compound has been introduced, which is said to be as efficient as gutta-percha or ebonite, and much cheaper. It has been patented by Dr. Fleming, and has been tested by, amongst others, Sir W. Thomson, Mr. Preece, and Mr. J. F. Moulton. It is understood to be a compound of sawdust, cotton-waste, paper pulp, and other fibrous material, which is so treated that it can be worked into any shape, and be made impervious to moisture or acids. The new compound has been named insulite.

In the course of a lecture delivered last week at the Crystal Palace, Mr. E. Bright stated that an electric railway, about thirty-six miles in length, had been projected for a district in the South of England, where abundance of water for driving Gramme machines could be found.

Apropos of the Crystal Palace Exhibition, notice has been given of the "last weeks," the increasing length of the days robbing the electric-light engineers of much of their opportunity.

We have the fifth annual report of the Hackney Microscopical and Natural History Society, and are pleased to see that it is steadily increasing in numbers, while its finances are in a satisfactory state. Dr. M. C. Cooke is president, and Mr. Collis Willmott, of the Triangle, Hackney, hon. sec.

At Llancaiach recently a fine seam of the red-ash house coal was struck in a trial pit near the Park quarries. The entire seam is 7ft. 8in. thick, with about 12in. of rubbish between the two coals. It was struck at a depth of seven yards, and it is estimated to extend over nearly 100 acres.

On the South Carolina Railway kaolin, mixed with plaster of paris and jute fibres, is used for coating locomotive boilers. The kaolin is said to preserve the iron from corrosion, while the coating is more effectual than the ordinary wood lagging.

The Abbé Moigno says that the results obtained at the Palace of Industry in the experiments with electric light in conservatories were not favourable. The naked rays were found, as discovered previously by Dr. Siemens, to be injurious to the plants, and when passed through glass globes, did not appear to affect them. The Abbé finds no proof that nocturnal illumination is beneficial to plants.

At a meeting of the Victoria Institute, on Monday, Prof. Reinsch stated that he had examined with the microscope no fewer than 2,500 sections of coal, and had come to the conclusion that coal had not been formed by the alteration of accumulated land plants, but that it consisted of microscopical organic forms of a lower order of protoplasm, and, although he carefully examined the cells and other remains of plants of a higher order, he computed that they have contributed only a fraction of the matter of coal veins, however numerous they may be in some instances.

The prizes offered by the promoter of the Naval and Submarine Exhibition have been awarded as follows:—For the best means of saving life in cases of shipwreck, to Mr. Roper, for his bridge life-raft, one hundred guineas; for the best contrivances in the shape of cork mattresses, hammocks, cushions, &c., for supporting individuals in the water, to Messrs. J. and A. W. Birt, fifty guineas. The exhibition will be repeated about May, 1881, and particulars can be obtained of Mr. Samson Barnett, jun., 4, Westminster-chambers, S.W.

For mountain observation of meteorological and other phenomena, a recent arrangement at the top of the Puy de Dôme seems well-adapted. Round the observatory tower, a continuous circular terrace, with balustrade about 40in. high, has been formed, giving a full view all round. The balustrade is divided into 360°, the numbers being cut in stone. North is 0°, east 90°, and so on. More than 300 localities have already been referred to this graduation. Two telescopes are mounted on chariots, which run on rails, and may be brought to any divisions of the circle, facilitating the view, which embraces some seven departments. Mont Blanc can sometimes be seen, at a distance of 280km. (say, 175 miles). A vocabulary gives all the places visible from the summit, and the places in each vertical plane passing through a degree are indicated. Further, geographical maps are constructed, having Puy de Dôme as centre, and a number of concentric circumferences with radii, indicating distances. With this system the path of thunderclouds, and various other phenomena, can be easily observed with great precision.

It is known that the action of the brain causes a rise of cranial temperature. M. Delaunay (we learn from *Les Mondes*) finds from experiments on himself during sleep, that, reciprocally, an elevation of cranial temperature stimulates the action of the brain. Dreams are usually illogical and absurd. M. Delaunay, by covering his forehead with a layer of wadding, gets sane, intelligent dreams. He has also experimented on modes of lying, which favour the flow of blood to particular parts, increasing their nutrition and functional activity. He has observed that the dreams one has while lying on one's back are sensorial, variegated, luxurious. Those experienced when on the right side are mobile, full of exaggeration, absurd, and refer to old matters; but those produced when on the left side are intelligent and reasonable, and relate to recent matters; in these dreams, one often speaks. The observations, according to the author, agree with what we know as to the seat of sensibility, of motility, of intelligence, &c., and the comparative psychology of the right and left brains.

It is a common notion that sunshine affects the draft of a chimney, exerting pressure against the rising smoke, and this idea might seem to be favoured by the mechanical effects of light discovered by Mr. Crookes. Herr Kohlrausch has recently, in Carl's *Repertorium*, described experiments in this relation made with a delicate means of measuring pressure—a thin piece of straightly-corrugated copper plate, fixed by two sides in a frame, and, through a needle, affecting a mirror by its movements. The instrument was fixed in the side of a wooden case, having vertical iron tubes connected above and below. The sun's rays, Herr Kohlrausch says, exerted no influence amounting to a few millionths of an atmosphere. He dismisses the idea in question as erroneous.

Various hollow glass objects (beads, pearls, &c.), are now prepared with the aid of Balmain's luminous paint, by a German firm, Schellhorn and Söhne, in Lauseha, Thüringia; so that, after exposure to strong light, they shine in the dark. Two methods are patented, some particulars of which are given in the *Deutsche Industrie Zeitung*, No. 15.

Among novelties recently shown at the annual *séance* of the Paris Physical Society, was a one-liquid battery of M. Aimonnet, which, with 32 elements in a case about 24in. long, 16in. broad, and 8in. in depth, worked a Cloris-Baudet motor, giving a force of 608 kilogrammetres, used for turning copper. A Gramme motor, driven by Faure accumulators, worked a powerful pump. The arc light given by the Salignac regulators was remarkable for its intensity and fixity. In the vestibule were 30 accumulators (600 kilogs.), feeding an arc lamp of 100 burners, and on the staircase 40 accumulators (60kg.) working 40 incandescent lamps. In one of the halls optical phenomena were projected on the ceiling, a method which would often be quite sufficient.

An electric railway is to be made in the picturesque valley of the Brühl, near Vienna. It will extend from the railway-station of the sulphurous baths of Merdling to the hotel known as the Zwei Raben, near Meierei, in the Hinterbrühl, which is annually frequented by thousands of tourists. The length will be nearly two miles.

The telephone system in Vienna (according to a German electrical journal) is only about three months old; but the number of subscribers in communication is 224, and it will soon be 250. This is a more rapid rate than in Berlin, where the system was begun in April, 1880, and the subscribers now number 668. We note that a full account of the telephonic system in Paris appears in *L'Electricien*.

Attention has lately been called by M. Roland to an animal of the rodent order, which is met with on the banks of American rivers, and which he considers well suited for domestication. It is about the size of a pig, and is called the *cubiai*, or the water-hog It is not an aquatic animal, but defends itself from its enemies by plunging into water and remaining there a few seconds. It lives among the reeds, and comes out morning and evening in search of its food, which consists of herbs and roots of all sorts. Its large incisors enable it to cut the hardest woods with ease. Taken young, it is easily tamed, and does not leave the house; it knows its master, and likes to be caressed, and it is very cleanly in its habits. Its skin forms supple and permeable leather, and the flesh is good eating. Without requiring more care than rabbits, it will furnish as much flesh as a sheep, than which it is less subject to disease (though the flesh is less delicate). The apathetic character of the animal enables it to utilise all that it absorbs, so that there is no need to fatten it, and a large number may be kept in a small space. It is not afraid of cold; in very hot weather it lies in water among the reeds.

A singular accident from electricity lately occurred at a corn-mill in Pittsburg, U.S. The mill is lit with the electric light, and the generator is surrounded by a barrier 4ft. in height. A workman leaned on the balustrade, but immediately he jumped up with a cry, and falling into the arms of the engineer, who was behind him, expired. It seems proved that the engineer, who had been making experiments, had stretched a conducting-wire from the machine to one of the other conductors, and along the base of the barrier; and it is supposed that the workman, leaning on the barrier, had touched the wire with a lamp he held in his hand, thus closing the circuit though his body and the ground. Since, to supply the 16 lamps of the mill, a tension equal, at most, to 800 or 900 volts was required, the accident shows that currents of tension approaching 1,000 volts should never be manipulated without special precautions being taken in insulation of the conductors.

On the occasion of the Venus transit in 1874, Prof. Tacchini suggested to Père Lafont the desirability of erecting a solar observatory in Calcutta by way of supplementing European observations under better conditions of climate. The necessary funds were supplied by private subscriptions and by a grant of 15,000 francs from the Government of Bengal, and in less than two years a large dome was constructed, having a splendid Steinheil telescope (9in.) with a Merz equatorial base, and a large reversion spectroscope (one of Browning's). An excessive exposure to the sun's rays compelled Père Lafont to desist from his observations. The work was proceeded with by Pères de Clipperen and Campigneulles, who began the daily registration of sunspots, protuberances, &c. They publish the results from time to time in a series of plates or diagrams.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

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DE MORTUIS NIL NISI *VERUM.*—THE LATEST ADVERTISEMENT OF THE COMMITTEE ON SOLAR PHYSICS—OTTO STRUVE 266 (COMA BERENICES)—μ^1 BOÖTIS—RIGHTS OF WAY, AND CLOSING FOOTPATHS—TESTS FOR A 3IN. TELESCOPE.

[19991.]—SINCE my last letter was written death has removed one of our mightiest intellects from our midst. I am, of course, referring to perhaps the greatest and most philosophical naturalist the world has yet seen—Charles Darwin. With what pride must not every Englishman ever regard him! To anything like mean, sordid, or selfish notions he was an absolute and utter stranger. His long and honoured life was wholly given up to the steady, patient, persistent study of the history of organised beings. That faculty of observation cultured and developed by his voyage in the *Beagle* 51 years ago, never afterwards slumbered nor slept; and the pure love of Truth constrained him to persist, through years and years of patient and persistent observation, for the purpose of arriving at it. It would be difficult or impossible to estimate the kind and amount of research embodied in such works as the "Origin of Species" and "The Descent of Man"; or even in his books on plants and earthworms. Moreover, the writing of the word "research" just now, suggests to me to recall the fact that he never went begging to Government to "endow" his investigations, or to grant him pecuniary aid in any shape or form. Like the really great discoverers in all ages and in all countries, he worked at his own cost and charge. He had faith in himself and in his cause; and had infinitely too genuine a love for Science for its own sake to use it for huckstering purposes, or for downright mendicancy. Such men as Charles Darwin are the very salt of the scientific earth. Alas! that they should be so relatively rare. Happily they leave their immortal work behind them, and their names are familiar to untold generations who follow them. Assuredly thousands will mourn for Darwin, who never beheld his face in the flesh; for of him may well be repeated the words of the Psalmist, "Know ye not that there is a prince and a great man fallen this day in Israel?"

So it would seem that an Eclipse Expedition has been despatched at the national cost, at the instigation of the "Committee on Solar Physics." It is to consist of that remarkably well advertised gentleman who seems, for some occult and inscrutable reason, to be always sent out to observe Eclipses (possibly in the hope that he may ultimately succeed in finding something out, if he only tries often enough!) and of Dr. Schuster. It is needless to add that the "expedition" received a parting puff in a daily contemporary, in which the "fine Roman hand" of the writer was but too distinctly perceptible. Luckily, that thoroughly competent astronomer, Mr. A. Cowper Ranyard, has gone out, too (it is needless to add *not* at the public charge), and that he takes with him a most complete and elaborate set of apparatus for Solar photography. He is to join M. Bischoffsheim's party. Other observers are also *en route* for Egypt. Now, the results of these separate expeditions will be awaited with keen interest; because if it be found—as I have little or no doubt whatever it will be found—that the unsubsidised and voluntary observers do all that, and more than is accomplished by the *Arcades ambo*, who made such a dismal fiasco, at a huge cost, in the year 1875, then I venture to think that the tax-paying public will have a distinct right to know at whose instigation and by whose authority Messrs. Lockyer and Schuster have been despatched on this errand. The initiated, of course, know that the whole thing is an advertisement, and an attempt to galvanise the Solar Physics Committee. If the nominees of this paltry little ring succeed in doing more than the unsubsidised observers, whose thought for themselves is subordinated and lost in their zeal for the advancement of Science, Mr. Mundella may, perhaps, be imposed upon a little longer. If not, then those at whose cost and charge the observers have been despatched to Egypt may conceivably claim, like the Cornishmen in the ballad, to "know the reason why."

In compliance with the request of Mr. Simms (letter 19936, p. 150), I availed myself of the opportunity afforded last night, by a few rifts in the clouds, to look at OΣ 266 (Coma Berenices). The driving moonlit cirrus haze prevented anything like an attempt at measurement; but my querist is certainly right as to the present distance of the components of this star, which is rather over 1·5″ than under it. I just turned the telescope on to μ^1 Boötis too; but failed to detect any abnormal faintness in the companion. It decidedly suggested no idea of a 10th magnitude. It may not be a very brilliant specimen of its class; but I should certainly rate it as of about the 8th magnitude myself. Of course, its bluish-lilac colour does not offer such a contrast to the background of the sky as the light of a white star of the same size would do.

In reply to query 46721, p. 183, highway boards, as such, have no power to agree, either with a landlord or tenant, to stop up a footpath over which the public possess a "right of way." The sole means of stopping a public highway is under 5 and 6 William IV., c. 50, ss. 84 et seq., which empowers two justices to stop up unnecessary highways, and divert and turn existing highways, so as to make them more commodious to the public, upon the requisition of the inhabitants of the parish in vestry assembled, through the Surveyor of Highways. The dedication of a road to the public constitutes a highway; and this is presumed if the owner of the soil throws open a way, and puts up no gate, bar, or other visible indication of his intention to exclude the public. In the case of Jarvis v. Bingham (and others) the Courts have allowed such presumption where the way had been only used four or five years and was actually in an unfinished state! Sixty years' uncontested user would indubitably establish the right under the Statute of Prescription; and I fancy that 12 years now would do so with equal certainty; especially, as I have just said, as only four or five years enjoyment of a right of way by the public has been held to be sufficient.

It is not very easy to comprehend what "Wykehamist" means (in query 46740, p. 183) by asking for tests for a 3in. telescope which can be found "without the use of a Star Map": because this may either indicate that he possesses a fair naked-eye acquaintance with the Heavens—or that he doesn't know a single star in the sky. However, he may try γ Leonis, ε Boötis, δ Serpentis, and σ Coronæ. If, though, your correspondent will only study your back volumes, he will find tests for telescopes of every size, sort, and description (including scores for 3in. ones) given over and over again.

A Fellow of the Royal Astronomical Society.

ASTRONOMICAL.

[19992.]—EYEPIECES.—Anybody who has a few astronomical books and has studied their utterances, and particularly their diagrams when referring to eyepieces, must have been struck with the idea that the subject is often very inadequately treated. I must say that, as far as my reading and observation extend, in no single work has the matter been dealt with and illustrated in a satisfactory manner.

Even in such a well known and useful work as Chambers' "Astronomy," we have a diagram of a Huyghenian or so-called negative eyepiece, and also of a Ramsden or positive eyepiece, but the paths of the rays are represented as being identical in both cases. At the same time we are informed that in the Huyghenian the image is formed between the two lenses composing the eyepiece, while in the Ramsden one it is in front of both, which statement is, no doubt, correct. By what perversity of ingenuity, then, are the diagrams made to contradict the test in the manner they do?

The path of the converging rays from the object glass through a Huyghenian eyepiece I take to be as I represent them here (Diag. 1), where R shows the converging beam, and E the eye of the observer. In the Ramsden form the ray path is something like this (Diag. 2), where F is the focus of the object glass, and E the eye as before. Will somebody kindly correct me if I am in error, and supply diagrams of other forms of eyepieces? While on this subject I may say that in Herschel's "Telescope" the diagrams seem to me to be, as one of our friends once said, when writing about another matter, "by no means inviting in their simplicity," and what another one might call a "caution." In Guillemin's "Heavens," edited by Mr. Lockyer, and revised by Mr. Proctor, we have a picture of the "Theory of an Astronomical Telescope," with the rays positively diverging from the centre of a convex object-glass. "My friends, these things ought not so to be."

FIG. 1

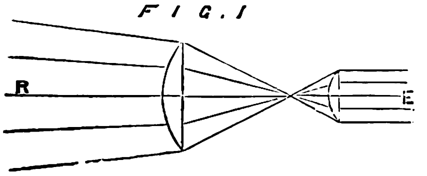
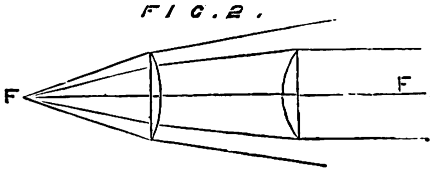


FIG. 2.



Powers Used.—We are favoured in this paper with a good many original observations and drawings of planets and double stars; but I wish that all the observers would give the focal length of the object-glass or mirror used at the same time that they give the power of the eyepiece. What would be even better than that, would be the adoption of the 6ft. focus plan as a standard to which all powers should be reduced. Seeing that the same eyepiece magnifies twice as much upon a 6-ft. focus as it does upon a 3ft. one, and that the focal lengths are very seldom given us, and the distance upon which the magnifying power is measured is never given us, the advisability of some uniform plan is tolerably evident if the pictures and observations are to be comparable with each other, or indeed to have any value at all.

Ascalon.

AURORA, APRIL 16TH—SUNSPOTS.

[19993.]—On the eve of Sunday, April 16th, there occurred one of the most brilliant exhibitions of the Aurora Borealis ever witnessed in these parts.

The Aurora began to manifest itself soon after sunset, and from that time on to midnight the northern heavens were the scene of most vivid illumination.

At 9 p.m., while observing some double stars in Leo Minor and The Lynx, I became aware that a bright haze was filling the field of the telescope to such an extent as to make it difficult to pick up faint stars. Removing my eye from the eyepiece, I at once saw the cause of this.

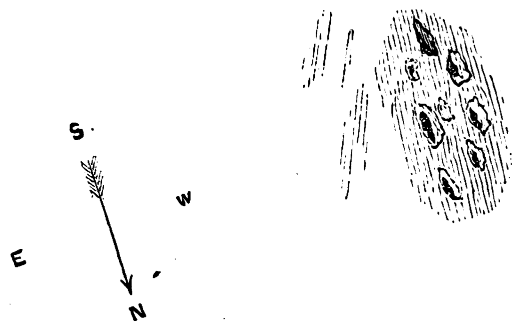
The Aurora, which but a few minutes before had been nothing but a faint phosphorescent glow along the northern horizon, was now rising a well-defined band of soft, even light. This band continued to rise until it spanned the heavens like an arch, the bases resting on the horizon at the N.W. and the N.E. points, while the centre was 25° or 30° above the horizon. Having risen thus, it remained stationary at about 9·45. Below and above this arch the heavens were as dark as ever; but about 10 p.m., spires of light began to shoot upwards to the zenith and downwards towards the horizon.

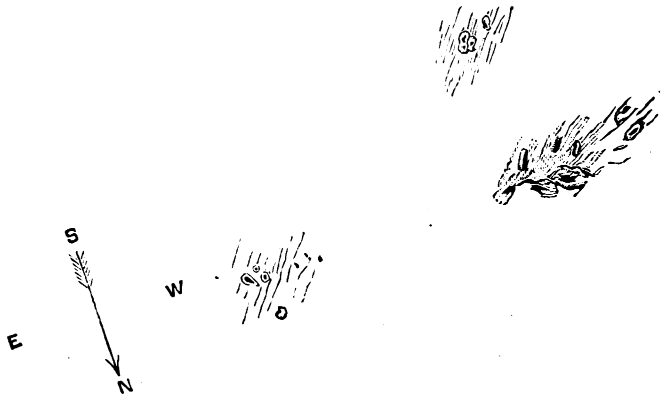
For more than an hour this continued; spire succeeding spire, flame succeeding flame, banner succeeding banner with great rapidity; while ever and anon large openings seemed to appear in the sky through which the light streamed with redoubled vividity.

At 11.15 the central portion of the arch began to reassume its quiet glow, while the bases began to brighten.

It now seemed as though a mighty wind had sprung up from the North, and was driving these bright bases to shreds, sending them through the air like flames or waving curtains. These, as the wind seemed to bear down upon them with fury, would bend before it like growing wheat; then, as it passed, straighten up again and glow with vivid tints of red, carmine, and green. Again they would fade away, but only to come back brighter than before. This continued until the flames had been driven quite to the S.W. and S.E.

At this time its appearance was such as to convey the idea that the upper strata of the atmosphere were on fire, and burning down through, and bright enough to read a newspaper. All this was doubtless caused by some tremendous action in progress on the Sun. While observing the Sun on the 14th, I saw some very large spots, and its face was dotted with spots of greater or less extent in both zones. On the western limb there was an aggregation of very large spots (of which I send a drawing), and the region all about was in a very agitated condition. Unfortunately I did not observe the Sun on Sunday, but to-day (Monday, 17th), I see the whole surface is entirely changed. The large spots on the western limb have disappeared, as also the chain of spots which encircle the disc on the southern zone, while towards the centre of the disc are a number of new ones (of which I send sketch), in the northern zone.





Perhaps—if such has not been done ere this reach you—some of your readers, who have well-appointed observatories, will give us the measurements and position of these spots.

Will "F.R.A.S." please accept my earnest thanks for his answers to my inquiries? So far, I have only been able to try γ Leonis and ζ Cancri, which I divided; γ Leonis being the easiest. I will try the others as soon as possible, and let him know the result.

Would he be so kind as to tell me what star atlas he refers to, when he says, "90 Leonis and 66 Cancri?" What is the best atlas for the amateur? I have Webb's "Celestial Objects"; but, though it is undoubtedly a most excellent work, I cannot see how I am to use it without R. A. and Decl. circles, and also all the star atlases referred to.

Perhaps I am dull of comprehension, and if some one will infuse a little, I shall be most grateful. **W. C. Herbert Bridle.**

1018, Wood-street, Philadelphia, Pa.

SCIENTIFIC RESEARCH AND THE ROYAL SOCIETY.

[19994.]—Permit me to amend a short sentence in my letter on Scientific Research, as I fear it is not so clear as it might be, the subject-matter being somewhat difficult. It is said that the "drop" phenomenon is owing solely to the *size* or *linear dimensions* of the source of the light, whether of the sun, or the flame of a rushlight. It should be that the "drop," as seen between two meeting bodies, whether of the Sun and the planet Venus, in a transit, or between the finger and thumb, or between two meeting penny-pieces held up against a sheet of white paper, is due, and due solely, to the *size of the eye-pupil*, and to that alone. Diminish this to the size of a needle-point hole in a thin metal plate, and the "drop" totally disappears; the meeting discs of other bodies being then seen to meet and touch each other, with clear and sharp outlines. It may be added that the pure and simple "black-drop" can be seen only between two *dark* objects against a bright light, as between two meeting planets on the sun's disc, could such an event occur. **C. B. A.**

THE COMET WELLS.

[19995.]—Ever since April 9th this comet has been observable with so small an aperture as 1¼in. and a power of 20; it was, however, only just within the reach of such an aperture on that date. Its appearance was that of a seven-and-half magnitude star a little out of focus, only distinguishable as a comet by averted vision, when a faint nebulosity was discernible on the preceding side. But by moving the telescope, so that the comet was viewed in various parts of the "field of view," the tail was made apparent to direct vision by steady gazing. It is almost needless for me to mention that the comet was only to be found by means of an equatorial.

On April 20th it was easily within the reach of such an aperture, being about three times larger than on April 9th, and by the 21st it had become so much brighter that according to Dr. Copeland it was "readily found with a good opera-glass."

We may, therefore, expect shortly to have the comet a naked-eye object, probably by the time these lines are in print.

Should the comet be as brilliant as it is expected to be, a splendid opportunity will be afforded us of adding to our spectroscopic knowledge of these, the most mysterious bodies with which the astronomer has to deal.

London, April 28. **B. J. Hopkins.**

A COMPACT FORM OF BUNSEN'S BATTERY.

[19996.]—I have made a very compact form of Bunsen's battery, and having used it a good many times, and it having thoroughly satisfied me, I thought perhaps it would not be amiss if I sent a description of it for the benefit of our numerous electrical friends.

The containing-vessel is an oak trough 19in. × 6in. × 4½in. outside diameter, and is made of ½in. stuff. It is divided into 12 compartments or cells by 11 partitions of ⅛in. deal, which slip into shallow grooves cut in the sides. Care must be taken that they fit very nicely, or they will leak.

The inside must be well waterproofed by giving it four coats of Japan black. For the first two coats a little turpentine should be added to the Japan, to make it soak into the wood. The outside may be French polished or varnished, and when a couple of good strong handles have been put on the ends this part of the job is finished; now you must go to the electrician's and get a dozen flat porous cells, 5½in. by 3¼in. by ¼in., two dozen zinc plates, 6in. by 3in. by ⅛in., and one dozen carbon plates, 5½in. by 2½in. by ⅛in. (these I had to have cut expressly for me, and got them with the rest of my things at Dale's), with a dozen ball-pattern clamps to fit. Now solder 6in. of 22 copper wire on to each zinc; now amalgamate them, and then put one carbon in and one zinc on each side of a porous cell, and put them in the outer trough. Now connect the two wires from the zinc of cell No. 1 to the carbon of No. 2, and so on through the whole series, leaving one zinc and one carbon for connection. Now charge the porous cells with nitric acid saturated with bichromate of potash (this is necessary to prevent it fuming), and the outer cells with sulphuric acid 1, water 10, and you will obtain a current of enormous power, very suitable for the electric light, for, with a good lamp, it will give a power equal to about 75 candles. It requires 2lb. of nitric acid (1s.) and 1lb. of sulphuric (1d.) to charge it, and with this charge it will give a constant current for about four hours. I would have sent description of the lamp I use with it, only I fear I have trespassed too much already.

H. S. B.

ELECTRO-MAGNETIC MOTORS.

[19997.]—EVER since the discovery that soft iron could be magnetised and demagnetised very rapidly, endeavours have been made to construct an effective engine for working purposes; and the increasing interest which at the present time is taken in the sciences connected herewith renders every attempt to stray from the beaten path worthy of investigation.

It seems, however, almost a forlorn hope, when we compare the cost of zinc with coal. But in competition with human and animal power, the case does not seem so hopeless when we consider that the food (which is the source of power) is also comparatively expensive. And hopes are further strengthened considering what Faraday says ("E.M.," Vol. XII., p. 106), that "the electrical relations of one drop of water equal a powerful flash of lightning," and that the power of a flash through 50 feet is equal to 12,220 horses, and the initial explosive force is equal to 300,000,000 tons. Here it is evident that explosive forces cannot be made to equate with correlated forces, which they supplement, and they elude our grasp.

It seems natural that an armature attraction (so long known) should be thought to be the most suitable means to utilise the discovery referred to; but seeing that it is known that battery power is being wasted to produce an average force far inferior to that at contact; and *that*, far less frequently in a given time than the nature of the case could admit of, great improvements are required.

In the presence of further light, I make bold to say that such a method is not the right one; and, moreover, I say that the power resides in the magnet itself; and that our efforts should be to contrive to use the *direct* force of the magnet (not acting at a distance) which can be proved exists.

Now, it is known that iron when magnetised, shortens by a small portion of its length, which is restored upon cutting off the current. This fact is, I believe, not generally known, and often considered doubtful. That such, however, cannot be but a fact, I have settled in my own mind, in this way: 1st. That anything can only produce motion in another thing at a distance by means of an intervening medium (in this case ether). 2nd. That anything can only produce motion in another thing when it is itself in motion.

But the difficulty lies in the application of so small a motion to practical purposes. This could not be done in the ordinary methods in use for such an object: the motion would be lost in what I may call the slack.

Although the motion is so small, we have two other circumstances in its favour (like the pawnbroker, 2 to 1). 1st. The power is very great; imagine the power required to compress a bar of iron (cold) the hundreth of an inch, or less. 2nd. It is known that magnetising and demagnetising, which corresponds with the shortening and lengthening, can be done with the utmost rapidity; in my opinion only limited by the number of vibrations corresponding to the musical note produced by striking the end of the bar.

But however an engine may be contrived, it is certainly necessary to avoid slack and friction as much as possible, and in order to give an idea of the elementary application of the power to other parts required to complete a machine, I describe Fig. 1, which represents a flat bar of soft iron riveted in many places to a like bar of brass, and wound round them a proper quantity of covered copper wire for the current, which flowing will cause a contraction of the iron bar, and deflection of the compound bar, becoming again straight when the current ceases. The bar is fixed at one end to a base or upright. Here is absence of slack or friction.

To manage a rapid cessation of current, I would suggest Fig. 3, which represents a circularsaw circumference with fine teeth (made of brass), which, rotating, breaks and makes contact with a suitable weak spring.

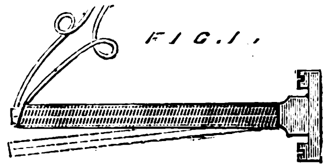


FIG. 1.

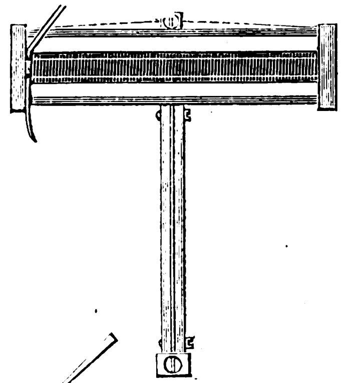


FIG. 2.

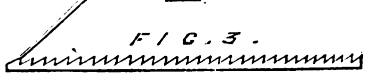


FIG. 3.

Fig. 2 represents a round bar of iron, surrounded by a parallelogram of gun-metal, in union, as if one piece. When the current is in the coil (shown) the outside bars are expected to bulge a little; but, nevertheless, a great increase of the motion compared to the iron bar. So far, I have had Fig. 2 made and laid aside for two years, and in the absence of a battery have been unable to test its performance. The lower part of Fig. 2 suggests a further increase of motion.

In conclusion, these ideas being only in their infancy, it is to be hoped that some of our readers will advance towards a perfect machine.

Barry-road, S.E. **J. H. Huxley.**

THE TELECTROSCOPE — DYNAMO-MACHINES—HEAT EQUIVALENT.

[19998.]—THE telectroscope, described in letter 19941 by "W. L." is certainly most ingenious, and I believe in theory is all right. In practice I am afraid the inertia of the moving parts connected with the Nicol's prism would render it impracticable. Those who know the difficulty of making a galvanometer with extremely light needle deat beat, will appreciate this objection.

With regard to "W. L.'s" first question, the changes of resistance of selenium attain almost the maximum instantaneously. The latest proof of this will be found in *La Lumière Electrique*, No. 16, April, 1882, p. 380—an account of experiments by Bellati and Romanese, showing that 1-1,000th of a second suffices to produce almost the total effect.

As to the second question, the resistance of selenium can, I believe, be altered 50 per cent. by bringing from darkness into a very strong light, assuming 50 per cent. to be what we work upon. If the selenium cell have a high resistance compared to the rest of the circuit, the resistance of the whole circuit may be altered nearly 50 per cent.; hence the whole current may be altered nearly 50 per cent., the resistance of selenium being about 10 per cent. that of iron, although the cell in this case must be very small (in theory a point), it might be possible to obtain the above result; still I think the objection on the ground of inertia would be almost insuperable. Now to turn to another subject. "Humble Bee" has stated that a current can be produced in a wire moving in a uniform field. "Conrad" objects to this. Now both are right. Whilst "Humble Bee" refers to a straight wire moving perpendicular to its own length and to the lines of force, "Conrad" thinks of a coil moving similarly. A coil moved similarly would have an electromotive force generated in the wire on each side of the coil; but these would be in opposite directions, and thus neutralise one another. A single wire can only be made to produce a current by letting the ends slide on two rails of metal joined at the end, thus virtually forming a coil, one side of which only moves, and thus the electromotive force in this side is not neutralised. By sliding the wire along we increase the area inclosed by the coil, and thus add lines of force to the coil or subtract, according to which way we move the wire.

In conclusion, I should like to ask a question. Will any one be kind enough to tell me the heat equivalent of one ampère per second through one ohm, as determined by experiment—not calculated?

Ll.B.A.

THE TELEPHONE RECEIVERS OF JOHNSTONE-STONEY AND OF PREECE.

[19999.]—MR. GEORGE TOLMAN is singularly unfortunate in his telephonic inventions. The forms of receiver referred to in his letter (19987, p. 177) as having been invented and used by him in November, 1880, had all been previously publicly described—the first two by Johnstone Stoney in the letter referred to in my previous communication (letter 19986, p. 177), the last by Mr. W. H. Preece in a paper "On some Thermal Effects of Electric Currents," read before the Royal Society on 27th May, 1880.

Johnstone Stoney says: "A spiral wire . . . was wound closely so that the spires were in contact or nearly so. One end of the spiral was fixed, and the other end attached by a thread to the middle of a . . . drum-head. A slight tension was put on the thread to draw the spires of wire slightly asunder. The spiral wire was then made part of a circuit, including one or two cells of Grove's battery and a line wire going to another room. The apparatus could obviously be rendered more efficient by using . . . a coil consisting of a number of concentric spirals not quite in contact, so as to allow small motion to exist. The induction might be still further increased by using a spiral of two wires, so that a powerful local current might be kept up in the alternate spires, while the varying line current is passing through the intermediate one. Another improvement would consist in using iron wire wound in a sufficiently loose coil. The self-magnetisation of the coil would co-operate with the electric induction to heighten the effect."

Preece says: "It occurred to me that if a long wire of small diameter and high resistance were attached to . . . the centre of a disc (such as one of those used for telephones . . .) and it formed part of a circuit conveying telephonic currents, sonorous vibrations ought to be reproduced." Experiments were made with wires of platinum, aluminium, palladium, tin, copper, silver, and gold, all under tension. **Alfred W. Soward.**

ELECTRIC-LIGHTING DANGERS.

[20000.]—WITH all due deference to "Sigma," for whom as an electrician I have the highest respect, I think he rather overrates the importance of the statement he refers to in his letter on the above subject. Mr. Johnson is certainly reported to have said that he would pass the "whole of that enormous current through his body." Still, it is to be remembered that his audience were not all electricians, and to go into the question of relative resistance of his body compared with that offered by the lamps and conductors would have been confusing and useless; what he wished to demonstrate was simply the inability of a low-tension current, as that generated by Edison's machine to do what the high E.M.F. in those of Brush and others have done—*i.e.*, give a fatal shock; and if in explaining this in popular language he allowed a technical inaccuracy to creep in, it hardly merits so severe a denunciation as "Sigma" would inflict.

No tyro in electrical matters would suppose that an E.M.F. of 110 Volts (or thereabouts) could send a current of 1,000 ampères through the resistance of the human body, and no one among the uninitiated will be in the slightest degree enlightened by "Sigma's" letter.

Suppose, then, we ask Mr. Johnson to reconstruct his unfortunate sentence, and make it run, "the whole current which that enormous machine could send through his body," and I think it will meet all requirements.

In conclusion, let me state that I am not in any way interested in the company concerned, and have never seen either Mr. Johnson or the machine.

Liverpool. **G. A. Moore.**

MEDICAL REPLIES.

[20001.]—VARICOSE VEINS (40673).—This is a permanent infirmity, due to congenital weakness in the fibrous coat of the veins, causing gradual stretching of the vein-tube with pain, swelling, and sluggish circulation in the parts affected. It is aggravated by much standing, by corpulence, by constipation. It is most frequent in the lower limbs, because there the veins have to support a long column of blood, and is more often found in the left leg than the right. Such occupations as do not throw strain upon the weak vessels; mechanical support to the legs by means of bandages, or elastic stockings, or adhesive plaster, and the prevention of constipation are the means of relief. I am not aware that climate is of consequence to such sufferers.

KIDNEY DISEASE (46667).—"B.D." who "has always lived freely, and smoked considerably," now has a series of symptoms for which he should get carefully examined by a physician. There is no means yet discovered by which a man who has "rotted his timbers" by "living freely" and smoking considerably can get a new set of timbers put into him. If he leaves off drinking and smoking he will stop the rotting process, and, if not gone too far, sound medical advice will show him how to tide along and make the best of such stock of vitality as is not yet used up. And medicine may help him. But his case is not one that can be served further by letter writing.

SCROFULA (46707).—This is too large and varied a subject to write upon usefully, as now requested. The forms of degeneration known as scrofula are endless, affecting as they do more or less all the organs of the body, and in very various ways. Querist probably has scrofulous disease of the glands of the neck—a disease in which earthy deposit takes place in the substance of the lymphatic glands. This slowly enlarges the glands to a chain of almond-like tumours, and when a little cold is taken, or the deposit softens, there ensue a series of abscesses. These abscesses discharge matter, and—so soon as all the scrofulous deposit has been got rid of—they heal up, leaving unsightly scars. The longer these abscesses are in clearing out the deposit, the greater will be the permanent scarring and deformity. Local applications, of which occasional dressings with a thin layer of soft-soap is one of the most useful as a domestic remedy, will often hasten and facilitate this discharge. But much depends upon improving the general health, so as to prevent further deposit, and make the blood so healthy as to quicken the healing process. Damp houses and damp clayey localities are prejudicial. Sea air, sea voyages, change of climate, and dry dwellings are advantageous. Open-air occupations, flannel clothing, such food as I have indicated in former letters—in fact, such hygiene, regimen, and diet as will keep the bodily health at its best, are the foundation of the treatment for such cases. Here, again, medicine also will do much; but I can only advise the sufferer to consult some good physician in his neighbourhood, who can personally examine him and realise his condition. Unless vegetarianism is distinctly beneficial, my opinion would be against it in your case. If thin in person you will find the fat bacon, milk and porridge diet useful. Abstain from alcohol and tobacco.

BROWN MARKS ON SKIN (46671).—Many such marks are cured by applying to the skin a lotion composed of an ounce of borax to a quart of water. The lotion should be dabbed into the skin every night at bedtime. If, however, the spots are of the nature of lepra or psoriasis, they will not go away without appropriate constitutional treatment. **James Edmunds, M.D., &c.**

Grafton-street, Bond-street.

"ENGLISH MECHANIC" MICROSCOPICAL SOCIETY.

[20002.]—SOME few weeks ago, a letter appeared in the ENGLISH MECHANIC in which it was proposed to establish a Microscopical Society amongst the readers of this journal, to be called the "ENGLISH MECHANIC Microscopical Society." It is gratifying to find that several of "ours" have already signified their willingness to help in getting up such a society, and it therefore only remains for those interested who are ready to become members to drop a line to either of the undermentioned, who will be very glad to receive any suggestions bearing on the matter. The proposed society could be worked somewhat as follows, subject, of course, to such modifications as might be deemed expedient, viz.:—

Admission to be by a small entrance fee and annual subscription, to defray necessary expenses.

A certain proportion of the members to be chosen annually to act as committee and honorary secretary.

Proper rules to be drawn up for the guidance of members.

Each member to contribute a stated number per annum of slides for circulation.

Boxes of slides, &c., to be sent from member to member at regular intervals. Note-books to accompany slides for receiving notes on the objects sent, or on any other matters interesting to the members generally.

The above is merely a bare outline of what might be done. It would be for the members themselves to say how far the idea should be extended. After a while the society would be found to be a pleasant source of recreation and mutual assistance, and could be made extremely useful in the way of naming and exchanging specimens, &c., &c.

Those favourable to the scheme will greatly oblige by communicating their ideas to

N. C. Sutton, 5, Courtenay-terrace, Portslade
near Brighton; or
F. Cowley, 106, Western-road, Brighton.

WENHAM'S UNIVERSAL INCLINING AND ROTATING MICROSCOPE.

[20003.]—THE readers of the ENGLISH MECHANIC are, I am sure, much indebted to the Editor for the publication of the figures and description of Wenham's new microscope in the issue of April 21. We are thus enabled to understand, in some measure, the scope of design of the microscope that most perfectly realises the modern ideal—especially after the numerous and splendid models of stands by Beck, Bulloch, Grubb, Ross, Swift, Tolles, Watson, and others, that have appeared from time to time in the pages of the "E. M."

I venture to offer a few observations in supplement to your published description, premising that I have examined the instrument carefully. I also premise that sundry of the movements are practically the same as those in Watson's microscope (devised by Mr. Moss, of Macclesfield), published a few months ago in the "E. M." As it is known, however, that the original models of both stands were in process of construction at the same time, neither party being aware of the other's design, they may both be regarded as original; my observations will, therefore, not include any direct comparison between them.

Dividing my remarks under four headings—(1) On the general design; (2) The fine adjustment; (3) The stage; (4) Minor items—

(1) The general design is the most ambitious hitherto constructed. Here are no half-measures. Mr. Wenham has grasped the idea of centralising the whole of the movements round the axes of the object to be viewed, and has developed it thoroughly. In Grubb's substage-arc, Nachet's double-sector substage, Zentmayer's swinging tail-piece, and Tolles's vertical disc-carrier for the substage ("Tolles-Blackham" microscope), combined with the rotating stage, we have devices enabling us to obtain every obliquity of illumination (within certain limits imposed by the construction). But for range of effects obtained with the minimum labour to the worker, Mr. Wenham's new microscope presents advantages over all previous constructions. He makes the focal point (*i.e.*, the object) the point of intersection of the three axes of motion by which the object can be presented to a fixed source of illumination at all degrees of obliquity. When utilising the movements to obtain obliquity of light, the observer knows exactly the direction of the change he is making. Every position can be registered, and the results repeated at pleasure. Moreover, within considerable limits alterations of the greatest possible delicacy in the obliquity can be made without removing the eye from the eyepiece. For example: Taking Fig. 2, "E. M.," April 21, p. 144, as the normal position for central light, by removing the condenser, clamping the tail-piece to the sector, and directing the mirror in the axis, the lateral inclination of the limb proper, carrying the optical tube, will at once give the range of oblique light from the nadir of the object, to within a few degrees of its horizon; or if the hemispherical lens be applied in the stage, in immersion-contact with the base of the slide, obliquity of incidence from 0 to 90° on a dry object (*i.e.*, in air) will be comprised within the lateral inclination of the limb, about 41°; for this inclination will utilise from 0 to 41° of the spherical surface of the illuminator, and the corresponding rays emerging into air above the plane surface will be at all obliquities from 0 to 90°. As regards dark-field illumination, the new stand gives the amplest facilities. With any objective—dry or immersion—the dark-field can be obtained. Even with the objectives of highest aperture—the homogeneous-immersion $\frac{1}{8}$ths, of Powell and Lealand, having 1·47 N.A.—the dark-field would be obtained by the lateral inclination of the limb, or by swinging the mirror on the tail-piece, 76° from the normal position, using the hemispherical immersion illuminator. On the whole, it appears to me that the combination of movements radially with the object itself as the centre, as embodied in this microscope, furnishes us with the most efficient means yet devised to utilise the resolving power of our finest objectives—to develop the finest images they are capable of producing. I commend the general design because I foresee that in the hands of the averagely skilful manipulator, results which have hitherto been regarded as extremely difficult, and obtained somewhat hap-hazard, will be brought within the compass of everyday ability. If the microscopist cannot now control the oblique light to his will, he must not blame his microscope.

(2) The fine adjustment is very conveniently placed, so that it can be worked on either side of the nose-piece. But the mechanism is lacking somewhat in delicacy. To my touch the movement was not so smooth as in a fine adjustment on a similar principle made by Swift. If the pinion of the fine adjustment projected slightly beyond the present milled heads, and were tapered conically, an extra sized milled head might be readily slipped on when required for very careful focussing—as generally adopted by Tolles. At present, too, one notes that the two milled heads of the fine adjustment and those of the coarse adjustment come together too closely in racking up the optical body, which might occur either in using 4in. or 5in. objectives, or in using the super-stage. If one required to rack out the optical body entirely, it would be necessary to remove the milled heads of the fine adjustment—which seems to me by no means an admirable or convenient arrangement. The great variety of movements in the new stand necessitate the adoption of a fine adjustment that will work equally well in all positions. Doubtless, Messrs. Ross found difficulties with the "Zentmayer" system that compelled them to experiment in new directions. I earnestly hope, however, that they will not rest satisfied with their present system, but innovate until real success is attained. A thoroughly efficient fine adjustment that will permit the free use of the "correction" collar of the objective without rocking, is one of the mechanical problems of the day still unsolved.

(3) With reference to the stage, the mechanical rectangular motions appeared to me rather too rapid, and I could wish (as suggested by your contributor), that Tolles's plan of giving rigidity to the fixed ring carrying the rotating plate, &c., by thickening the exterior flange vertically, and above the general plan of the stage, towards the shoulder, had been adopted. A clever mechanic like Wenham cannot fail to appreciate the merit of Tolles's plan,—Tolles who is regarded across the Atlantic as the microscope optician *par excellence*.

(4) As to minor items, I would suggest that the "iris" diaphragm beneath the achromatic condenser and the rotating disc of central stops, &c., might advantageously be replaced by the simple disc of central apertures, as in Powell and Lealand's condenser. The "iris" never acts centrally enough for delicate work with the condenser. The centring motions of the substage did not appear to me quite up to the mark—I found loss of time and general sluggishness of action in the movements. The modifications which Messrs. Ross contemplate making in the base-plate, &c., to enable the mirror to be slid in a rotating plate in the centre, and so that a lamp can be carried on the swinging tail-piece or at the lower end of the sector, are all commendable, and will get rid of what now appears an enormous area of blankness in the basal disc.

In the above remarks I have used some freedom of criticism—not, however, in an unfriendly spirit to the inventor of the new microscope. We have many of us come to regard Mr. Wenham as the type of a practical mechanician from whom improvements in the construction of the microscope are to be expected. Let me urge upon him to focus his attention on the fine adjustment, and thus crown his efforts by making the most perfect all-round microscope that has ever been seen.

F.R.M.S.

RAILWAY BRAKES.—THE WESTINGHOUSE AUTOMATIC VACUUM.—TO "A RAILWAY SERVANT."

[20004.]—THE Westinghouse patent, No. 1735, dated May 13th, 1873, contains, among many other improvements in details, a valve apparatus for, and is the earliest patent in relation to, automatic brakes. The system, as at present designed, is almost identical with the Westinghouse automatic air-pressure brake, and has a triple valve, auxiliary reservoir, and brake cylinder, modified to suit vacuum action. As in all vacuum brakes, the cylinder and reservoir are necessarily larger than in the compressed air brake; and the weight of the parts, with the exception of the main brake-pipe, is considerably in excess of that of the corresponding parts in the automatic air-pressure system, though not so great as in the Sanders and Bolitho apparatus, as used on the Midland Railway, one great advantage being that the heavy and expensive rocking shafts are dispensed with.

As mentioned in my letter, page 156, the hose connection between the vehicles is made by means of the Westinghouse universal coupling, which can be used either with air-pressure or vacuum, and will be understood by reference to the annexed illustrations.

Fig. 1 shows the main brake-pipe, tap, hose-pipe, and coupling, as seen upon the end of a vehicle. Fig. 2 gives a section of the coupling, and also the internal wire-coil *b*, used to strengthen the hose-pipe.

It will be seen that the cap 1, at the back of the coupling, presses the flexible diaphragm upon the internal cage 2, which, in its turn, holds in its place the packing-ring 3, at the face of the coupling, a spiral-spring 4, has the effect of pushing the packing-ring outwards, thus insuring a perfectly air-tight joint; a small hole 5, is drilled through the cap 1, to allow the pressure of the external air to act on the diaphragm, and assist the spring.

Large numbers of vehicles may now be seen on different railways fitted with the hose-pipes of both air and vacuum systems; this is of great convenience in the interchange of rolling-stock, but it necessitates double expense, and the adoption of universal couplings as above described, will avoid the duplicate cost.

In my letter, 19924, page 130, I pointed out the very great advantages to be derived from the use of a triple valve. As before stated, the Westinghouse Automatic Vacuum Brake, being provided with a triple valve and a pump, instead of ejectors, obtains results superior to the existing vacuum brakes. It has been perfected in order that railway companies who desire may possess a better vacuum-brake than those hitherto placed before them; but of course no improvements in details can overcome the inherent defect of all vacuum brakes having but a low pressure available; they must, therefore, always remain inferior to the automatic air system.

FIG. 1

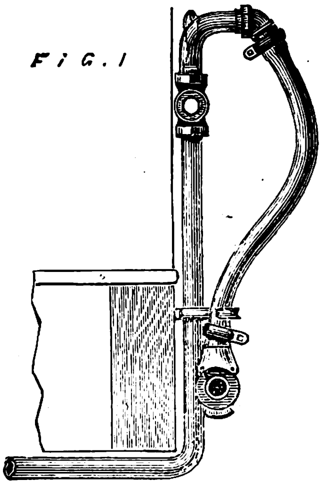
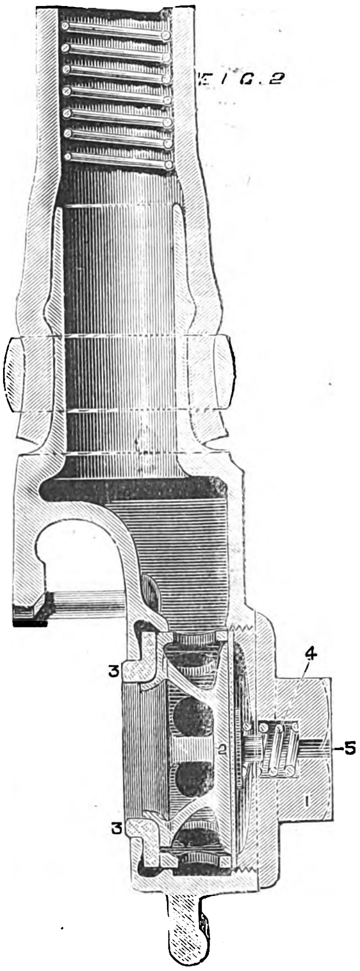


FIG. 2

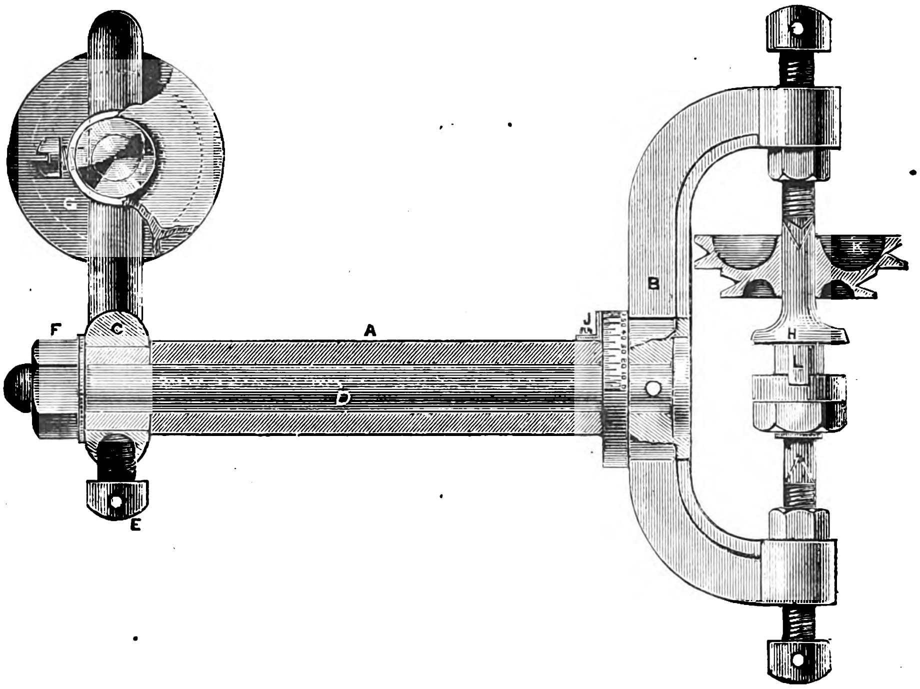


Clement E. Stretton.

Leicester, April 28.

CUTTING FRAME.

[20005.]—I HEREWITH send sketch of my cutting frame which I have had in use about eight years, and which I think is an improvement on "F. W. G.'s," and of which Mr. J. Evans mentioned in his letter. It will be seen that it can be set at any angle. Description: A is a piece of ¾in. ron square, with a hole bored through to fit D and urned down one end for C to work on. B is a gunmetal frame with an index plate cast on and divided as a sector from 0 to 90, so you can find the angle of the work to be cut. Then unscrew the nut F, and set it by the steel pointer J, then tighten up F, then slacken out E, and put on the cord, and it will soon find its position; then tighten up E. You can regulate the guide wheels G up or down. I have broken one of the wheels away to show, and I have broken the boss of B away to show the head of bolt D. The pin is to help hold it from turning round. H is the cutter-bar, with a slot L, 3-16in. by ⅜in. to take fly cutters. The collar I has a groove cut in half its depth, so as to grip the cutter: but circular cutters can be used by fitting a piece in the slot so as to form a feather on one side to keep the cutter from slipping. K is the speed pulley in section just driven on tight. I have not broken the division-plate, but kept it whole to show the divisions. When the cutter-bar is perfectly upright the pointer J should stand at 90°. The sketch is one half real size.

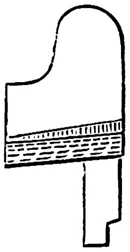


I am now making one for a gentleman, and should be pleased to show it when it is finished to any of my fellow-readers, or give any information if necessary. I have several different heads to take the place of B when required. **C. E. Sibley.**

29, Woodville-road, Mildmay-park, London, N.

UNIVERSAL CUTTER.

[20006.]—IN reply to Mr. J. H. Evans's letter 19950, I know that in using the universal cutter for cutting spirals it is usual to set it at an angle. But for this work I use, instead of it, a drill, the shape of figure, in the drilling instrument, and it cuts very clean and rounds off the corners as well. Sometimes I use a large step drill. **F. W. G.**



ORNAMENTAL LATHE-THREADS—ERRATUM.

[20007.]—IN my last letter (19973) by some oversight, at page 173, the woodcuts, Fig. 2 and Fig. 3, have had their angles interchanged, and need correcting with the pen in order to be brought into accordance with the description, which will be found in the third paragraph of the text. Fig. 1 shows accurately the deep Holtzapffel-thread of 50° angle. Fig. 3, with its full triangles at an angle of 60°, indicates the shallow Holtzapffel-thread. Fig. 2 was intended to show the Whitworth-thread in triangles of 55°, but rounded off one-sixth at top and one-sixth at bottom, as shown by mistake on Fig. 3. Fig. 3 was intended to show the American thread in triangles of 60°, but truncated by horizontal planes to the extent of one-eighth top and bottom, as shown by mistake on Fig. 2.

There are other well-known sets of screw-threads whose data would be of permanent value if put upon record in the ENGLISH MECHANIC. Such threads as those of Clement exist in dividing-screws and other valuable apparatus; but if their data are published, I do not know where to find them. I know that "J. K. P." has a very fine set of Clement's original steel hobs, and that upon screw-threads he could supply authentic and valuable data, which may drift into oblivion unless put upon record. Perhaps "J. K. P." will favour us, 1st, with any such data which he may be possessed of; 2nd, with an expression of his opinion upon the screw questions which I, as a mere dabbler in amateur mechanics, have ventured to raise.

To anyone interested in following up the screw question from a mathematical standpoint, with a view to establish a system of screw-threads, of which the pitch will be a definite fraction of the diameter of the cylinder on which it is cut—thus forming a universal and natural system of screws—I would recommend the perusal of a learned and valuable treatise (Systematique des Vis Horlogères) by Professor Thury, of Geneva, published by H. Georg, à Geneve.

James Edmunds.

PROPELLERS.

[20008.]—IT has occurred to me to suggest a plan of propeller, of which I made a small model many years ago, which may be described as having the motion somewhat of the connecting or coupling-rod between the side pair of driving-wheels of a locomotive engine. Look at these as a train passes: they appear to rise and fall most gracefully, but in reality they rise forward, fall, and retire.

If, therefore, there were two pairs of cranks working at each side of the vessel, with a framework acting as a coupling, and to this framework were attached suitable floats (there might be a dozen, forming a set of boxes without top or bottom), which would each inclose for the time a large mass of water, the dead-weight and resistance of which would, doubtless, by its reaction give a good progressive tendency to the vessel. I would propose to work these with slow but powerful motion. It has always appeared to me that there is a vast waste of power in the enormous speed at which both paddles and screw are driven. If, for instance, a rower were to drive his oar through the water at the same proportionate speed and force, the chances are he would soon either break his oar or kill himself for his trouble, but the boat would not gain the speed he would expect. I believe a vastly-larger blade—in fact a continuous blade, strengthened by tie-rods and guides from the shaft, so that the diameter would be as great as the beam of the vessel, would be the correct thing for a screw-propeller, and would be obliged if you would allow the subject to be discussed in the ENGLISH MECHANIC AND WORLD OF SCIENCE, by those who are more competent to form a correct opinion. **Milford.**

IRON MOULDING NO. 2.

[20009.]—As promised in my last, the subject for the present paper is "Screw Propellers." After having examined the drawing and the loam-boards, the moulder prepares for a start. First, by making a plate to build it on, if there is none already. The size to make it will be about one foot larger in diameter than screw. The building-plate may be made circular if the screw is small, and can be dried in the stove. If large, and to be dried in the pit, or on the floor, it is best to make it with three or four blades, according to number required. Or, if the moulder prefers a separate plate for each blade, will, in a great many cases, be superior, as they are easily shifted from place to place; and, besides, if the mould is made to answer when built, each blade can be lifted separately from its bed and dried in the stove, which is very convenient, as they take up little carriage room; and, besides, the drying in the stove is superior to the pit, and less fuel is required. We will assume the screw is about 16ft. diameter with four blades. There will be a circular space required, about 20ft. diameter, to work in. Concerning the pitch, size, and shape of propeller, are matters for draughtsman and pattern-maker. The screw we will commence with will be what is known as a plain screw, or constant pitch throughout. It is the most simple made, and one often in use. Some propellers are made with two or more different pitches, which will be spoken of as we get along.

The one we are commencing shall be built so that each blade, if convenient, can be taken off its bed and dried in the stove, or without being moved, and dried where built. The first thing to be done is to lay down a plate about a foot larger in diameter than boss of propeller, with a round hole in the centre of it to admit of centre of cross for the spindle to work in. Have the ring bedded solid, and either clamp or bolt the cross to it, so that the spindle will keep firm and steady till the job is finished. Having put the spindle in its centre, on the arm of it you fasten a parallel board about 10ft. long, taking care to set it at right angles to the spindles, so as to have the surface that it sweeps straight. This board, when secured in its place, is for forming the bottom of boss of screw, and also a bearing or surface about 12in. outside of the mould proper to lay a template or guide on (resembling in shape a wedge) for another board to work in, which will be explained further on. Take now some loam and brick, and on the centre plate build up to within ½in. or ¾in. of face of board; on the face of bricks rub on some soft loam till it is a little higher than face of board, which is now made to revolve, and you have the form of the bottom of boss with a print for centre core. The same operation is gone through with outside bearing. For a sketch of mould in present state see Fig. 1. A A, brickwork; B, point of centre core; dark lines, loam. The board is now taken off, and after the loam has become stiff another board is made fast to spindle to build the boss, or, properly speaking, to build a pattern of boss (see Fig. 2). It matters little how it is built so that the outline is good, as it is afterwards pulled down. You now space or divide the outside bearing into four. On one of these lines you place the guide, having a centre line on it corresponding with one on the bearing. When in its place a weight is put on the bottom of it to keep it steady and secure until the face of one blade is finished or swept up. A parallel board is now secured to arm of spindle (and I should mention that in this part of the job the arm requires to be in the form of a right angle). On account of the model of boss having been built first, the one end of board is made fast to arm, while the other rests on the guide (see Fig. 3). To the top of spindle is attached a small pulley, over which a rope works, at one end of which is a counterbalance weight, *w*; while the other end is attached to the arm or board, so as to facilitate the sweep in its passage up and down the incline plane. The arm in this part of job is not made fast, but the spindle is. The arm revolves, and should move freely up or down the spindle, as required. Having got the arm in working order, you now commence to build the blades, which I shall reserve for the next paper. **Foundry.**

FIG. 1.

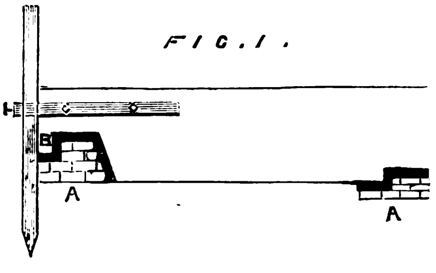


FIG. 2

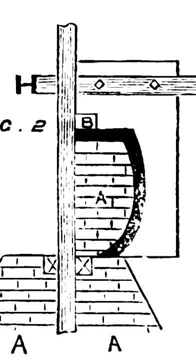
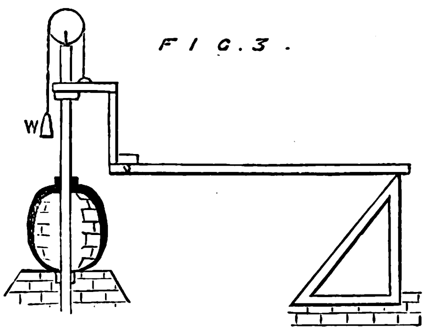


FIG. 3.



SOAP-ANALYSES AND FATTY ANHYDRIDES.

[20010.]—In answer to query 46698, page 183, ordinary fixed oils and fats are salts of the triad organic radical glycyl, C_3H_5, which performs the same function in the oil that the metal bismuth does in nitrate of bismuth. Thus, nitrate of bismuth has the constitution:—

$$\left.\begin{matrix}\mathrm{Bi}'''\\(\mathrm{NO}_2)_3\end{matrix}\right\}\mathrm{O}_3$$

while olein, the chief constituent of olive oil, is—

$$\left.\begin{matrix}(\mathrm{C}_3\mathrm{H}_5)'''\\(\mathrm{C}_{18}\mathrm{H}_{33}\mathrm{O})_3\end{matrix}\right\}\mathrm{O}_3$$

The process of ordinary saponification consists in the decomposition of the oil by caustic alkali, with consequent formation of glycerine and a soap or salt of the alkali-metal. Thus, the following formula represents the saponification of olein by caustic soda:—

$$\underset{\text{Olein.}}{\left.\begin{matrix}(\mathrm{C}_3\mathrm{H}_5)'''\\(\mathrm{C}_{18}\mathrm{H}_{33}\mathrm{O})_3\end{matrix}\right\}\mathrm{O}_3} + \underset{\text{Caustic soda.}}{\left.\begin{matrix}\mathrm{Na}_3\\\mathrm{H}_3\end{matrix}\right\}\mathrm{O}_3} = \underset{\text{Glycerine.}}{\left.\begin{matrix}(\mathrm{C}_3\mathrm{H}_5)'''\\\mathrm{H}_3\end{matrix}\right\}\mathrm{O}_3} + \underset{\text{Sodium oleate.}}{\left.\begin{matrix}\mathrm{Na}_3\\(\mathrm{C}_{18}\mathrm{H}_{33}\mathrm{O})_3\end{matrix}\right\}\mathrm{O}_3}$$

If the sodium oleate, or "soap," be treated with hydrochloric acid, as occurs in the course of an analysis, free oleic acid is produced, together with chloride of sodium. Thus:—

$$\underset{\text{Sodium oleate.}}{\left.\begin{matrix}\mathrm{Na}\\(\mathrm{C}_{18}\mathrm{H}_{33}\mathrm{O})\end{matrix}\right\}\mathrm{O}} + \mathrm{HCl} = \underset{\text{Oleic acid.}}{\left.\begin{matrix}\mathrm{H}\\(\mathrm{C}_{18}\mathrm{H}_{33}\mathrm{O})\end{matrix}\right\}\mathrm{O}} + \mathrm{NaCl}$$

Calculating from this formula, it will be found that dry sodium oleate yields 92·76 per cent. of free oleic acid, and similarly the alkali of the soap would be stated at 10·20 per cent., so that the analysis would be:—

Oleic acid	92·76 per cent.
Soda (Na_2O)....	10·20 "
	102·96 "

Here there is an error of nearly three per cent. in excess caused by assuming that the soap contains oleic acid; whereas, if it be regarded as containing oxide of sodium, the fatty constituent should be stated as oleic anhydride $(C_{18}H_{33}O)_2O$, which differs from oleic acid by the elements of water; 564 parts of oleic acid correspond to 546 of oleic anhydride, and so 92·76 per cent. is equivalent to 89·80 per cent. This, with the 10·2 per cent. of Na_2O, adds up exactly to 100 0. The proportions of anhydrides corresponding to palmitic and stearic acid are not greatly different from the above; hence, the necessary correction of the observed weight of fatty acids to the corresponding quantity of fatty anhydrides may be made by multiplying by the factor ·97—100 parts fatty acids representing approximately 97 parts of the anhydrides. In properly stated soap analysis the percentage of fatty anhydrides is given in the body of the report, with a note or reference to the corresponding amount of fatty acids.

Sheffield, April 29. **Alfred. H. Allen.**

STRING VIBRATIONS.

[20011.]—It is a curious thing, that two strings in unison and on the same violin will not sound louder than one string. I have never had this accounted for; perhaps the following may be a step in the right direction—remembering that where there is a mystery, it is best to go out of the beaten track, because there are always two sides to every question:—Take a lady's U-shaped hairpin, 'twill suit our purpose better than a tuning-fork, push one end in a piece of wood (say, the end of a shelf in a greenhouse) in this position ⊃ so that the upper arm will be free to move up and down or vibrate—push it in about 1in. with a pair of pliers; press down the free arm and let go, a dull thud is the response, but you will see it go up and down past its stationary centre, forming a figure which becomes an oval when started out of a straight line. Now tie a piece of white cotton near the round part of the ⊃ that is fixed in the wood, vibrate it as before, and the cotton has all the appearance of being electrified; it seems to be attracted and repulsed by what some would say is a current of electricity. Who knows what electricity is, or what sound is? I leave this thought, and next I tie a glove-button to 10in. length of the cotton. When I vibrate this, as before, through the ⊃, I get a vibrating-string with no sound; it is, in fact, a negative vibration, in opposition to the positive vibration of the ⊃ or tuning-fork. I only mean that one sounds and the other does not. But a change has taken place; the vibrating-string is divided into two parts, forming two bow-like segments. Without the button-weight the vibrations were dispersed without form, but with it they are collected together. This shows, however, that vibrations do not produce sound, but that sound produces vibrations dependent on weight. We shall see the effect that weight has on sound presently. You see the two parts with the weight of button. Now, slightly pull the piece of cotton hanging below the button—viz., put on more tension, when the string will come out in one bow form, as a violin string, but without any sound. Next, lift the button slightly, and the string divides into three parts—more slight, into four parts—the less weight the more divisions. This is very plain, but infers a different state of things to that inferred by standard books. There is only a thud from our primitive tuning-fork or hair-pin. Can't we make it sound? Take a violin bow and vibrate the under arm that is in the wood (soundboard); vibrate it about 1in. off the wood: you only get a nasty mixture of harmonics, because there is not sufficient weight to collect them together, but pull the cotton and out comes the true sound.

I infer from all this that harmonics are produced on the violin by a change of weight—viz., the tension is altered from end to end to different parts of the string. And that pressure on the string acts as a lever placed under a tension bar (a rod of iron, a stick, or any lifting arrangement.) But I need not go into this. Now let us take two strings on a violin, the D and G, or covered string. When I put my third finger on D, I get the upper note to the open G—viz., an octave; but look at the silver string, it is divided into two parts. How is this? Why, the weight of third finger acts on the unison lower string through the bridge, and changes its tension. This, however, takes away some of the weight belonging to the D string, and it does not sound so loud as any other note, say those produced by first or second finger, which would not be in unison with open G. If I want the upper G to sound as loud as the other notes, I must stop the open G from vibrating, and directly I put another finger on it, and only allow the stopped D to vibrate by itself, then the upper G is as loud as the other notes. This, then, is the reason why two strings will not sound louder, because one takes the weight off the other.

My great rule is this, "That an open string does not form itself into parts," although this is implied in all class books. **Fiddler.**

Patterns for Moulding Name-Plates.—In the *American Machinist*, Mr. G. B. Foote gives the following ingenious method of obtaining patterns for moulding name-plates, &c.:—First. Set up a card with suitable type; if you have an engraved trade-mark or cut of medal, put it in the card as set up. Then, after the forme is made up, justify it, plane down, &c., press it into a sheet of hard rubber of proper thickness which has been softened by heat; let the rubber cool under pressure until hard, then file off the face of the rubber until you get down to the level of the impression of the face of the letters, &c. You now have apparently a flat piece of hard rubber. Now put this on a flat heated surface, and the face of the letters, &c., will rise up, showing a reversed impression of the type, beautifully adapted as a pattern for moulding. This pattern can be bent to any shape for attaching to a curved surface.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[35398.]—**Jenny Lind Engines (U.Q.)**—I am much obliged to "Carstairs" for the information on p. 109. The description given of these engines agrees with what I have seen on the North Staffordshire line. I was under the impression they were "Jenny Linds" when I wrote the query; but I wanted proof. What number was the M. S. and L. "Carstairs" refers to? I remember seeing two engines on the M. S. and L. of the "Jenny Lind" type; but having four-coupled trailing driving-wheels, and the wheels had round spokes. They were numbered 55 and 59. Can "Carstairs" give the date of their construction, or of that class? I believe the "Jenny Linds" came out in 1847.—R. N. H.

[46095.]—**Preserving and Arranging Fossil Shells.**—"Mollusca" might possibly find the following arrangement suitable. First, the cabinet may be made 42in. by 24in. (and capable of extension in height). The drawers must be such as to receive fair-sized fossils, but must not obstruct the light; thus, the sides and back may be 1½in., and the front 3½in. deep. The front of every third or fourth drawer may be 5in. deep to accommodate any extra large specimens. To get maximum depth, have only *side* slides. Next, as specimens must be readily transferable, use boxes, and to prevent them being jarred or from rolling about, line all with cotton wool (pink). One sheet of grey drawing-card (4d.) will make 48 boxes 2½in. sq.; thus, bend a piece of zinc into the form of a very acute V, equal in depth to the side of the box, and by inserting the card, bend up by pressure on the table. Next, snip out with scissors four little triangular pieces from the creases on two opposite sides, making two (opposite) snips much larger than the other two: this will make the intervening side slope. The ends of the unsnipped sides will then overlap, and may be secured quickly and neatly with stationer's brown sealing-wax. The object of the sloping side is to inscribe the formation, locality, and name of specimen. The advantage of making the boxes one's self is that you can suit your own requirements as to size, height of sides, and economy. The boxes, for sake of uniformity, should be multiples of the smallest. Specimens too large and heavy for these boxes may be mounted on card-covered boarding, and pinned in place. As to classifying, the method adopted at the Jermyn-street Museum, of placing strips of wood, labelled, at the head of each fam., class, &c., is very good, as, by running the eye up the columns, you see at once the grade of any particular specimen. I was told by a professional collector that glycerine and gin formed a very good preservative compound. I should be very glad to know myself whether this is better than gum.—Pholas.

[46381.]—**Three-Legged Gravity Escapement.**—"Alfojoe" and E. M. Nelson do not seem to be aware that they have been disputing about an escapement which was superseded at least 23 years ago, by the double three-legs of the Westminster clock, which was put up in 1859. I cannot now refer to any but the sixth edition of Sir E. Beckett's book, but I am sure that the Westminster escapement has been described in four or five editions, and in the *Encyclopædia Britannica*, and also the four-legged one for small clocks or regulators. I concluded when I saw the one which "Alfojoe" copied from the copy of the original three-legs in "a book by J. W. Benson," that it must be an old book, written soon after Sir E. Beckett's first publication of that escapement, nearly 30 years ago; but he now says it is only seven years old, which is an odd commentary on his remark on the high authority of Benson as a writer on clocks. No doubt Mr. Nelson is right in saying that the late Astronomer Royal preferred an escapement which he had invented and published above 50 years ago, for the standard clock at Greenwich; but I have never been able to learn that it was preferred by anybody else. I remember and have found a letter in these pages, just two years ago, from "C. A. T.," and, I think, others also, saying that the writers had themselves made gravity escapement regulators from Sir E. Beckett's book, and found them most successful. "C. A. T." said: "the rate had been simply perfect," but "the beats not so equally loud," as he wished for astronomical purposes. Mr. Nelson mentions pin-wheel escapements with train remontoires as better; and certainly no recorded rate ever equalled that of the "Dent and Denison" clock in the 1851 Exhibition; but remontoires—at least the best—have been abandoned on account of their delicacy, and the practical equality with them of these later gravity escapements—not spoilt by the errors which he rightly censures in the late Mr. Cooke's supposed "improvement" of them. It is quite true that their great and unquestioned superiority is in turret clocks, but equally true that the "four-legged gravity" in regulators may be at least equal to a much more costly and delicate dead-escapement clock.—Horologus.

[46395.]—**G. W. Tank-Engines.**—I wish to ask "Clyde," if "Hesiod" (G. W.) is not of the same type as 2042, illustrated on p. 87, and if so, if he has not omitted the *original* date of their appearance, which I understand was 1849? Clark's "Railway Machinery" of 1855 has an engraving of one of that class.—R. N. H.

[46396.]—**Terrestrial Eyepiece.**—To "Paugul." — The eyepieces alluded to are seemingly of the usual character supplied with terrestrial telescopes. The lenses C and D are probably one-half the sum of their focal lengths apart, and the lens A just within the focus of the object-glass, so that the emergent rays cross immediately in front of B. This would cause the central rays to diverge; but they are nevertheless brought to a focus midway between C and D. No doubt this appears incongruous to "Paugul," but he can easily verify its correctness by a little actual experiment. It is very easy to quote a string of optical truisms, and so account, in an off-hand manner, for all the phenomena of refraction; but it is much better to practically apply these precepts before doing so, and this, as it seems to me, is just what "Paugul" has neglected, when he says, "The position of the diaphragm is wrong; it should be at the point where the rays cross where the image is formed." Now, he is apparently not aware that between C and D the rays do not cross at all, nor that he is describing two different kinds of foci which cannot be formed at one and the same time. The focus caused by the crossing of the rays is simply a round spot of light, and there can be no image until these rays have become palpably divergent, or until they have been collected by another lens. This may be very easily demonstrated by holding a piece of white paper at the outside focus of D, when the white spot of light will show that here the rays do really cross, and that an image of the object is not formed until some distance from the focus. He may also notice that the conjugate foci of this spot, and that of the image between C and D, do not accord with what he evidently conceives to be their theoretical position.—Aldebaran.

[46424.]—**Circular Saw.**—I see "Circular Saw" is not exactly satisfied with "Pattern Maker's" reply. I think if he will act on my advice he will have no occasion to be dissatisfied. In the first place, he must not expect to accomplish, at his first, second, or third trial, what it has taken a saw-straightener his lifetime to learn. What I would recommend him to do is to go to a sheet-iron warehouse and get three half-sheets of iron, say, one 24, one 18, and one 14 gauge, next get a heavy iron block, say an anvil with a good round face, i.e., not hollow, as a worn anvil gets; next, a fair-sized hammer, take off your coat, and turn up your shirtsleeves, then take one of the sheets (it does not matter whether it is the thick or thin one) in his left hand, and the hammer in his right, throw it across the block, and hold it at such an angle as the eye can look over the edge and scan the surface. You will notice that it is warped and buckled in all forms—anything but perfectly flat—some places rising up, others going down into valleys. Now, what you want to do is, by hammering around the edges of the valleys, to stretch and thus relieve the buckle, and you must try by this means to get all the little inequalities into one great hollow, rise, or buckle, and then by the same method around the edge, to bring your sheet perfectly flat. When you have got one right, then try the next, and then the next, and if you can succeed in all three thicknesses, try your saw, and not before. I would caution you, in straightening the sheet iron, to finish straightening the first before you touch the second; and if you can succeed, you will be able to do what hundreds of sheet-iron workers can't. I would also advise "Circular Saw," as he does not know a saw-fettler, to take it to his ironmonger for him to send it to a saw-maker, so he may have his saw to do his sawing, for it may be it will require straightening again against the time he has straightened his three pieces of sheet-iron, and certainly he ought not to touch his saw before he has done so.—Working Tom.

[46440.]—**Analysis of Soot.**—The ammonia is the only valuable constituent of soot; that is estimated as sulphate. An analysis gives 43 parts organic matter, containing nitrogen ·21, sulphate of ammonia, 12·7; carbonate of lime, 10 6; insoluble silicious matter, 15; oxide of iron and alumina, 6·5; carbonate of magnesia, alkaline salts, &c.—Sabbas.

[46443.]—**Handel Organ.**—An account of the alterations and repairs to the Crystal Palace organ will appear soon in the *Engineer*.—J. W. W.

[46445.]—**Gazogene.** — Try whether you can stop the leak by grinding the two parts together with a little fine emery and oil.—T. P.

[46448.]—**Powder - Mixing Machine.**—You can make one either by adapting a sieve, or by having a pan in which arms revolve. Should advise you to see some of those made by machinists, and you will be able to give an idea of what is wanted; for one that would do for mixing manures might not be exactly adapted to mixing the substances sold as fruit-salts.—Nun. Dor.

[46454.]—**Gas from Wood.**—This query is unanswerable without knowing the kind of wood, whether wet or dry, and what "gas" is meant. The ash would be charcoal, plus the mineral constituents—valuable as a dressing for the ground, if for nothing else.—E. G. M.

[46458.]—**Fernery Pipes.**—There is no help for it but to polish up the pipes, or to allow them to become discoloured. They are easily cleaned with oxalic acid; but perhaps they would look better when thoroughly discoloured than when perfectly bright.—Nun. Dor.

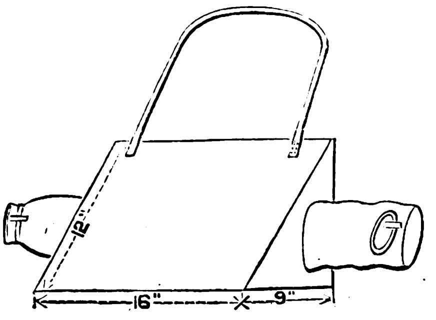
[46490.]—**G. P. Joints.**—There is nothing very remarkable about these joints. The wires are twisted together and soldered (using rosin as the flux), and are then covered with guttapercha strips, which are melted together by the aid of a warm tool, and pressed into shape with damp fingers. Culley, "Practical Telegraphy," pp. 169 *et seq*, gives full and explicit directions for making joints, to which I would refer the querist, if he wishes to excel in this work, as applied to long telegraph lines, where every little detail is carefully studied. I don't know whether a later edition than the seventh of Culley is out; but, in that, he refers to Chatterton's compound as one component of the insulating covering.—Nun. Dor.

[46493.]—**Lathe.**—To "Sunlight."—I wish for correct sizes and weight of 5in. lathe, gap-bed and screw-cutting, to cut square bars, 1in. by 1in., with circular saw. I hope you will send sketch of drilling-frame, and spindle for drilling holes in hubs of bicycle for ordinary lathe, with slide-rest not backgeared, 5in. centre.—Long Tom.

[46497.]—**Fortified Cities.**—Several fragments and lengths of the walls of Limerick yet remain. Near one extensive portion, a beautiful bronze statue to Sarsfield, who so bravely defended those walls, has just been erected. There are also some towers and parts of the ancient walls of Waterford remaining, interesting as having been built by the Danes, and resisted the efforts of Strongbow. I have also seen portions of the old walls at Fethard, Cashel, and Clonmel in county Tipperary, and at Youghal and Kilkenny. In many Irish cities, fragments of their walls, castles, and towers yet exist, and may be studied.—E. B. F.

[46497.]—**Fortified English Cities**—Perhaps the following may assist "Antiquary." Stafford was anciently encompassed with walls having four gates. They were demolished by Sir W. Brereton, General of the Parliamentary forces in 1643. Coventry was also protected by walls, which remained till 1661, when they were almost wholly destroyed by the Earl of Northampton. The walls of Worcester existed till 1651, when they were thrown down after the battle of Worcester, wherein Charles II. was defeated by Cromwell. Leland says in his Itinerary:—"Shrewsbury is strongly walled and defended with water, which is to be counted in manner for the towne ditch.... The walls are more than a mile in compass." "Oswestry was formerly surrounded by strong walls, which were a mile in compass, having four gates, also strengthened with a ditch. The gates remained till 1783." "The towne of Ludlow is well walled, and by estimation a myle in compass. There be in the wall five gates—Broad Gate, Old Gate, Gaolford Gate, Corve Gate, and Mill Gate. The castell hemmeth in part of the towne, and standeth on a strong rocke, well ditched between Corve Gate and Mill Gate" (Leland).—Student.

[46510.] — **Photography.** — The following arrangement may not suit large plates, without some modification; but I find it very handy with the cabinet-size and smaller plates I work with. The dimensions must be regulated to suit size of plate-box, and dark slide when open. My dark slide is a single one, so I find the following suit me perfectly. I procured two stout tradesmen's show-cards. One, for the bottom, I cut 16in. by 9in.; the other, for the front, is 16in. by 12in. I hinged these together along a pair of their 16in. edges, by glueing with pieces of tape, so that they open and shut like a book. They are then covered with a black bag, as shown in the annexed figure. There is no need of cardboard at the back. The front cardboard is kept up by its being slipped within a tape that is sewed to the inside of front of bag, about 4in. from top. I rather think this front cardboard could be dispensed with, if the top were kept stretched from side to side, by a piece of stiff cane, or other suitable material. The front, back, and bottom of bag are made of one piece of black stuff, with the seam underneath. I have the seams sewed, but probably elastic glue would be a safer fastener. When the first bag, with its ends and sleeves, is complete, another one, identically similar, is made to cover it. The inner and outer bags are not sewed together anywhere except at the outer extremities of the sleeves. One or more bags could be made to cover these, if thought necessary. I have found two bags quite safe, but am thinking of adding an outer cover of mackintosh to keep out wet. This would give additional security against light entering. The sleeves should be wide enough to admit plate-box and dark slide, and long enough, say, 12in., to reach the elbows. The indiarubber sleeve-bands are attached, as shown in the figure, so as to slip off easily when inserting or removing the plate-box and slide. The tape that goes round my neck is sewed to the outer bag only. It is essential that stitches should nowhere go through both bags, except at the ends of the sleeves. The bags are made of the stoutest black twilled calico. This costs 6d. a yard. It is quite easy to know the coated side of plates by touch alone, but the less fingering they get the better. Damp or dirty fingers would probably ruin them. It is well to carry a second plate-box into which to put plates that have been exposed. Each box should have a distinctive mark. After a little practice plates can be changed as safely, and very nearly as quickly, as in a dark room. I think windows unnecessary. It must be nearly impossible to see the inside through them, and they are liable to be broken. I have seen plans for changing bags in which there is only one hand inside; but it is a manifest advantage to be able to use both hands. This is the reason why I suspend my bag from my neck, as it leaves both hands free. I recommend all plates to be examined in the dark room for defective coating or other flaws previous to going out. I usually retire to a shady place when changing, but I have tested my bag in sunshine and found it light-tight. —W. H. S. W.



[46512.]—**Boring Horizontal Bar for Steel Core.**—Many thanks to "Jack of All Trades," but what I want principally to know is the manner in which an ash bar 9ft. long is bored for the steel core. A sketch of the drill would also oblige.—J. Wilson.

[46531.]—**Yacht's Deck.**—"Working Tom" should be careful how he advises; the idea of putting deck planks 6in. wide into a twenty-tonner is absurd; at the very most they should be only 3in. in the widest part, and taper fairly at each end; aft they will all reach to the archboard, but forward they will of course be cut short by the round-in of the bow. The proper method of laying a yacht's deck is by dowels and scant nails: that is to say, to fit the first plank (and of course begin at the side), put the dowels into the covering board, half their length, then mark their positions by pulling the plank to them; bore your holes, then tap the plank all along till it fits the inside of covering-board nicely, then fasten by nails driven obliquely through the edge of the plank, not down through; then repeat the operation with every plank. In this way no nail holes or anything of the kind will show, and when planed down will look nice and neat; 3 by 1½ in the middle will do very well. The plan proposed by "Working Tom" might do for a flat or collier, but not for a yacht. If "J. J. A." takes my advice, he will not attempt to lay his own decks. He will be better off by getting a yacht-builder to do it for him; it requires great care to lay decks.—W. R., Liverpool.

[46542.]—**Broken Steam Gauge.**—To "Sunlight."—As you say the tube can be soldered, will you please send sketch of a mercury vacuum-gauge as you promised? Also I see in the "E.M." of Dec. 30, 1881, a model steam-gauge. Will you please say what kind of rubber diaphragm it is? whether it is rubber such as we use for steam joints or not.—Gauge.

[46589.]—**Sack-Marking.**—I have used boiled linseed oil and best vegetable black for sack-marking many years, and find sacks sent for repairs after long usage with the mark nearly as good as ever; the preparation should be fairly thick, and a little driers added if you are not sure of the oil being right; the brush should be used with little of it on at a time. It does not require much to mark a hundred sacks. With reference to stamp or plate, some twenty years back, we used a stamp with wood letters fitting in a frame, but it soon dropped, as no advantage. I prefer using oilcloth. As for Farmer's waggon-sheets, cut like a stencil plate when not more than three hundred marks of one kind are needed; it yields to the sack better than a plate. The very large sack-makers use steam printing presses, but I do not know their price and construction.—Thos. M. Hewitson, Birmingham.

[46617.]—**Sewer-Gas.**—"C. G. H." can ascertain if his drains and house-pipes are defective by pouring some strong-smelling volatile odorous material through an opening, which should always exist for this very purpose, outside, and letting someone else smell about suspected places inside. —Bor.

[46627.]—**Measuring Polarisation in Battery.**—The only means we have of estimating the amount of polarisation is by interposing in the circuit any one of the forms of galvanometer. The measurements can be made, and loss due to polarisation tabulated.—W. J. Lancaster.

[46630.]—**Steam-Launch.**—I am sorry I cannot answer your query to my own satisfaction. There are, however, many willing contributors to "ours," who will have pleasure in giving you every detail you require. I should be sorry to mislead you on any point, and I feel that I am not sufficiently conversant with the subject of your query to give you a satisfactory answer.—W. J. Lancaster.

[46642.]—**Drilling Fluid.**—"Kismet" will find, I think, that nothing will beat soap and water; some use soft soap, others common yellow soap, for turning wrought iron. For steel, train oil is better, and is certainly cheaper, than olive. For boring steel, I have lately adopted paraffin, as it "seeks" into a hole so much better than a thicker oil. If much oil is used, it is worth while to catch turnings, borings, &c., in a suitable vessel, and let the oil drain off, when it may be used again and again. I also catch my soapy water, it saves a good deal of cleaning up after its use.—Bor.

[46649.]—**Mounting Micro Lenses.**—You may use either 36 or 37 threads to the inch for micro objectives. The lenses must be mounted with Canada balsam, and eyepiece lenses may be carefully rolled into their cells. In mounting achromatic combinations great care is necessary to get each combination perfectly true, and this can only be done after some experience. I shall be pleased to give you any assistance I can through our pages. —W. J. Lancaster.

[46658.]—**Date Marks.**—I send "Alpha" the following marks and dates of the London Assay Office, which is now in its 23rd cycle. Each cycle is composed of 20 years, and each year is denoted by a letter of the alphabet, which is different every year. The letters used are:—A, B, C, D, E, F, G, H, I, K, L, M, N, O, P, Q, R, S, T, U. The 1st cycle commenced in 1438-9, and had 3 stamps—1st, Leopard's head; 2nd, date mark; 3rd, maker's name (the letters used being Lombardic capitals), and ended 1457-8. Cycle 2 began 1458-9 and ended 1477-8, but the stamps and letters for it are unknown. Cycle 3 commenced 1478-9 and ended 1497-8, and had 3 stamps. 1st, The leopard's head, which was crowned in 1477; 2nd, date mark; 3rd, maker's mark (Lombardic letters). Cycle 4 began 1498-9, ends 1517-8, has 3 stamps. 1st, Leopard's head, crowned; 2nd, date mark; 3rd, maker's mark (black-letter, small). Cycle 5, from 1518-9 to 1537-8, three stamps, as last. No lion passant till 1545 used (Lombardic capitals). Cycle 6, 1538-9 to 1557-8, has 4 stamps—1st, Leopard's head, crowned; 2nd, date mark; 3rd, maker's mark; 4th, lion passant (Roman capitals). Cycle 7, 1558-9 to 1577-8 has 4 stamps—1st, Leopard's head, crowned; 2nd, lion passant; 3rd, date mark; 4th, maker's mark. No escutcheons had been used up to 1561, when the date letter was first put into a shield (black-letter, small). Cycle 8, 1578-9 to 1597-8, 4 stamps, as last (Roman capitals). Cycle 9, 1598-9 to 1617-8, 4 stamps, as last (Lombardic capitals). Cycle 10, 1618-9 to 1637-8, 4 stamps, as last, small italics). Cycle 11, 1638-9 to 1657-8, 4 stamps, as last (court hand). Cycle 12, 1658-9 to 1677-8, 4 stamps, as last (black-letter, capitals). Cycle 13, 1678-9 to March 1697, 4 stamps, as before (black-letter, small). Cycle 14, March till May, 1697, began letter A, then as usual, till 1715-6, 4 stamps. 1st, Britannia; 2nd, lion's head, erased; 3rd, date mark; 4th, maker's mark, which was the first two letters of surname (court hand). Cycle 15, 1716-7 to 1735-6, 4 stamps —1st, Leopard's head, crowned; 2nd, lion passant; 3rd, date mark; 4th, maker's mark (Roman capitals). Cycle 16, 1736-7 to 1755-6, 4 stamps as last; but after 1739, the initials of maker's Christian and surname (Roman small); there are 4 different shields used in this cycle for the date mark. Cycle 17, 1756-7 to 1775-6, 4 stamps as last; but after 1721 (I should have added the leopard's head was smaller than before) black-letter capitals. Cycle 18, 1776-7 to 1795-6, 5 stamps: 1st, leopard's head crowned; 2nd, lion passant; 3rd, date mark; 4th, after 1784, the duty mark of king's head; 5th, maker's mark (Roman small). Cycle 19, 1796-7 to 1815-6, 5 stamps as last (Roman capitals). Cycle 20 (Roman small), 1816-7 to 1835-6, 5 stamps as last; but after 1823, the leopard's head without a crown. Cycle 21 (black-letter capitals), 1836-7 to 1855-6, 5 stamps; but the Queen's head from 1837 in the place of the king's head. Cycle 22 (black-letter, small), 1856-7 to 1875-6, 5 stamps same as last. Cycle 23, 1876-7 to present time (Roman capitals) (the letter for the present year till 1st of June being the letter F). Some short time back I sent an answer to "ours," in which I gave a list of the assay towns and their separate marks; but not having the papers at hand, I cannot refer so as to give the exact date, but perhaps "Alpha" can do so. I have only given the date marks of the London office, but am afraid I have made this answer too long already, or I would have given the letters for the other eight offices, but will do so at any future time if the Editor thinks they will be of sufficient interest. In reading plate, the shield of the date letter must have the point downwards. Some workmen have had their work marked by a X or star near the maker's name to distinguish their particular work. The date letters are in parentheses.—J. Chamberlain.

[46651.]—**Problem in Mensuration (Nesbit's).**—The following is the way I worked the problem:—

```
                 A B and C D = 100.
                 B C and A D =  80.
                 I A         =  10.

   100  = A B or C D            100      10 = I A
    80  = A D or B C             80      10
   ----                         ----    ----
 2)8000                        2)20     100
   ----                         ----
   4000(63·245 = A H            10 I A
   36
   ----              A H
123) 400          63·245^2 = 4000
     369                      100
    ----                     ----
1262) 3100                   4100(6403 = I H or I G
      2524                   36
     -----                   ----
12644) 57600              124)500
       50576                  496
      ------                 ----
126485) 732400        12803)  40000
        632425                32409
       -------               ------
         69975                 7591
            Then 64·03 = I G or I H
                 10·   = I A
                 ---------------
                 54·03 = A G;
             And 80    = B C and A D
            Less 54·03 = A G
                 ---------------
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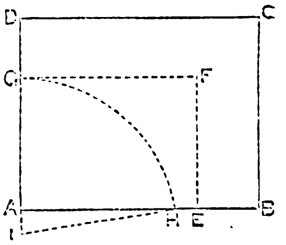
Width of walk = 25·96 = D G and E B.



By using more decimals you can prolong the answer.—Sharples.

[46656.]—**Pitch of Propeller.**—The rule as given in Molesworth is as follows:—

$P = \frac{101\ V}{R}$. where P = pitch of screw in feet

R = number of revolutions per minute

V = velocity in knots per hour.

Or,

$P = \frac{88\ v}{R}$. where P = pitch of screw in feet

R = number of revolutions per minute

v = velocity in miles per hour.

—Dix.

[46651.]—**Problem in Mensuration.**—By simple arithmetic find that a walk 26ft. wide round two sides would occupy 4 sq. ft. more than the half area, and that the inner edge of this walk is 128ft. long; then if 4-128ft. or 1-32ft. or ⅜in. be taken from the 26ft., it will give the required width, and agree with the answer given in decimals.—W. W. S.

[46659.]—**Spongy Platinum.**—"G. F." would have done better not to have troubled about the "washing." I would suggest that he should add a little liquid ammonia to neutralise the solution, which is probably acid. Then add some more chloride of ammonium, evaporate to dryness, and fuse the residue in an earthenware assay crucible with an equal bulk of oxalic acid. The ordinary kitchen fire will do if no furnace is at hand. The fused mass of spongy platinum may be well washed. I often prepare it in this way, both for use as such, and for the sake of the recovery of platinum used in my assays of potash and ammonia salts.—EXPERIMENTER.

[46660.]—**Sutton's Secondary Battery.**—You say that you have bent the plates "into a spiral, with indiarubber between top and bottom to prevent contact." If by this you mean that the indiarubber entirely covers the plates, I should say that is the cause of failure. If I made one on the spiral principle, I should use felt, or some other porous substance, as a separator. Indiarubber is non-porous. Some time ago I made a cell on the parallel plate plan, with only about half the lead-surface of yours, which answered well, and had plenty of power to drive a medical coil. At the end of a week it had not entirely lost its power.—J. HEZMALHALCH, jun., Fellisclifle, viâ Leeds.

[46664.]—**Resistance of Electric Lamps.**—Many thanks to the gentlemen who have so kindly replied to my query. As "Sigma's" reply contains the real answer, may I venture to make a suggestion to him? He is doubtless aware that amongst the visitors to the Crystal Palace Exhibition there are many busy men who have not time to study even his excellent book, but who are anxious to understand the elements of the subject—especially as concerns electric lighting. These persons have been informed in the ordinary colloquial way that the incandescence of the carbon in the lamps is due to the "resistance" which the filaments of that substance offer to the passage of the current, and they have also been told, as stated in my query, that the resistance of one lamp being 50 ohms, four in series would be 200 ohms, or if in multiple arc (is not "circle" more correct?) 12·5 ohms—presumably, as I said, for each lamp, simply because there was nothing to indicate that what was meant by "resistance" in this case was really increased conducting capacity. This resistance, in fact, has nothing to do with the lamps themselves, but is the resistance of the circuit. "Sprague's Electricity" was issued before much had been done in electric lighting, or there would doubtless have been a chapter on the subject; but when I tell my friends they can find all the principles clearly explained in that book, they reply pertinently, "We have not time to study the subject, but we would gladly endeavour to understand the rudiments—especially what electricians mean by ampères, volts, ohms, &c." The use of the expression "resistance"—though quite intelligible to those who understand the subject, is confusing to the tyro; and some recently published textbooks seem only to have been written to show what the writer knows, and not for the purpose of instruction. I do not suppose that is the intention, but it is the effect. In one I refer to the index for "resistance," and on turning to the page, discover that the paragraph is headed "conduction." Another reference shows that "resistance" is a tangible something which the current has to "encounter" and "overcome." In the same paragraph the water-pipe analogy is used, and it is said that if the pipe be a very "thin" one, the water will only slowly run through. Of course, it is clear enough to those who understand, but then there are thousands who want to know, who are simply puzzled by these textbooks. In the case cited, it is evident that the writer meant "small" by the word "thin"—the analogy having become mixed up with wires. However, not to ramble, I think I have shown where misconception arises, and I now arrive at my object, which is to ask "Sigma" if he cannot write us an explanatory article on electrical terms, giving examples of their application in practice. For instance, at the Palace, I have often heard the question, How many cells would it require to work one of these lamps? Supposing Swan's to be meant, I make out that one cannot be worked with economy, for the same battery plant would work five. Is that so—meaning the lamp which is supposed to have a resistance of 50 ohms? Another example may be given as an instance: a good deal is said about storage batteries, and people want to know how many Bunsen cells are necessary to charge a Sutton or a Faure secondary. I have heard it said, "one, if you keep it on long enough"; but if the E.M.F. of a Faure is over 2 volts, how can a cell, with an E.M.F. of only 1·8 volt, charge it? Another: Griscom's motor is shown driving a lathe, current being furnished by a bichromate battery. An example of the electrical terms or units, as applied to calculations of that kind, would be useful. I know I am asking for something very much resembling a "royal road" to knowledge, but I think "Sigma" will understand what is wanted, and I know that he can, if he will, put the information into just the form that is required by those who are too busy to make a study of the subject, but yet desire to understand with intelligence.—NUN. DOR.

[46669.]—**Patterns for Engines.**—To give you the proportionate sizes would take up much valuable space in these columns, that is, if fully stated. Briefly, for the 1⅜ bore engine, the cylinder should be 4¼in. long inside the covers; piston-rod, ¼in. diam.; connecting-rod, 9in. long between centres; crank-shaft, according to steam pressure, from ½in. to ¾in. diam.; nominal power, about 1-6th of a H.P. The 4in. bore and 8in. stroke engine should have the cylinder 10in. long between the covers. The piston-rod should be ¾in. diam., crank-shaft, 1¾in. to 2½in. diam. The proportion of the valve, ports, &c., must be determined by the class of engine, the proposed speed, and the pressure of steam. Put these particulars before me,. mentioning the names of parts you still want, sizes of, and I will tell you. Horse-power would be 1¼ nominal. I am assuming that the pressure of steam would be, say, 50lb. in the latter case. The first engine would be but a toy; whilst the 4in. engine would indicate probably more than 2 H.P.—SUNLIGHT.

[46672.]—**Binding Screws.**—I would strongly advise you not to attempt to make any substitutes for binding-screws. Dirty connections are the cause of more annoyance and trouble than any other part of the battery, and makeshifts are sure to come to grief just at the moment when most wanted. You can make good connecting screws of all kinds at a cost to yourself of twopence to threepence each, and I shall be pleased to give you instructions how to make a few useful connecting screws.—W. J. LANCASTER.

[46674.]—**Telephone.**—The induction coil is used in conjunction with a carbon transmitter. The secondary, induced by the primary, possesses properties not contained in primary current, thus it will go over longer distances without much loss, and it gives a smoothness to the sound at the receiver. I have used induction coils of every form with carbon transmitters, and find the advantages I have named; but I have not found such a marked difference as some have. You can make a suitable coil out of 2oz. of 18 primary, and 2oz. of 36 secondary, well insulating each layer from its neighbours, and more especially the primary from the secondary. Connect two wires from primary to transmitter, and from secondary to line and earth.—W. J. LANCASTER.

[46675.]—**G.N. Engine, 48**—No. 48 has outside cylinders, 18in. by 28in., and 8ft. 1in. driving-wheels. I believe all the 8ft. engines are the same as regards wheels and cylinders. No. 47 was the engine that was sent to the Darlington exhibition, and was built at the company's shops at Doncaster in 1875. It never runs to London. No. 48 was built also at Doncaster in 1874, and is No. 150 of their build. This engine was on the Leeds express when the latter ran into the Scotch express at Abbotts Ripton in Jan., 1876. Full dimensions of the class will be found in back vols.—MURANO.

[46676.]—**Focus of Lanterns.**—The only way for you to produce a large disc is to move your lanterns sufficiently far from screen You must, of course, remember that your light will enable you to obtain a disc about 12ft. to 15ft. in diameter, and beyond this it would be unwise to go, as the loss of light would more than counterbalance extra size of disc. It is always better to have a small disc well illuminated than a large one but dimly lighted.—W. J. LANCASTER.

[46676.]—**Focus of Lantern.**—The size of the picture of a lantern, as I have repeatedly stated in these pages, depends on the focus of the objective, and that only. If you want a large picture at a very short range from the screen, you must get a very short-focus objective or focus lens. The condenser has nothing to do with the question: it is simply a light gatherer. If I understand you aright, your present lantern has an objective of 4in. focus. Is that so? If it is, you can get a larger picture at the same range, or the same size near the screen, by using a 3½in. focus objective. Shorter than that I would not advise. If you do, you will find a want of focus and definition. I have lenses made specially for me that are 3in. focus only; but the definition is not equal to a 4½in. one, although no cost was spared. Large pictures at a short range mean very short-focus lenses, and consequent bad definition; and this is intensified by any attempt to depart from the exact square position relative to the screen. On the other hand, a long-focus lens will bear to work at a small angle, and gives splendid definition and depth of focus.—SUNLIGHT.

[46678.]—**High Temperature Fluid.**—Linseed oil boils, I believe, at 602° F. Would this do for your purpose? This is the nearest to 600° of any boiling-point I am acquainted with. If the vessel which is to contain the oil is perfectly smooth, the boiling-point might be raised a few degrees, and a temperature of 600° obtained without the oil boiling. Sulphuric acid boils at 640°: this, I suppose, would be out of the question. Then there is mercury, which boils at 660°.—W. J. LANCASTER.

[46678.]—**High Temperature Fluid.**—Fusible metal composed of lead 1, bismuth 2, tin 1 fulfils the conditions stated, and if its solidification at about 200° F. is no objection, might do. An alloy of bismuth 15, lead 8, tin 4, cadmium 2, melts at a lower temperature—said to be about 140° F.—J. BROWN, Belfast.

[46679.]—**To Mr. Lancaster.**—I cannot lay my hand on your original query. Will you be good enough to say exactly what it is you wish to do? I do not remember your first query, but shall be pleased to give you an answer when I know exactly what you wish to do.—W. J. LANCASTER.

[46683.]—**Magneto-Electric Machine.**—To MR. LANCASTER.—You have not one-tenth part the amount of wire on bobbins that you ought to have. I have repeatedly written that to get full power out of a core the wire on bobbin must be as deep in layers as the thickness of core. Now your core is ⅜in. diameter, then you must wind as much wire on as will make the whole just over 1in. diameter. Let the end nearest magnet revolve in a socket in connection with the framework of machine; the other end should be insulated from frame by a bush of boxwood or ebonite; then, of course, the spring must be screwed to frame, and touch round parts of axle twice during each revolution. A double magnet gives, of course, a stronger current; but a single magnet would give as much current as you would care for. You can make the spring out of any shaped piece of steel; the holes in the one you saw were there because probably the spring had been stamped, and originally belonged to something else. You can make a magnet-compound one out of bars of steel, coupled at one end with iron; but it would be a bad one. You can, if you like, make a magnet of a V form, the ends being riveted together; but this is not so strong a form as the horseshoe or U form.—W. J. LANCASTER.

[46684.]—**Photo. Background.**—You should buy a piece of "Avery's" background cloth. This you can have with a different colour on each side, dark and light, or dark and medium; in fact, any shade you like. It is remarkably cheap, and is the best background you can have.—W. J. LANCASTER.

[46689.]—**Focal Length of Photo. Lens.**—Take the solar focus and work from that. Thus: A lens of 12in. focus would give an image at 12in. of everything having parallel rays. Thus the sun's light would produce such a focus, and the most distant part of the horizon would produce an image in almost the same plane, while nearer objects would produce an image beyond that plane. In the case of a double combination, you must obtain its equivalent focus.—W. J. LANCASTER.

[46690.]—**Waterproof Cloth.**—Canvas can be made waterproof as follows: but calico will suit quite as well for this purpose. Give four or five coats of linseed oil, equal parts, boiled and raw. If colour is desired, one of the coats can be of paint, but it will be more pliable without paint.—D. BROWN.

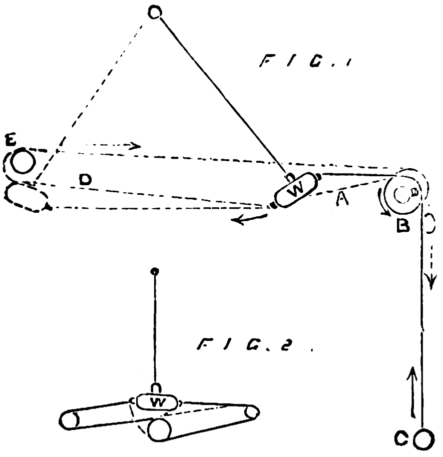
[46697.]—**Railway Grease.**—The querist is to some extent correct in supposing these compositions contain soap. I give the following from Barry's excellent work on "Railway Appliances," but the quality of the oil employed differs greatly on different lines.

	For winter.	For summer.	For very hot weather.
	lb.	lb.	lb.
Russian tallow ..	214	342	426
Palm oil	240	210	210
Soda	20	18	18
	Gallons.	Gallons.	Gallons.
Water	64	48	48

The great objection to grease as a lubricant is being applied from the top, it carries down with it any dirt or grit, and thus causes circular grooves to be worn in the journal. Oil is now considered to be a more efficient lubricant, after many severe trials.—A MEMBER OF THE SOCIETY OF ENGINEERS.

[46687.]—**Lifting Water by Motion of Ship.**—The height to which water will be lifted by motion of a ship going at speed of one mile per hour will be (theoretically) ·38in.; two miles per hour, four times that height; three miles, nine times; and so on, making the height at ten miles per hour 38in., and at twenty miles 12ft. 8in. Practically about 30 per cent. might have to be taken off the theoretical heights to allow for friction and bend in the pipe.—G. PINNINGTON.

[46687.]—**Lifting Water by Motion of Ship.**—"R. W.," in ENGLISH MECHANIC of 21st April, asks the height to which water could be raised according to the speed of the ship. This query does not intimate for what purpose the water is to be raised, but it has reminded me of an idea that I thought of when going to India in 1855—namely, of utilising the oscillating or pitching motion of a vessel by suspending a very heavy weight with room to swing from side to side. From this weight, W, there were to be two bands, one A, leading direct to a pulley on a shaft B, inside of which there was to be a ratchet acting on the shaft, so as to carry the shaft round with it. A band-spring or weight would carry the pulley back again on the return of the weight W. From this weight, W, there was to have been a second band D, passing over a fixed pulley, E, in the side of vessel, and thence to another ratchet pulley on same shaft as first mentioned, and rigged in same manner. It is manifest that at each sway of the weight W the shaft would revolve so many times, according to the diameter of the pulley, and work either a screw or pump, or punkah. Another and more compact arrangement is shown below. Each band works on a different ratchet pulley, having a ratchet working into the shaft, and reversed either by a spring or a separate weight, or by a band leading to the main weight W, but in a reverse direction.—Milford.



[46700.]—**Intensity Coil.**—There is some connection between the two sets of tin-foil in your condenser, which completes the circuit. Each sheet of foil should be a quarter of an inch smaller each way than the paper between it, and the two sets of connections kept some distance apart. —R. V.

[46702.]— **Mounting Oleographs.** — White linen is best for mounting. Strain the linen over a clean, flat board, fastening it down by a few small flat-headed tacks; tin-tacks will do. When strained free from any wrinkles, slightly damp the linen with a sponge with clean water. Let this remain a short time. Then paste the back of your oleograph, and rub it well down over the strained linen. Let this remain to dry overnight. After this, sponge gently over with vellum size, which is the best for the purpose. Let this get thoroughly dry, after which apply one smooth coating of white-paper varnish. Tack only round edges of linen.—G. Fryer.

[46708.]—**Rain-Water Tanks.**—Iron, galvanised, would keep the water clean and sweet; and I should recommend four supports unless you have very strong iron. Wood tank, lined with 4lb. sheet lead, will keep the water clean and good. Frost? No. As regards price, materials vary in different localities. You should ask your ironmonger what a galvanised iron tank will cost of the size you mention; then, for the wooden one, ask your carpenter to quote, and your plumber the price he will line it for, and, by comparison, judge for yourself. Durability: the iron one, if thoroughly galvanised, needs no further trouble or expense. Wooden one will require frequent coats of paint to keep from rotting. You may get a good cheap water holder by taking a quantity of oil-casks, and connecting together at bottom. Last a long while.—Working Tom.

[46712.]—**Yacht.**—If "Minum" will say what distance "house" is from the pond, and what means he has of transporting his proposed yacht, I will gladly help him.—W. R., Liverpool.

[46714.]—**Power of Engine.**—The rule that I generally use is as follows:—$A \times P \times V / 33{,}000 =$ actual h.p. Where $A =$ area of piston, $P =$ pressure per square inch, $V =$ speed of piston per minute. Making use of this formula in your case it becomes, therefore, $7{\cdot}00 \times 50 \times 200 / 33{,}000 = 2{\cdot}13$ actual h.p. I generally use 200ft. as the speed of pistons to my engines.—H. E. B., Ex.

[46714.]—**Power of Engine.**—Rule: Multiply area of piston in inches by pressure in lb. per inch, the product by the number of feet travelled by the piston per minute, and divide by 33,000. This will give h.-p. required. To find area of piston: Multiply the square of diameter of cylinder by ·7854. To find number of feet travelled by piston: Multiply the number of revolutions per minute by twice the stroke in feet.—E. S.

[46714.]—**Power of Engine.**—It is quite impossible, I regret to say, for me to give an opinion on the querist's engine, as he has not mentioned the speed, or revolutions per minute; but I append two rules that will enable him to easily calculate it out for himself. Let us take one rule, for instance, which is to multiply together the square of the piston's diameter in inches, the number of strokes per minute, the length of the stroke in feet, and the steam-pressure, together with the constant ·0000467, and the product will be the horse-power; or, to state it briefly, let us take C as the piston's diameter in inches, N the stroke per minute, P the pressure of steam, and S length of stroke, when the rule is $D^2 \times N \times P \times L \times {\cdot}0000467 =$ the horse-power. This is one way; but if the querist desires something that, perhaps, looks simpler, then he may multiply the area of the piston in square inches (which, in his case, is 7·068 square inches) by the effective pressure of steam, which is only to be ascertained by the indicator; then multiply that by the speed of the piston in feet per minute; divide this product by 33,000, and the quotient is the power, less friction.—Sunlight.

[46716.]—**Sound in Pipe.**—Local circumstances in so many cases greatly control the question of sound transmitted by a water-pipe. If it be a noise due to the transmitting power of iron, then a remedy would be to have a joint in the pipe, with pretty wide flanges, and between them a thick rubber ring. This would make a watertight joint, and, at the same time, abolish the noise, in a great measure. Would this be practicable?—Sunlight.

[46717.]—**Gas-Engine.**—To "Sunlight."—The sliding light of a gas-engine is one of the difficulties, and a great one, too, of the compression-engine. I will, however, briefly tell you that the description to which you refer of Crossley's patent, No. 2,177, of 1877, of the igniting arrangement is, to my mind, an absurdity. Not only so, but I have never met with an engine so fitted, and I do not think any were ever made on that plan. Therefore, you have been following a bad plan, to say nothing of the question of infringement. It is an exceedingly difficult matter to first get a good ignition and one certain of action, and yet be clear of infringement of existing patent-rights. And, apparently you have overlooked the operation and effect of the parts mentioned at Nos. 5 to 35, p. 9. As it is a special point of the patent, I hardly feel justified in saying more than that you have no doubt misinterpreted its meaning. And that, hence, it is quite impossible for you to get ignition. Broadly, the question you really want to know is, how to get the same pressure behind the light as before it. As far as the specification in question goes, I cannot venture to say anything, as I should be doing what I take to be a wrong to the patentees. And let me add that you are apparently most clearly infringing their patent as it stands. As it is held to be an infringement to make even one article or motor even for one's personal use. There are many points at issue that I should not care to mention publicly. I have myself a variety of plans, several of which depend entirely on the arrangements of the slide itself for their action, and not in any way depending on the grooves or channels on the valve-face. I need hardly say that these are, with other points, fully patented. The only thing I can do to help you is, that if you advertise your address I might be able to give you some assistance by private letter and in confidence, that I should decline to make public. As to the launch, I know the suction-gear you name; but it could not be applied to the purpose named, for several reasons. I carefully thought out the matter; but so far, insuperable objections came in against suction-gear. One very potent reason is that the engine, the screw-shaft, and the reversing motion must all be in the same horizontal plane. —Sunlight.

[46718.]—**Varnish for Venetian Blinds.**—Use what is called "church" oak varnish; as to the mode of application, with a 00 or 000 varnish-brush; varnish costs from 8s. per gallon upwards, according to quality and maker.—Hampstead.

[46721.]—**Right of Way.**—It would take many pages fully or even clearly to answer these wide questions. If the footpath has become a public highway it can only be closed by taking the proper steps under the statute 5 and 6, Wm. 4, ch. 50, and upon an order made by the justices in Quarter Sessions. But there are rights of way which are not highways. A right of way arises either by grant of the owner of the land or by prescription—*i.e.*, user, for more than twenty years. Rights of way are of endless variety, and depend upon the purposes for which they are used, the neighbourhood, and other facts, so that a general definition is as impossible as it is useless.—Fred. Wetherfield, Solicitor, 2, Gresham-buildings, Guildhall.

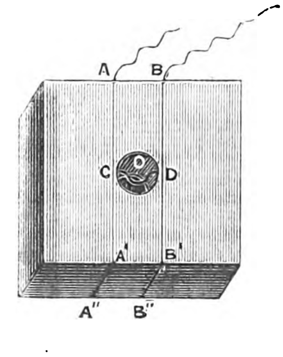
[46724.]—**Concrete Walls.**—We find nothing beats Portland cement concrete. One sack of cement to $\frac{3}{4}$ of a cube yard of gravel or broken stone. Yours will not want washing. See that there is some of all sizes, so as to fill up all cavities: if not, add sharp sand to make it do so, or a few ashes are good when above damp lime. We find ground lime to be a failure. If you like to write I will answer same. Be sure you have stones of all sizes, so as to have no cavities.—H. Booker, Sidcup, Kent.

[46725.]—**Plumbers in Paris.**—The English plumber can work his way in Paris as in England, and with the same success. The streets are not paved with gold, but where there's a will there's a way.—P. J. Davies.

[46726.]—**Paints for Spanners.**—Use black japan, and put into a japanning oven to dry. Put it on either with a brush or your hands.—Working Tom.

[46727.]—**Firing Gunpowder by Electricity.** —All you need is a small battery. One cell even will be sufficient for home experiments. What is needed is a short length of very fine iron wire, as fine as a human hair. If you take the two wires from your battery, and round one of them give the fine iron wire a few turns so that it is held fast, and then apply the other battery wire to the iron wire held in tension, you will quickly find what length of wire the battery will render red-hot. There is no need of an induction coil at all. —Sunlight.

[46727.]—**How to Fire Loose Powder by Electricity.**—The following is a good and effectual method. Take a piece of wood, about 1in. square by $\frac{1}{2}$in. thick. Make niches A′ A″ and B′ B″, about $\frac{1}{4}$in. apart. Also make two corresponding niches at the opposite end at A and B. Next, in the centre of the piece of wood, bore or scoop out a small hole O, say, about $\frac{1}{4}$in. wide.



Then fix two pieces of copper wire in the niches by bending them round and knocking them in in the position seen in the figure. Next, at the centres of these two wires, solder a piece of thin platinum across, about $\frac{1}{2}$in. long, and bend it down into the hole. The points where it is soldered are seen at C and D. The wire may be obtained for 2d. a foot at any good electrician's. Then fill up the hole with gunpowder, and paste a piece of paper over it to keep the powder in. Lastly, solder two wires to the wire at A and B to serve for heading wires. A couple of bichromate cells should fire this fuse. The poles, of course, are to be connected with the two leading wires. To fire the loose powder, the fuse should be inserted in the middle of the heap. Its action is that the current in its passage through the platinum wire (which must be very thin) heats it red-hot, thereby igniting the powder in the hole. No induction coil is needed. The dimensions of the fuse may be smaller than this.—W. H. L. H.

[46731.]— **Moulder's Blacking.**— I hardly know what "P. C. M." wants to know; is it how or what the blacking is composed of, or is it how does the moulder mix it for use? For very best work I have seen blacklead—servants' friends—as sold by the ironmongers, used; next, a cheaper sort of plumbago, and a cheaper sort for big work is the charcoal blacking, that is, ordinary charcoal ground as fine as flour. The moulders mix it for use as follows:—Take a bucketful of clean water, some potter's clay to thicken it, and put in a few handfuls of the above blacking. Proportions are all rule of thumb.—Working Tom.

[46732.] — **Micro. Fungi.** — Usually opaque. Some are soaked in spirits of turpentine, and mounted in balsam; others, without the soaking, in glycerine jelly.—John Alex. Ollard, F.R.M.S., Enfield.

[46733.]—**Screw Propellers.**—Your question cannot be definitely replied to as it stands. Every vessel almost needs a special size and pitch, so that there is no general size and pitch for all purposes. Certain rules—such as the draught of water aft, and other considerations—govern the size of the screw, whilst the speed of the engines and the lines of the hull are the data on which we go for determining the pitch.—SUNLIGHT.

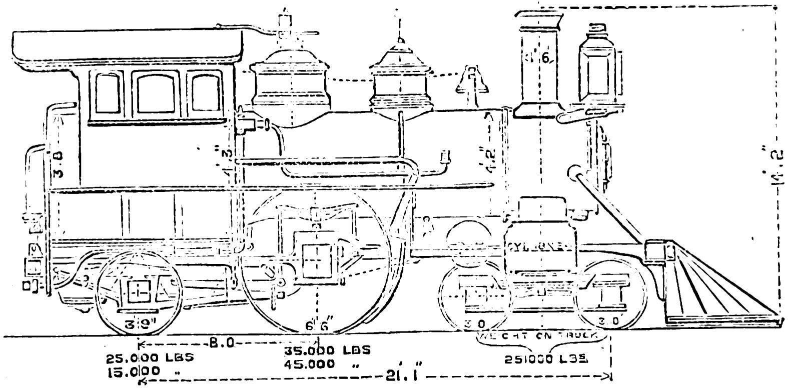
[46734.]—**M. R. Engines.**—All the engines "C. H." inquires about are six-coupled double-framed goods engines; 510 was rebuilt 1879: cylinders 16½ by 24 originally, 17 by 24 after rebuilding; 481 is a straight-framed engine of the same class, but I do not know the date. Most of the 480 class were rebuilt in 1878. The 430-449 class were built by the company in 1860, but most have been rebuilt; 395 was rebuilt 1878. Most of the 290 class of engines stationed at Birmingham were renewals of 1869 (such as 293, 297, 299): I have not seen 291, but perhaps it is one of these. The 270—289 class are nearly all rebuilt at various dates, mostly 1875-7. I do not know dates of those mentioned. I give dimensions of the old straight-framed goods engines—cylinders 16 by 24; driving-wheels 5ft. 2in.; wheel base 16ft. 6in.; grate area 14·5 sq. ft.; 180 tubes 2in. dia., ⅝in. clearance; weight on leading-wheels, 12 tons 6 cwt.; on driving wheels, 11tons 5cwt.; on trailing wheels, 8 tons 14 cwt. Dimensions given are those of the engine in the Exhibition of 1862 built by Fairbairn, Manchester. Can any reader give its number? All these engines which have been rebuilt have had their cylinders enlarged to 17 by 24. The boiler is also much larger. No. 429 engine belongs to a set of two engines built by Beyer, Peacock, and Co. in 1858, with Cudworth's fireboxes. They ran trials with two engines (426 and 427) built by the company in 1858, with the ordinary Midland brick-arch fireboxes. The result was in favour of 426 and 427. No. 428 eventually exploded at Nottingham in 1863, and was rebuilt. No. 429 was rebuilt in 1865. The fireboxes of both engines were changed to the ordinary Midland pattern.—METEOR.

[46735.]—**Eames's Locomotive.**—"Tyre" will find a full-page elevation of this engine about p. 412 of *The Engineer*, in the first half of 1880, and also a sectional elevation, &c., in *Engineering*, p. 265, March 24, 1882. I should here like to remark the engine in question was not, as some of the daily papers made it appear, built for the Eames's Brake Company; but for the Philadelphia and Reading Railroad Company, by the Baldwin Company, and bears date March, 1880. It has worked some of the L. and Y. trains; but with what success, if any, beyond the English locomotive, has yet to be stated.—R. N. H.

[46735.]—**Eames's Locomotive.**—This engine was purchased by the Eames' Vacuum Brake Company from the builders, Messrs. Burnham, Parry, Williams, and Co., of the Baldwin Works, for transportation to England, and what object they had does not appear, as the locomotive is fitted with the Westinghouse automatic air-brake, with the reservoir between cylinders and pump fixed on rear-end of firebox. It was originally intended for the Pennsylvania and Reading Railroad, to run on the Philadelphia to Bound Brook section. The engine, as will be seen from the tracing appended, is of the outside-cylinder type, with single driving-wheels, with a four-wheeled bogie in front and a small pair of trailing-wheels under the firebox. The load on the driving-wheels can be altered at will by the engineman by means of a lever (worked by a small vertical steam-cylinder) acting on the compensating-beam of the springs in such a way that the loads respectively of the driving and trailing-wheels may be altered from 35,000lb. on driving and 25,000lb. on trailing to 45,000lb. and 15,000lb. The trailing springs are somewhat curiously arranged, as will be seen on reference to tracing. They are placed in rear of the axle and the two ends of the frame as usual, while the centre of each spring is connected to the rear-end of a beam which passes over the corresponding trailing axle-box, and has its front-end coupled to the compensating-beam coupled to the driving-wheel spring. The heavier load that can be thrown upon the driving-wheels is for enabling it to start promptly on a gradient or with a heavy train. I append a few of the principal dimensions:—Diam. of cyl., 1ft. 6in.; stroke of cyl., 2ft.; length of ports, 1ft. 4in.; width of steam-ports, 1⅜in.; width of exhaust, 3in.; outside lap of valves ⅞in.; inside, 1-32in.; lead, 1-16in.; travel of valves, 5½in.; travel of eccentrics, 6¼in.; diam. of wheels, 6ft. 6in.; tractive force, $18^2 \times 24 / 78 = 99{\cdot}7$lb.; total wheel base, 21ft. 1in.; driving to trailing, 8ft.

Weight on driving-wheels ..	45,000lb. or	35,000lb.
Weight on trailing-wheels..	15,000lb. or	25,000lb.
Weight on bogie-wheels	25,000lb.	25,000lb.
	85,000lb.	85,000lb.

Diam. of barrel at smoke-box end, 4ft. 2in.; thickness of shell-plates, 7-16in.; length of firebox inside, 8ft. ½in.; width of firebox inside, 7ft.; thickness of firebox tube-plate, ½in; thickness of firebox plates, ⅜in.; diam. water-tubes forming grate, 1⅞in.; thickness water-tubes forming grate, ¼in.; pitch water-tubes forming grate, 2⅜in., number of boiler tubes, 198; outside diam.-tubes, 2ft.; length of tubes, 12ft. 2¾in.; length of smoke-box, 4ft. 2in.; height of chimney above rails, 14ft. 2in.; height of centre of boiler above rails, 7ft. 4in.; diam. exhaust nozzle, 4⅛in.; total heating surface, 1,400 sq. ft.; grate surface, 56 sq. ft.; the area through tubes, 3·5 sq. ft.; sectional area of chimney, 1·77; ratio of grate area to heating surface, 1 : 25; flue area (tubes) to grate area, 1 : 16; ratio of sectional area of chimney, 1 : 31·7. It will be seen from the above figures that the enormous grate area causes the ratios of flue and chimney to appear abormally small, although these areas are themselves amply large for the size of the boiler. The smokebox is very long, and is intersected a little above its centre by a wire network (3½ meshes to the inch), through which the blast-nozzle projects. The engine has no footplate in rear of the firebox, the stoking being done from the tender footplate. There is, however, a small footplate running along the side of the firebox, and on which the cab is built. One of the difficulties in introducing it in England would be difficulty of getting from side to side. The boiler is fed by two injectors, pumps being used. The smokebox is carried on four movable links, two before and two behind the firebox. These are the principal particulars and dimensions. For further particulars see *Engineering*, March 24.—E. W.



[46738.]—**Universal Brake Couplings.**—The East Coast and Midland Scotch Joint Stock carriages have already brake-pipes for air and vacuum. The West Coast Joint Stock has at present the chain brake, but is to be provided with the Westinghouse pipes, so that it can be worked on the Caledonian. The L. & N.W.R. don't seem to have fixed on a brake yet; when they do decide, it may be necessary to add other pipes to the Joint Stock. I cannot speak from experience about the brake worked through the buffers; but, on looking to page 4 of Mr. Stretton's little book on "Railway Accidents," of February, 1881, I learn that George Stephenson tried such a brake upon the Liverpool and Manchester, and Leicester and Swannington Railways in 1832, and he gave it up because he found a difficulty in setting the train back. The statement quoted upon page 177 is quite true, that the vacuum brake on the Midland leaks off in two minutes, and that it cannot be fitted to engines or tenders. *I do not consider* that it does fulfil the conditions, and should be glad to know the opinion of our correspondents. I quite agree with "Railway Servant," that ejectors, when running a stopping train, use quite 2lb. of coal per mile. I cannot say for certain how much a pump uses, but it is very little. During the next two weeks I shall work engines with both pumps and ejectors. I will take very careful notice, and report experience I gain in a letter to ours.—A DRIVER.

[46739.]—**Nitro-Glucose.**—Take equal measures of strong nitric and sulphuric acids, mix, allow to cool, and then stir in finely-powdered loaf-sugar. Nitro-glucose will speedily form in a stiff pasty mass, which should then be removed from the acids and well washed with water. Owing to its insolubility and impermeability, it is difficult to entirely free it from acidity; but if that is any objection, it may be still further purified by dissolving in alcohol, and precipitating by pouring it into water.—WM. ROBINSON, jun.

[46741.]—**Landscape Photography and Dry Plates.**—"Holiday Work" might resort to some of the old collodion processes, either with the bath or emulsion, and of which I think there are ample details in back volumes; or, if he likes to prepare his own gelatine plates, he can make them as slow as he thinks proper—it is all a question of "cooking." It is quite a mistake, however, to suppose that gelatine plates cannot be manipulated without an "inconveniently dark non-actinic light." It is simply a question of a little dodging, such as working with the back to the light; in a part of the room where no direct light from the window can fall upon the plates, or interposing an opaque screen between the light and the plates.—W. ROBINSON, jun.

[46741.]—**Landscape Photography and Dry Plates.**—In answer to "Holiday Work," I find in my experience that gelatino-bromide dry plates are the most simple and pleasant process of any I have tried. Plenty of light can be used if of the right kind; a ruby hock-bottle with a candle used inside gives a very pleasant light; these can be bought at most dealers in photographic apparatus. Plates can be bought about as sensitive as wet plates. I use Edwards' Glycerine Developers, give long exposures and slow development. On reference to my notebook I find the following: Waterfall near Wales, light moderate, time 3 p.m. Small stop, Dallmeyer's Rapid Rectilinear, exposure 35sec., very slow development; the result is all that could be desired, and splendid in detail. (The plate was an extra rapid).—JAMES PARKINSON.

[46742.]—**Daniell Batteries.**—To use Mr. Sprague's words, "the great drawback to this cell is that the copper salt passes by endosmose into the zinc solution; and suggests as a remedy the use of two porous cells, the space between them being filled with a strong solution of sulphate of zinc, and some zinc cuttings added to decompose any copper salt entering." It is almost a perfect remedy, but increases the internal resistance somewhat. You would not gain anything by using water instead of acid and water, or semi-saturated solution of sulphate of zinc.—AN ASSOCIATE OF THE SOCIETY OF TELEGRAPH ENGINEERS.

[46743.]—**Microscope and Magic-Lantern.**—Much has been written on this question in back numbers of this journal. I myself always prefer to use a proper lantern micro. objective; that is one constructed to utilise as much of the available light as possible, and not only this, but it allows the micro. attachment to be so arranged that the great condensation of heat on the slide is avoided. As you apparently do not know this, I would tell you that when using the lantern as an enlarging microscope, the slide is placed approximately where the focus lens usually is, and hence, being placed where the rays of light converge to a focus, great heat is also thrown on the slide, so much so that with the usual form, small animalcules are speedily killed by the heat of the water in the tank, or by the great concentration of heat on them, if in a cage. Not only so, but the heat damages the slides by starting the balsam, and sometimes even cracking the glass. With the objective from an ordinary microscope, the aperture is not sufficient to get the projection sufficiently well lit, and nothing but a lantern micro. will remedy this. The best of all micro. attachments is a form that has been introduced by Mr. Browning, of London, the definition of which is something splendid. But the high price of it, and the fact that nothing short of the oxyhydrogen light is of any use with it, preclude its use except by a few.—SUNLIGHT.

[46745.]—**Stopping for Decayed Teeth.**—"Murano" will find plain indiarubber tooth-stopping the most effective. It can be obtained at all chemists.—SEAWEED.

[46745.]—**Stopping for Decayed Teeth.**—If you cannot go to a good dentist, don't stop them at all. I had several teeth stopped with metal. The teeth decayed below the stopping, which became loose. Nothing would pick it out (being as hard as iron), and the agony was intense, as I could not cleanse the tooth out. No stopping is of any use unless the tooth is well and thoroughly cleaned out. Then use some soft stuffing. Keep your teeth well cleaned out and well cleansed, and attend carefully to diet (this is all important), and you will seldom have toothache. If you have, use carbolic acid and chloroform in equal parts. It need not be kept in the tooth for long, and should be carefully put in, to avoid burning the lips. I used to use it daily and hourly. To clean the tooth out use caustic. The taste is unpleasant before eating or smoking. I have also used nitric and hydrochloric acid, but they are painful. I am now a vegetarian, and suffer seldom from toothache.—JOHN ALEX. OLLARD, F.R.M.S., Enfield.

[46746.]—**Stopping for Decayed Teeth.**—Several years ago, finding some of my teeth were showing signs of rapid decay, I bethought me to stop them with an amalgam of silver, which I made by filing some pure or coin silver to a powder, and working it up to a stiff paste with quicksilver. After having scraped the cavities of the teeth to remove decayed and soft parts, and otherwise cleaned them out and dried with plugs of cotton-wool, I packed and pressed the amalgam in, and shaped off as nearly as I could to the original forms of the teeth. After it had set, which occupies about half an hour, or less, I had as good a biting and grinding surface to my teeth as could be wished for. Observe that this stopping should not be applied if the teeth are aching, or an exposed nerve left undestroyed. After several years, these stoppings show very little sign of wear. The only thing that detracts from universal use is that the amalgam turns black, so is rather objectionable for front teeth. For back teeth this discolouration does not matter. Only on one occasion have I found it necessary to remove the stopping from the tooth in which it was placed. Owing to subsequent decay, the cavity had enlarged and the stopping got loose. Toothache following from a severe cold in the facial nerves, I was constrained to remove it to get relief. It is out at the present time, but I intend, as soon as the nerves are in their normal condition, to stop the tooth with the silver amalgam. I must append a caution: Do not let the quicksilver touch any article of jewellery, or you may be caused vexation. White guttapercha makes an excellent stopping *pro tem.*; it soon wears away. Carbolic and other such diabolic combinations should be eschewed as much as possible; they invariably accelerate decay. Creosote notoriously crumbles up the molars.—ALFOJOE.

[46753.]—**A Water-closet Nuisance.**—I think that the rubber washer edges are loose; but try a small ball-valve with pea waterway. If you cannot get one, send to me, and I will let you have one cost price. I expect you have a very high pressure behind your valve.—P. J. DAVIES.

[46754.]—**Watch Repairing.**—To "ALFOJOE."—It gives me great pleasure to know that what I have written upon the subject of watch-cleaning, &c., has proved of service to "Country" and others. As regards the query put to me, there must be something defective in the action of the stopwork of the watch referred to, or through frequent breakage the chain has become too short, and is pulled out at the barrel-hocking before the fusee snail-point catches against the stop-finger attached to the top plate. These defects must be sought for, and you can ascertain which causes the trouble if you take the movement from the case, and with the eyeglass examine the run of the chain from the barrel to the fusee, and the action of the stopwork, whilst the watch is slowly wound up. If the chain is of the correct length, there should be fully a quarter of an inch of it upon the barrel when fully wound up and correctly stopped. If too short, it will be seen that the snail-point does not come up to the end of the stop, while the chain is wound off the barrel and pulls on the hook. To correct the chain, you must attach about an inch of the same substance and strength. This will allow the fusee to pass further round, and so make the stopping effectual. Should the fault prove to be in the stop-finger or its spring, it will be necessary to take the watch to pieces. Occasionally a little bit of bristle from the brush will get wedged between the chaps of the plate stud, or dirty oil may prevent free action, or the lifting spring may be too weakly set. In these cases the remedy is obvious. If you take the watch to pieces, put the plates together with only the barrel, fusee, and chain in, and set the mainspring up at the ratchet as usual. Then with a pair of hand-tongs or a small hand-vice, wind the chain from the barrel on to the fusee, and watch closely whether the stopwork fails or acts correctly. If it does not, try to ascertain the cause and so correct the error. I have occasionally found that two hook-holes have been made in the ring of the barrel because the first-made hole has been either too high or too low to deliver the chain correctly. If such is the case with this watch, you must try both, to ascertain which is the correct one. There is yet another chance that the fault may be caused by the lifting spring having shifted from its place, and so prevents the extreme end of the stop-finger resting against or near enough to the top plate, and thereby allows the snail point to pass by. It is needless to give sketches to illustrate my meaning, as five minutes' close study of the parts themselves should make all perfectly clear to you. Respecting the 'scape-wheel, by "fastening" do you mean "riveting" to the pinion? If so, you can do this with the little tool (Fig. 3, letter 19974) and a small round hollow punch, a portion of which has been cut away and the remaining part bevelled off from the hole outwards. By gently tapping the punch with a hammer, when the wheel is placed teeth up in the stake, and that screwed in the bench vice, the protruding part of the pinion is closed over the edges of the hole in the wheel and so made secure. Great care must be observed in riveting over, as a little excess to one side or another will throw the wheel out of truth. You must ascertain the correctness of this either in the calipers or in the depthing tool, which, in many ways, is the better tool for the purpose of trying the flatness or truth-in-the-round of all kinds of watch-wheels. If one side of the scape-wheel is found a little higher than another rivet that part a little more. When correct, finish off by rolling it in the centres of the turns by a horse-hair bow against a piece of Arkansas stone slightly oiled and held firmly at right angles to the teeth of the wheel, and so "tipped" up, and then with a suitable balance file thinned off equally. In my letter 19974, "Watch Mainspringing," read "turning" for "twining."—ALFOJOE.

[46755.]—**Enlargements and Developing-Tins.**—A very good and inexpensive method of enlarging will be found in the "Photographic News Almanac" for 1882 on page 54. Directions are sent out with each packet of paper. I have used tin developing-trays, for alum and fixing-baths, without the slightest trace of evil of any kind; but for developing coat with Bates' black varnish, after the manner of coating a negative; warm the tin first.—JAMES PARKINSON.

[46755.]—**Enlargements and Developing Tins.**—Block up all the window of operating room except a small space for negative, remove dark slide and focussing screen from camera, place back of camera against negative, focus image to size required on sheet of plain paper, and then take enlargement on bromo-gelatine paper. Leave developing tins alone; carefully dry them when done with, and they will most likely last your lifetime.—W. ROBINSON, jun.

[46756.]—**Bookbinding.**—Get your sheets of paper, cut them to the size required, glue one of the cut edges which you intend to form the back of book with ordinary hot, thin glue. When dry, stick on your end papers. Then, afterwards, paste your boards on, to form the cover. When pressed, glue a piece of bookbinder's cloth over the back with good hot glue. Paste on the marbled-paper sides. Let this dry. As the book has not been sewn, but merely glued at the back, you will be able to remove a leaf from it without loosening the others, providing you are not too rough in the way you go about it.—G. FRYER.

[46757.]—**Emery Wheels.**—To "SUNLIGHT."—Just fix on the size wheel you think would suit you; you would do well to write to one or two firms who supply the unmounted wheels, when they would not only quote price, but give the required speed. Having gone so far, I could then tell you speed of overhead shaft and size of pulley needed.—SUNLIGHT.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last "R. N. H." has replied to 35398.

46150. Engine Query, p. 601.
46159. To Mr. Evans, 602,
46167. Block Signalling, 602.
46183. Opals, 602.
46191. Air Absorbed by Water, 602.
46192. Sugar Refining, 602.
46196. Siemens' New Armature, 602.
46198. Hydrometer Scales, 602.

46427. Electric Engine, p. 69.
46430. Colours on Fabrics, 69.
46447. Gauges for Lead Pipes, 69.
46451. Spring Blinds, 69.
56455. Educational Prize Trust, 69.
46466. Staining, 70.
46467. Rheocard, 70.
46468. Brake for Omnicycle, 70.
45470. Diagrams of Oscillating Engines as on London River, 70.
46471. Great Eastern and Great Northern Joint Line, 70.
46474. Chime Clock, 70.
46476. Dull Window Glass, 70.
46477. G.W. Engines, 70.
46478. L. and N.W. Engines, 70.
46479. Steam Carriages, 70.
46483. Diamond Work, 70.

QUERIES.

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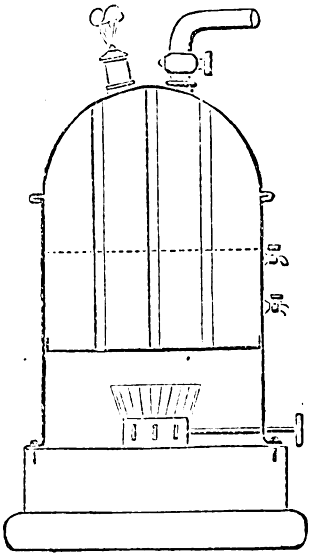
[46760.]—**Making Boiler.**—Would "Sunlight" or Mr. Lancaster please kindly explain the best means by which I can accomplish the following?—I want to make a copper vertical boiler as sketch. I have the dome or crown made of copper, semi-circular, like a deep copper scale. I want to make the sides come down below the bottom to form a support for boiler, and at same time suit as a furnace for burning spirits. Please say the best means to unite strongly and substantially the top or crown to sides and also the bottom. I have seen one similar which was brazed. Can I do this, or what way would you approve of—two or three brass tubes, vertical, to run through the boiler, and be expanded at crown and bottom, and I suppose a little solder, or brass, run round at the union of both metals? Crown dished out of the solid. What will be the best way to join the vertical seam of side? Copper crown is 7in. dia. by 20 W.G. Please say what pressure this may bear; I do not require it very great pressure. I shall have an ordinary model boiler spring safety-valve on it.—JUNO.



[46761.]—**Compensated Watch.**—I have recently bought a combination lever watch, Swiss make, in gold keyless case, with full plate, jewelled in 10 holes, with compensated balance. I found great difficulty in rating it. Since I brought it nearly to time I have been comparing it with a regulator clock controlled from Greenwich, and the following is the result:—

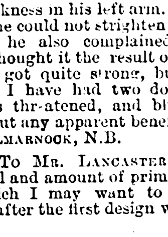
Feb. 4 .... 1m. 15s. slow.
11, 18, 25 .... 45s. slow each week.
March 4 .... 1m. 30s. slow.
" 11.............. 45s. slow.
" 18, 25, April 1.. 6m. slow in three weeks.

Was not observed in the interval. It appears from this that the normal rate, as rated, is to lose 45s. a week. What is the cause of the variations? Can it be rectified? There is a "ring" or "jingle" in the tick. It is steadily carried, never shaken in any way, or exposed to variations of temperature. It is a highly-finished one of the best of its class.—A. A. C.

[46762.]—**Sick Child.**—Would Dr. Edmunds kindly consider the following?—My little boy, aged 5 years, on recovering from influenza about three months since, showed signs of weakness in his left arm. On examination we found that he could not strighten it without pain at the elbow-joint; he also complained of pain in the back. Our doctor thought it the result of general weakness. He has now got quite strong, but the arm is no better—but worse. I have had two doctors, both say that joint-disease is threatened, and blisters have been applied freely without any apparent benefit. Is there no other remedy?—KILMARNOCK, N.B.

[46763.]—**Coil.**—To MR. LANCASTER.—What is the best length for a coil and amount of primary wire to give $\frac{3}{4}$in. spark; but which I may want to give 2in. by increasing secondary after the first design was complete?—T.

[46764.]—**Punches for Boiler-plates, L-irons, &c.**—Will some of your correspondents please give a sketch, with full-sized dimensions, of a common or ordinary punch, showing how it is held in the machine, an explain why it often makes such ragged holes in th plates. Some time ago an American, S. H. Jenkins, of



New York, introduced a punch which had cutting edges or teeth, something like inclosed sketch. Can any reader oblige with an accurate sketch, and say how it answered in practice? It claimed to clear out or rimer the hole after first punching it.—RIVETER.

[46765.]—**Periosteal Rheumatism.**—Some time ago I felt a stiffness in one of my elbows and thereupon briskly applied friction, but it still continued, attended with pain on moving the joint, and more especially in moving the muscles of the arm in putting on my coat. I subsequently tried counter irritants, but without success, and finally applying to a physician, was told that most likely it was the result of a strain, and a liniment was prescribed. It still continued as before, although attended with somewhat less pain. And now after having expended several guineas in doctors' fees, I am informed that it is periosteal rheumatism, and all that was lastly prescribed was "Fredricshall" water, for generally improving the system. Being now on the verge of 50, I should feel grateful if any fellow-reader of "ours" could advise me as to its removal.—R. A. V.

[46766.]—**Lathe.**—What is the correct size of round belt to drive a 6in. treadle lathe? And what is the dimension of a triangular band? How is the latter sort joined? Is it advisable to make a good lathe having both the bearings of mandrel coned one way? Are any made so by good makers that do not jump? Also, should the nose be screwed with a finer pitch than Whitworth's standard? If so, what is the ratio to the above mentioned? Is 1⅛in. the proper dia. of mandrel and loosehead spindle for 6in. lathe? Is there anything to supersede the emery-wheels used with overhead that will not injure good tools?—INVINCIBLE.

[46767.]—**Repolishing Ebonised Piano.**—One of Neumeyer's highly-polished ebonised pianos having become dull and scratched, how can the original brilliancy be restored? Or what is best plan to adopt to give a less brilliant but more durable surface?—CHESTER.

[46768.]—**Surveying.**—Would a correspondent to the "E. M." kindly give an easy and graphic method of finding the true meridian, latitude, and longitude of any place? The aspirant to be possessed of a theodolite, chronometer, and star-map, but to have no knowledge of the country. The same inquirer would also like to be informed of the method of determining distances by aid of micrometer attachment to telescope of theodolite, and the maximum error per mile arising from its use? Also, a good maker to whom to apply for surveying instruments to be constructed with suggestions of improvements?—YOUNG ASPIRANT, Tasmania.

[46769.]—**Silvering Mirrors.**—In No. 878, Jan 20, 1882, a process is described of silvering large mirrors. I have tried the process twice with rather disappointing results. The mirror, although quite perfect in most parts, in others is streaky and covered here and there with blackish dots. I would be obliged to some subscriber for some further hints on the subject. Solutions of perfectly pure chemicals were made up in the proportions described, and the face of the mirror, 2½ft. by 2ft., made chemically clean by washing in nitric acid, then in caustic soda, and water ammonia was added to the silver solution till the turbid appearance first produced had quite cleared; the potash solution was then added, and ammonia again till the solution was clear. Then a weak solution of silver added drop by drop till the appearance was decidedly turbid again. I then dissolved the glucose separately, but while this was taking place a film of evidently reduced silver rose to the surface of the silver solution. The glucose was now added to first solution, and the whole well stirred and poured into a wooden box lined with guttapercha. The mirror was then carefully hung on the surface of solution with about ¼in. betwixt bottom of box and and face of glass. I may mention that just before the solutions were mixed warm water was dashed over the face of glass. The basin in which the two solutions were mixed had a beautiful coating of silver all over the sides and bottom, although the mixing would not take longer than ¼ of a minute. The solutions were made up with water at about 180° F. The mirror was allowed to remain about 30min. in solutions. By that time all the silver had been reduced.—SIGNED CHEMIST No. 50.

[46770.]—**Cold-air Motor.**—Could some kind reader give me a description of Giffard's cold-air motor. I should be much obliged for a rough sketch? I wish to make one, and intend making it like one I once saw, but I cannot say now whether it was a patent or not. It was in the way of a steam cylinder with perforated ends and a piston, and was driven by steam-power.—SUMMIT OF ENGLAND.

[46771.]—**Zincography.**—Information wanted as to zincographic process. The way I work it is this:—Clean sheet of roofing zinc with fine emery cloth, write on lithographic transfer paper with litho. writing-ink rubbed down in water. When dry lay transfer face down on zinc, damp back well and pass through press, damp again and take off paper. Then smear gum-water over zinc with camel-hair brush, and having got printer's ink prepared on roller, pass same lightly over zinc. I got this recipe from a scientific paper. Result: Printer's ink smears irregularly over zinc plate, and does not catch to the writing as it should. What is wrong? Should zinc be treated with acid to bring writing up in relief?—A CANADIAN SUBSCRIBER.

[46772.]—**Steam Launch.**—I am building a small launch 16ft. on water line, by 4ft. beam and 3ft. deep from keel to rail, and am fitting it with a single cylinder engine 3in.×4in. stroke, and balanced to run between 250 and 300 revolutions per minute. The boat will have fine lines, as it is intended only for river work. What propeller will probably give me the best results, what diameter, a fine or coarse pitch, and especially whether two or three bladed? My own impression is, that a two-bladed propeller at this number of revolutions is the best; but should like to have the experience of others. Further, would a boiler having 1¼ sq. ft. of grate-area, and a total of 10 sq. ft. of heating-surface give ample steam? What is the best speed I can expect from this machinery?—SCREW PROPELLER.

[46773.]—**Prince of Wales Harp.**—Could some of "ours" give me full instructions how to make the above? What are the kinds of woods most suitable, the kind of strings and cost of same, how they are tuned, and a few hints on playing? I should like, if possible, the exact dimensions of two sizes—the smallest useful size, and the largest? But if this is not to be had, anything on this subject will be thankfully received by—W. WORLEY.

[46774.]—**Bristol and Exeter Locos.**—Will "Clyde" kindly oblige with dimensions of any of the other classes of Bristol and Exeter engines?—those of the 9ft. singles having already appeared in Vols. XXV. and XXIX. (I think), and he having supplied those of Old 69 class. There are, I believe, some 6ft 6in. coupled, and some 7ft. 6in. singles.—CARSTAIRS.

[46775.]—**Staining Walls, and Plain Decoration.**—Would any of your readers give me the proper ingredients to mix to get the following colours for bedrooms and sitting-rooms:—The colouring matter to be made from dissolved lime, whiting, size, and the stuff to give the proper tint. The colours wanted being salmon colour, pale light blue, with a greenish shade. Where could I get stencil plates to make a border for top of wall and at bottom near skirting? Is there any cheap work on plain house-decorating?—F. J. C.

[46776.]—**New Form of Cheap Battery.**—Will Mr. Hawkins (19957) kindly give approximate cost of six cells as described above—*i.e.*, cost of six quart jars, six smaller ones and ingredients? If the Swan lamp referred to is the usual 20 candle-lamp or a smaller one? Mr. H. says the six cells will sustain a good light for over eight days. Will Mr. H. kindly say how many hours per day he has allowed for lamp-burning?—R. D. T.

[46777.]—**Timber Loading.**—Will some fellow-reader give me some information on the subject of timber loading, the best way of going about it, and if it would pay to use a crane on wheels? If it would do so, what is the best crane to get, and the price? Of course I mean when hauling a lot of timber from one place. Would a crab be of much use? I understand the common way of loading timber by means of skids and rollers; but this is a very slow and clumsy method, and knocks the horses about a great deal before they really commence their work of hauling. Would one of the patent blocks suspended to tree—timber always being put under tree—be of much use?—JUMBO.

[46778.]—**Spectral Photography.**—Will any of your readers kindly inform me what apparatus is required for photographing the spectra of metals, &c., and what is the kind of spectroscope suited for the purpose? Also, whether the same spectroscope and apparatus could be used on a 9¼in. reflecting telescope for stellar spectral photography?—CINQUANTA.

[46779.]—**Bleaching Cotton.**—How can I bleach small articles made of cotton? Have tried boiling in water with chloride of lime. The colour is good, but the articles feel harsh and smell of the chloride. I want the cotton to feel soft. DIX.

[46780.]—**Water-power.**—1. What power could be got from a body of water equal to the fill of a 10in. pipe, having 35ft. of a face, by using a "turbine wheel"? 2. What power could be had by using an overshot wheel from the same fall? 3. What would be the probable cost of each wheel and where could they be got?—QUEENSLAND.

[46781.]—**Music.**—What books are most suited to the requirements of the First Bachelor Music, London University?—PENURIA.

[46782.]—**Explosion in Firebox of Loco. Engine.**—To "SUNLIGHT," OR OTHERS.—A rather extraordinary affair has lately occurred in connection with a burst and plugged locomotive boiler-tube. As the occurrence was quite unexpected, and not capable of explanation on ordinary lines, perhaps after reading the narrative you will kindly favour me and others with your opinion on the subject. It is briefly as follows: A loco. engine burst a tube at a distance from stables, and had it plugged at the nearest shops. On arrival home, the boiler was emptied of steam and water, and immediately filled up with cold to cool, and after an interval emptied again. The boiler-maker then began to extract the plugs preparatory to drawing the tube. But it seems there had been a very heavy charge of "something" in the tube, for no sooner was the plug slightly loosened with the hammer than it blew out with a report like a musket, and the discharge, whatever it was, took effect in the man's face and hands. Eyes very severely inflamed from the effects, hands and face specked all over with little black particles driven into the skin. Altogether, he had a very narrow escape. Now the tube was empty when the plugs were inserted, no water could be in it, or very little, if at all. And in the latter case the heat remaining in boiler after being cooled would not, I should think, be sufficient to vapourise it. What do you think of this? Tube burst just inside tube-plate, firebox end.—SCOTUS.

[46783.]—**Battery for Continuous Current.**—Will someone kindly give me particulars of an inexpensive cell suitable for maintaining a current for about eight hours per diem through about 100 yards of wire in a closed circuit, and how often such a cell would require recharging? My object is, that on the circuit being broken at any point, an alarm shall be given by a Leclanché battery being brought into action through the release of an armature or some other convenient means. The strength of the continuous current need not, therefore, be great.—F. H. B.

[46784.]—**Bicycle Making.**—I should be glad if "Sunlight" will oblige me with a sketch of frame for drilling hubs for front and back wheel. I have a small upright drill with rising and falling table, 8in. in diam. takes in 6in. I have also a small lathe, 5in. centre, 2ft. 6in.×2¼in. V. and flat-bed, single-geared, no slide-rest. Will "Sunlight" also oblige by answering the following?—1. What will be the right width between hubs for 50in. machine? 2. Size of back wheel? 3. What rake to allow from centre of spindle to centre in neck?—E. STEVENSON, junr.

[46785.]—**Churn.**—Would some of the readers of the "E. M." tell me what is the best sort of churn for making a small quantity of butter at a time, say from 1lb. to 4lb.? I have heard of a small American box-churn being adapted—also the atmospheric churn; but I have seen neither. Probably there are other sorts which have superseded them in efficiency.—TOPY.

[46786.]—**Ventilating Weaving-Shed.**—We have a weaving-shed which is very hot in summer, and we cannot do with the ordinary ventilators, because it injures the yarn, owing to the drying of the size. What we want to know is, whether there are any means of lowering the temperature or heat of the room without causing a draught or making the room dry?—MANUFACTURER.

[46787.]—**Condenser.**—To T. N. ANDREWS, Plymouth.—Will this gentleman kindly inform me as to the size and number of sheets of tinfoil used in the construction of the condenser of the coil described by him in No. 885 of this paper?—B. B.

[46788.]—**Varnishes and Stains.**—Can any reader tell me of a varnish or polish for small turned work? A dark yellow preferred, to be applied whilst the work is in the lathe, and dry at once. The wood used is ash. Also, what coloured matter is used on soft wood and beech to imitate mahogany for door-knobs, &c.?—WOOD-TURNER.

[46789.]—**Screw-Steamer.**—I am making a model yacht to be propelled by a screw of 2½in. dia. with three blades. The boat is 22in. long, 4in. wide, 5in. deep, made of zinc. The engines are two in number, 1¼in. stroke, ½in. bore—double-action oscillating. The boiler is made of brass, well stayed, 6in. long, 2½in. dia., and can be pressed to 15lb. per sq. in. I shall esteem it a favour if any kind reader will inform me whether I am correct in making it to the above sizes, and also if the engines are large enough to travel at a good speed, and at what speed?—PROPELLER.

[46790.]—**"Stirling Castle."**—I shall be glad if any reader can give me dimensions of the engines as well as the size of the above-named ship, which left last month for China?—PROPELLER.

[46791.]—**"Sahara."**—The Cunard's largest, which, I believe, is being constructed for the Atlantic trade. Can any reader give the dimensions of her as well as the engines?—PROPELLER.

[46792.]—**Aquarium Front.**—What should be the thickness of a plate-glass front for an aquarium, 4ft. × 2ft. × 2ft., depth of water 1ft. 6in., stout wood back, sides and bottom. What pressure of water would be on the glass?—STICKLEBACK.

[46793.]—**Glueing Belt Splicings.**—Will any reader kindly tell me what sort of cement to use for cementing the splicings of belts before they are sewn, and in what way it is used?—G. H.

[46794.]—**Model Beam Engine.**—I am about to make a model beam-engine 2in. stroke. Will "Sunlight" or any other kind reader, tell me the best way to get the parts drawn to scale?—more particularly the beam, size, and weight.—AMATEUR.

[46795.]—**L. & N.W.R.**—Will some correspondent kindly give the exact distance of Rugby and Northampton from Euston by the new route?—LORD OF THE ISLES.

[46796.]—**The New Bee Motor.**—Can any reader give a section of the new motor above named?—AMATEUR ENGINE DRIVER.

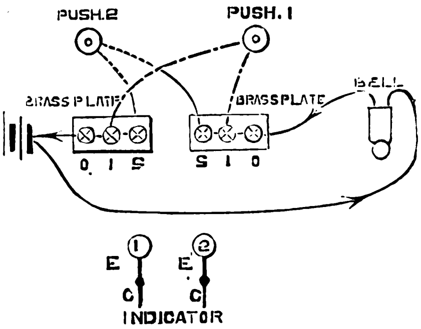
[46797.]—**Academy Boards.**—Are the Academy sketching-boards trustworthy for finished paintings on a small scale?—H. W.

[46798.]—**South African Railways.**—Could any reader of the "E. M." inform me how many miles of railway are in actual working order at the Cape at the present time? Also, how many miles are under construction, and the builders of their locomotive engines?—A DRIVER.

[46799.]—**North American Indians.**—Can any of your travelled correspondents give any information upon the Indians of North America, especially the tribes of the Apaches and Comanches? The latter tribe were stated about 30 years back to number about 100,000, and to live mainly upon the chase of the bison. Do they still inhabit Western Texas, or are they placed on reserves? And what is their means of subsistence now that the buffalo is extinct, at least, in that locality?—J. W. W.

[46800.]—**Engine Query.**—I am much obliged to "Labor Omnia Vincit" and "Sunlight" for their replies. The reason why I fear to apply high pressure to my engine is that there is a hole in one of the steam passages. It is stopped by soldering a plate over it and secured by screws. I think it would be quite safe at 20lb. pressure. I have not room for any but a vertical boiler.—ELEPHANT BILL.

[46801.]—**Sub-Circuit to Indicator.**—I have fitted up an arrangement as shown in diagram (where only two room connections are shown for simplicity) for making one bell serve for 12 different circuits. I now desire to arrange a sub-circuit from each room, wire to an indicator to show which room has signalled, but am at a loss how to do so, as it appears to me that one room push will throw all the sub-circuits into electric activity. Full lines on figure indicate part of circuit common to all rooms. Dot and dash line, room No. 1; dotted line, No. 2. Wanted description of connections to E, E', &c.?—BOB.



[46802.]—**Early Rising.**—Some time ago you had some ingenious ideas for getting up of a morning, but they all failed in one respect—viz., the noise comes to an end, and with me such would have no effect, as I should simply wake up, open an eye, listen to it; when over, go to sleep again. So I had an electric bell fitted up over my head. Push outside the door. When the push is applied it keeps on until I get out of bed, open the door, and take it off. It answers beautifully with one exception—I have no reliance that the push will be applied. Now would the following do?—A clock with a weight to it, underneath the weight lay the push-flat, so that the weight would ultimately rest on the push and keep the electric bell going until relieved. Say an alarm clock, so that the alarm weight set the bell going. Could not I have two sets of wires—one for the door, and one for the clock? I should be glad if someone with necessary apparatus could try it and gives details of same, or better invention?—JOHN ALEX. OLLARD, F.R.M.S., Enfield.

[46803.]—**Movable Bookshelves.**—Can any reader suggest a convenient form for such, readily removed from one house or part of a house to another? —B.

[46804.]—**Furniture Cleaning.**—I am asked "how to get off all that nasty black and rough stuff which oozes out of furniture (walnut especially) without injuring the French polish on the articles?" Brandy and spirits of wine have been tried without success. Can any reader assist?—B.

[46805.]—**G.E.R. Locomotives.**—Will someone give dimensions of the new six-coupled goods engines just out, designed by Mr. Bromley, and built by Kitson and Co.? I hear that they can take 50 loaded trucks of coal from March to Stratford—is this correct? Also, are the four-coupled engines, with inside cylinders, now in course of construction, being built at Stratford?—G. C. M. HALL, Colchester.

[46806.]—**Mounting Plate Machine.**—I have a plate 18in. diam., and wish to mount it as a Winter's or any other type of machine. Will Mr. Lancester, or any other kind reader, help me with a working diagram and instructions?—A BEGINNER.

[46807.]—**Royal Engineer's Department.**—Will "Unfortunate" kindly inform me if we may take two subjects in part (*a*) (*b*) (*c*)—viz., architectural drawing, &c., preparation of working drawings, or must we confine ourselves to one?—STARTER.

[46808.]—**To Mr. Evans.**—Would Mr. Evans be kind enough to fulfil his promise of giving a description of the compensating index for the oval chuck, a drawing to scale for, say, a 5in. centre lathe, and a separate drawing or two of any complicated part would, I think, enable anyone to try their hands at making one for themselves.—THOMAS S OW.

[46809.]—**Restoring Leather Bag.**—A deep red (nearly black) leather courier bag has become faded and spoiled by wear and damp. How can the bag be made to look less shabby?—M. C. H.

[46810.]—**Inhabited House Duty.**—Will Mr. Wetherfield kindly say, from the following, whether I must pay the above duty or can I claim exemption?—A house let weekly, gross annual rent £23 8s.; total amount of rates and taxes all paid by the landlord, £3 8s. 10½d.—LANDLORD.

[46811.]—**Revarnishing Dog-Cart.**—I wish to revarnish my dog-cart. How am I to proceed? What ought I to use for the woodwork, which is of a light colour, and how is the black varnish prepared that is used for the iron parts?—J. B.

[46812.]—**Ethoxo Limelight.**—I have made a hydrogen generator on the wash-bottle principle, but it does not saturate the oxygen with sufficient ether vapour. Could any reader inform me of a better principle? and oblige—ENGINEER.

[46813.]—**Dry-Rot.**—This has made its appearance in the framework of a cellar window. Is there any means of preventing its spread? I have given the frame a coating of red paint.—R. N. H.

[46814.]—**Caledonian Engines.**—Will "Carstairs" please give the date of the Cal. tank engines with outside cylinders and three axles, but running on four wheels, 4ft. 7in. diam. Had they saddle-tanks, and are they still working? Also, date of six-coupled outside cylinder goods? In each case, the earliest.—R. N. H.

[46815.]—**Paste for Pottery Transfers.**—Will any reader kindly inform me how to make paste for use with the tissue paper tranfers for pottery? I have been making it with flour and water, but it gets stale in a few days, and the print will not leave the paper well.—LITHO.

[46816.]—**Sulphate of Baryta in Glue-making.**—Can any reader tell me what use is made of the above? —CIVIS.

[46817.]—**Griscom's Electro-motor.**—Will some reader kindly give description, dimensions, and rough drawing of Griscom's electro-motor? Also, how to alter it so as to make it a dynamo machine?—A. E. HARRIS.

[46818.]—**Putting Chain in Watch.**—Will "A Fellow-Workman" tell me how to put the chain on in a watch? I have the other parts together, but don't know how to put chain on.—ONE LEG.

[46819.]—**Telescope.**—Why are not telescopes made with concave eyelenses, by which the image would be seen erect and the definition would be improved?—AQUA FORTIS.

[46820.]—**Piston Ring.**—Would "Sunlight," or others, tell me how to straighten a large brass piston-ring? It is twisted after hammering to make it spring. —R. Q.

[46821.]—**Clause in a Testator's Will.**—To MR. WETHERFIELD.—I give and bequeath to my said executors the sum of five hundred pounds, in trust to invest in their names, in Government securities or railway debentures, stock, and to pay the interest arising therefrom as soon as it shall be received by them, to my four cousins, A, B, C, and D, during their lives, in equal parts, and as each of my four cousins departs this life, I direct that one-fourth part of the said sum of five hundred pounds be divided equally and amongst the eight children of my brothers, W and J. One of the cousins is now dead, and the stock invested is much increased in value—whether does this increase be added to the eight children's share, or does it properly belong to the residuary legatees? Your opinion will greatly oblige—T. A.

[46822.]—**An Unpredicted Occultation.**—While examining Plato on the evening of 26th April, I observed the Moon approaching a sixth magnitude star, and on consulting the *Nautical Almanac* could find no mention of any occultation on that evening. I watched the star till it was occulted. The disappearance, which was instantaneous, took place at 10.54 mean time. I could find no star on my map corresponding to the exact position of the one occulted, the nearest being 9 Sextantis, and I should be obliged if "F.R.A.S." would kindly tell me whether this was the star or not.—ALCOR.

[46823.]—**To "A Fellow-Workman."**—Will "F. M." kindly inform me which is the most satisfactory way of weakening a powerful hairspring; it is a verge, and, though I have a pretty good stock of new ones, I can't find one the right strength. A sketch, with explanation will greatly oblige me. I am very much obliged to "A Fellow-Workman," also to "Alfojoe." I believe that all the watch-jobbing readers of the "E. M." thoroughly appreciate them both.—TED ARTHUR.

[46824.]—**Watch.**—Will "Fellow-Workman" or any other obliging correspondent instruct me how to fasten a flat crystal glass to a Geneva watch, which at present has an ordinary thin one.—G. FRYER.

[46825.]—**Electric Bell-ringing by Cylinder-machine.**—Will Mr. Lancaster please tell me if a 6in. cylinder electrical machine would produce enough electricity to ring a small electric bell at a short range of wire; if not, would he be so kind as to tell me how to construct a small machine (not very expensive) to do the work?—AN ESSEX BEGINNER.

[46826.]—**Dulling Brass.**—Will any reader kindly inform me what substance will give brass a permanent dull bronze colour, or a colour similar to that given to fishing reels which are made of brass? I want it for a landing net, the metallic parts of which are very bright. —FISHERMAN.

[46827.]—**Boiler Capacity.**—I shall be glad if any of your kind readers can tell me how to find the size of steam boilers of different horse-powers. I have seen in Molesworth's book, page 299, that 1 cube yard or 27 cubic feet is required for each horse-power, but the sizes given for boilers from 1 to 35 horse-power, on page 300, do not work according to this rule—e.g., Cornish boiler, 10 h.p.; should be 27ft. by 10 equal to 270 cubic feet. Now the size given for this is 16ft. long by 4ft. 6in. diam., which, deducting the flue, 2ft. diam., equals 204ft. only, and in vertical boilers there is less capacity still, so that I am in a fog how to make out which is right.—J. H.

[46828.]—**Guerin Brake.**—Will one of your readers give me the details of the Guerin brake, tried some years ago and reported on by Col. Yolland; also of a brake said to have been invented by a Mr. Robbins, and used for a little time upon the South Western line? Was Mr. McConnell the first gentleman to fit steam-brakes to engines and tenders? I should also like to know the construction of the Great Western vacuum brake. Unlike other systems the cylinder appears to move and the piston-rod to remain fixed.—A DRIVER.

[46829.]—**G.N.R. Slide-Valves.**—What lap and lead has the slide-valve of the G.N.R. passenger and goods engines? Has the goods engine any inside lap?—R. Q.

[46830.]—**Spring Pins.**—What is the best way to get the length of spring-pins?—R. Q.

[46831.]—**Photographic.**—Would any reader oblige with instructions for making a retouching desk for retouching negatives? and oblige—COLLODION.

[46832.]—**Value of Lease.**—Will some of your readers kindly oblige me, if convenient, what is the present value to sell of a lease £260 annual value, fixed for 18 years, safely secured? You will grant a favour to an old reader.—FARMER.

[46833.]—**Bumping Noise in Engine.**—Would "Sunlight" kindly tell me the cause of the bumping noise in my engine at the end of each stroke? It is a new one, six horse-power, but has never worked well from the first. It has been taken to pieces once, and fitted with new brasses in the main shaft, but it did not stop the noise altogether, and now it is as bad as ever, although the brasses are all tight without the least shake. I fancy the fault lies in the main shaft or else in the crank-pin. But I don't know how to prove it or to correct it.—ONE IN A FIX.

[46834.]—**Churchwardens.**—To MR. WETHERFIELD.—Has any alteration been made in the law of voting in the election of churchwardens since the year 1818? What is now the qualification for voting?—J. K.

[46835.]—**G.N.R. Engines.**—Would some of the readers of the "E. M." kindly oblige by giving general dimensions of the G.N. bogie that now takes Scotch mail? To the best of my belief, it runs only as far as Grantham and leaves King's Cross somewhere about 10 a.m. Are these engines generally liked, what brake is used, what rate per hour are they permitted to travel?—H. N.

[46836.]—**Chloride of Silver Cell.**—I have made a cell as follows:—A plate of zinc 3in. by ¾in., and a silver plate same size, the latter coated with fused chloride of silver, separated by a strip of stout blotting-paper saturated with a solution of chloride of zinc. Cannot get sufficient current to work a miniature coil, though a bichromate of above size does so powerfully. Am I expecting too much from so small a cell of the De la Rue type? Primary of coil is No. 22 B. W. G.—TOLEDO.

[46837.]—**Electro-Magnets, &c.**—Will an electrical correspondent kindly inform me what rules should be observed in working the above in order to insure the battery-power being properly proportioned to the requirement? I have heard that the magnets should be wound with wire offering a resistance equal to that of the line wire, and that the combined internal resistance of the cells in series should equal the resistance of the external circuit. Is that correct? If so, what is the internal resistance in ohms of a Daniell, Fuller, and Leclanché?—TOLEDO.

[46838.]—**Chuck.**—If it is not abusing "F. W. G.'s" kindness, he would confer a great favour by describing a good 4 independent jaws chuck, suitable for a 4in. centre lathe, and if accompanied by illustrations as good as those in his description of backstays in your last number, it would be of great advantage, I have no doubt, to many readers of the "E.M." who, like myself, are troubled with more ambition than money.—CHUCK.

[46839.]—**To Mr. Wetherfield.**—A. obtains goods, oilcake, &c., of two persons, B. and C. respectively, and consumes them upon a farm he rents. A. goes to America leaving the debts due to B. and C. unpaid. D., the father, puts an auctioneer in and sells the stock, &c. (cattle, implements, &c.), for rent and money lent. The auctioneer realises £300 more than the amount of rent and money lent claimed by D., who, however, takes the £300. When D. is asked to pay the debts due to B. and C., D. deputes a son, E., to tell or promise B. and C. verbally that if they will kindly wait a little B. and C. shall be paid. In the meantime D., the father, dies, and now the son E. refuses to execute D. the father's promise, and says neither he nor his father can be called upon to pay. By means of the auctioneer it can be proved that the father received £300 more than he was entitled to. What course ought to be taken by B. and C. to recover the payment of their debts? —NA F.

[46840.]—**Organ Reeds.**—I should be very much obliged to Mr. Dresser for a few practical hints on the treatment of organ reeds. I am quite sure that practice and skill are both required—but the practice I mean to have, and some skill I hope to get. An organ builder's help is a luxury that I am seldom able to indulge in; I wish I was. Meanwhile, I must try to do the best I can. My difficulties are: (*a*) a stoppage altogether, (*b*) a coarse grunting sound, (*c*) slowness of speech, (*d*) the tone as it gets near its pitch decreases in quantity and finally goes off altogether, (*e*) or else becomes horny and loses the peculiarity of a reed. Now who will throw some light on the mysterious subject, so that I may be no longer at my—WITS' END?

[46841.]—**Vacuum Pump.**—In No. 886, page 34, of the "E. M." is described a vacuum pump by Mr. Sutton. I have been trying some experiments with one made from that description, but with a reservoir of mercury raised by a pulley, instead of the pump that Mr. Sutton recommends, as I find it (the pump) would be very expensive to make. I find that when you once fill the bulb A with mercury, and empty it, you cannot get any further vacuum, on account of the vacuum in G sucking up the mercury in F; so that before you can get sufficient pressure of mercury in A to force the second quantity of air in it out through J, the mercury flows over into G. It seems to me that F should be at least 30in. high to prevent this. I may say I used a barometer-tube connected at I, and I got, by once filling and emptying A, a column of mercury of between 28in. and 29in. high. I shall be glad if any kind reader of the "E. M." can give me any advice as to where I may be wrong in using the pump.—J. R. EDDINGTON.

[46842.]—**Estimation of Tannin.**—Is there any other method than the tartar emetic and gelatine processes for estimating the quantity of available tannin in different substances; I have worked the gelatine process, but have invariably failed to arrive at an accurate estimate, and I find it difficult to obtain tartar emetic.—PRO BONO PUBLICO.

[46843.]—**Gas Inspectors.**—Could any of your correspondents inform me to whom to apply, or what steps to take to be appointed a gas-meter-inspector for a district? All gas-meters, when made, must be tested and stamped by an authorised inspector before being sold; also, all meters taken to pieces for repairs must be duly stamped afterwards before being used. Now, it is common in the district in which I reside for the gas-companies to repair their own meters, and then put them into use without being tested and stamped, as the carriage to and from the nearest inspector would be a very large item; the distance, I believe, is from 60 to 70 miles. The consumer, in this case, has no guarantee that the meter is correct.—GAS-METER.

[46844.]—**Clock.**—I have a very good clock beating and indicating seconds; but the minute-hand is rather loose, so that, though from 12 to 6 it indicates correctly with the seconds-hand, yet from 6 to 12 it is half a minute behind the time indicated by the seconds-hand. What can I do to remedy this, so that all round the twelve hours the minute-hand will indicate what the seconds-hand does, and advance with every beat of the pendulum. —WISEAF.

[46845.]—**To Mr. Davies.**—Will you kindly inform the musical part of the readers of the "E. M." the proper way to tune a piano? I have an old one I want to tune. I've put several new wires, which do very well; but what I want to know is this—which is the proper way to begin, from middle C or, as some say, tune from both ends to the middle? An answer to this, I think, will oblige more than one reader of the "E. M."—TED ARTHUR.

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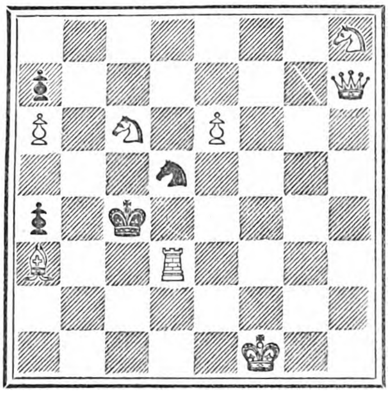
CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCXLIII.—By J. A. Miles.

Black.



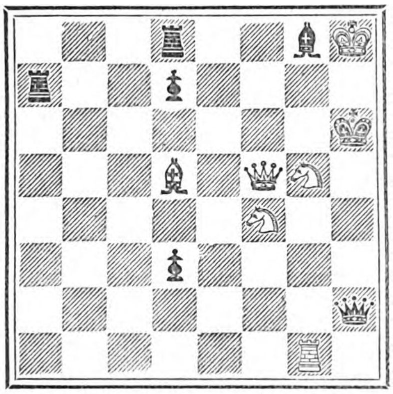
White.

White to play and mate in three moves.

PROBLEM DCCXLIV.—By W. A. Shinkman.

From *Brentano's Chess Monthly.*

Black.



White.

White to play and sui-mate in two moves.

Solution to 740.

White.	*Black.*
1. R takes P at Q 6	1. Kt takes R.
2. Kt to Q Kt 6.	2. Anything.
3. Mates accordingly.	
	1. Q Kt moves.
2. R takes Kt.	2. Anything.
3. B or R mates.	

NOTICES TO CORRESPONDENTS.

Problems received with thanks from J. A. Miles, H. J. C. Andrews, Sergt.-Major McArthur, C. R. Baxter, J. P. Taylor, and H. F. L. Meyer.

We have pleasure in drawing attention to the new edition of the "Chess Club Directory," just published. The thanks of the Chess world are due to Mr. Bland and his coadjutors for their zeal and ability in producing a work so needful and interesting. We have first a paper by the editor, giving a brief account of the principal matches in 1881. This is followed by an admirable paper by Mr. Potter, on the principles involved in successful play. Suggestive remarks succeed, by Mr. Andrews, on Problem Tourney Codes and Regulations. Mr. W. T. Pierce returns again to his favourite subject, "The A 1 Notation." His arguments are unanswerable; but, we fear, not convincing. Mr. Thompson once more waxes eloquent on Pawn on 8 in Chess Problems. There are also some lighter and amusing papers, and some capital verses by Messrs. T. P. Taylor and J. G. Cunningham. The list of Chess Clubs and resorts in England and Wales is very complete, and will, no doubt, be found exceedingly useful. In addition to all this, we have the Prize Problems in British Tourneys in 1881, and the laws of the game as established at the International Chess Congress, 1862 (has not the time arrived when these should be revised ?). The work is, therefore, of considerable value, and ought to become an annual; and thus a Chess landmark from several points of view. If we have any improvement to suggest, it is that a few more problems by leading composers might have been published with advantage. Also, some of the most notable games of the year. We are sure that no lovers of Chess would grudge the slight increase in price that this might have entailed.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or requies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, May 3, and unacknowledged elsewhere :—

P. Argall.—W. H. Harling.—W. A. Smith.—F. W. Reynolds and Co.—E. S. Hindley.—J. L. Gallard.—C. Nickalls.—W. Kitney.—Morris Cohen.—Jas. Roberts. —O. S.—Rev. T. Calliphronas.—Farquhar.—Railway Fireman.—Thirds' Practical Watchmaker.—A. H. B.—Darkness.—Young Wheelwright.—J. L. Davies.—Volvox.—Cumberland.—W. B. A.—A. Rigg.—Perplexed. —J. R.—Brickwall.—Blackwater.—F. G. du Pont.—H. Nolan.—Namdrah.—Anxious to Get On.—The Gas Man.—Kingsmill.—Poor Quill Driver.—E.—Orderic Vital.—Glow Worm.—Hugh Tunnadine.—Dispart.—Jas. Parkinson.—Collodion.—H. M.—Yoshi.—Fellow Workman.—An Old Subscriber.—J. T. M.—Gelatino Bromide.—Inquirer.—Krautbach.—F. W. G.—Foundry.—J. H. Huxley.

W. H. Skelton. (Are you not rather hard to please? So long ago as April 14 we indicated the course of comet *a*, and on April 7 our correspondent, the "Fellow of the Royal Astronomical Society," actually placed it, so that a little sweeping on any subsequent night would readily lead to its finding. However, as you appear to want the position assigned by the latest calculation, it is May 6, G. midnight, R.A. 21h. 59m., N.D. 73° 9′. Any other particulars of importance we may receive will be found in "Scientific News.")—Housewife. (Many remedies have been suggested in back volumes, but the best appear to be a hedgehog, and powdered borax mixed with sugar and bran.)—R. Dale. (We do not understand your difficulty. The scheme of tuning has been given many times, as well as the actual manipulation required.)—H. W. (A Swan lamp with sufficient current to keep it incandescent would do for the purpose; but we are afraid those to which you refer would not give light enough.)—J. T. Ingham. (The cause is clearly a radical defect of the instrument, and a practical man must be called in to examine it, as it is impossible to say whether it can or cannot be improved from a mere description.)—G. B. Taylor. (No, certainly not. You should study first principles.)—Swan. (It would be absurd to put such a question to Dr. Edmunds. They are known as *muscæ volitantes*, and are of no moment.)—Brakeblock. (The pressure on the drums of vacuum brakes cannot exceed 14lb. per square inch, and it is extremely doubtful if such a pressure as that can be obtained. Where do you find the statement that it is 30lb. per square inch ! 2. They are joined by an "extension" line between Bishop's-road and Gloucester road stations. 3. Practically identical. All the companies north of the Thames, we believe, except the North London, and that is practically connected by the North-Western. Such a question can be answered by reference to the time-tables.)—C. S. Cannell. (It will be time enough to publish the sketches and description when the machine has been made and found an improvement.)—W. G. E. (Change of air is the best remedy. Simple antimonial mixtures are preferable to the honey, vinegar, &c. If the cases are very severe, you should call in a medical man to *see* the patients.)—Douglas. (You could use the pipes as return, but not as line. See many places in back numbers.)—Teddy. (No cement; could be brazed, for which, see indices under head Soldering, and recent numbers; but it is a difficult job, and you would act wisely by getting it done by a skilled hand.)—Dry Plate. (See p. 124, No. 890.)—W. W. Jones. (Mitchell's "Manual of Practical Assaying," edited by Crookes, Longmans and Co., contains methods, but perhaps Bauerman's "Metallurgy of Iron," Lockwood and Co., will answer your purpose. A great deal of information on the subject can be found in back volumes.)—Pro Bono Publico. (There is Napier's "Manual of Dyeing and Dyeing Receipts," published by Griffin, and Crookes's "Dyeing and Calico Printing," Longmans, both of which are "illustrated" with specimens of dyed fabrics.)—P. Ingle. (The use of the acetic acid will do no harm, and very little good. A medical man would probably recommend cod-liver oil.)—Isle of Wight. (You are not entitled to any compensation under the circumstances.)—W. H. (1. Unsuitable; it cracks. 2. Do you mean *income* tax ? If so, No. 3. It is impossible for us to say if the assignment of H.'s policy was legally effected; but if it was C. is entitled to the amount insured for. Better show the document to a respectable solicitor.)—W. S. F. (Thanks for your kind offer of the photograph, but we fear we could not spare the space. Thanks also for congratulations. While "ours" retains good friends like yourself, its continued and increased success is assured.)—B. M. (We do not think Sir Edmund Beckett supposed his idea would much help people who use worn-out screws and badly-shaped screwdrivers; but with good tools and screws the inconvenience complained of occurs, and might, we think, often be obviated by the adoption of Sir Edmund Beckett's contrivance.)—K. Y. (If the "child" is 26 years of age, we do not see why her mother, or any one else, need be under any anxiety on her account, unless, of course, she is imbecile, in which case, if the matter was properly seen to, her maintenance would devolve on the person who adopted her.)—Alexander. (Directions for making blacking, soap, &c., have been repeatedly given in back vols.; but we do not think you can hope profitably to make and sell small quantities of such things in competition with the great houses that cover the field.)—A Two Years' Subscriber. (558 can be had post free for five halfpenny stamps; 565 is out of print.)—A Subscriber from the 10th Volume. (If the widower of the intestate's daughter is entitled to his deceased wife's property, of course the administrator of the estate now in course of administration is justified in including him. If the property is personal, no one can hinder the husband from disposing of it as he thinks fit, unless he was merely appointed trustee of his deceased wife's property for the benefit of their children)—F. Rowe. (If you refer to p. 178 you will find that Mr. Lancaster has injured his hand, and finds a difficulty in writing. No doubt he will redeem his promise as to the medical coil as soon as possible.)—Bullock. (You mean a magneto-electric machine, we imagine. See p. 470, No. 826, and look again under that head.)—Ovin. (There are no text-books which give detailed instructions; but in Nos. 517, 525, 533, 551, 573, you will find information that will help you.)—Lo Ko. (Try gymnastic exercises. No other safe way.)—A Country Watch Jobber. (If you are wise you will do nothing except on the advice of a medical man, for the most important thing is to find out what is the matter.)—Esimus. (Immaterial—half inch inside good size for the mercury tube. 2. No, the platinum becomes at its brightest just as it reaches fusing point. The carbon gives much the better light. 3. We really do not know. They are not suited to the work, and no electrician would think of using them for the purpose.)—Collodion. (There is no difference, for there is no such substance. Hyposulphite of soda is the common name for sodic thiosulphate. There is sodic sulphite and sodic sulphate, and you have probably confused the "chemist." Hyposulphite of soda is the commercial name of the salt you require.)—J. J. V. (We do not know the exact method adopted, but there is nothing new in the arrangement. Reeds were arranged vertically in American organs years ago by English builders, and they are placed in all sorts of positions by American builders.)—G. Fryer. (See "Joiner's" letter next week. You say there is an objection: two correspondents say there is not. Leave the matter now to the judgment of our readers.)—A. C. H. (It cannot be done as specified. The best way is to have a cistern raised some feet above the aquarium.)—Miner. (You require a battery, and you will be able to judge whether you can make one by referring to back numbers. See "Replies.")—Young Engineer. (All particulars of Whitworth's Scholarships are given in the "Whitworth Prospectus,' to be obtained from the Secretary, Science and Art Department, South Kensington.)—F. L. (It depends on the size of the machine and the energy put into it. In all probability, it is of use only for furnishing current for medical purposes, or for the usual experiments.)—David. (See p. 176, last paragraph.)—X. Y. Z. (See p. 431, No. 876.)—Tomtit. (For electric bells, kindly look through the last volume. You will find a new door-contact on p. 617, No. 884. Leclanché cells, or the tinpot battery recently described.)—Pongo. (Will not the clock described on p. 112, No. 785, suit? See the indices to Vols. XXX., XXXI., under heads Gravity Escapement and Clocks.) —Cat's Tail. (See p. 77, No. 705. Yes, a Leclanché.) —An Amateur Electrician, Dublin. (Yes, quarterly, 2s. 9d. 1. Drawings have been given in several serials and in some of the books. 2. Two at least. 3. We suppose, in the absence of the context, that it formed the negative plate of the battery. 4. We do not know. They are scarcely suited for arc lights. 5. About three-quarters of an inch, but there is nothing of the kind.) —Trydau. (As far as the, production of current is concerned, the crack would have no effect; but we should not like to be in the line of flight when you set your machine at work. Have you forgotten that it must revolve at a high speed, and that a crack, however slight, would be sufficient to condemn the casting ?)—A. H. Metz. (See p. 77. No. 705. You have merely to divide the alphabet between two needles. Yes, such a battery would do. Gas-carbon or coke, not charcoal. Use copper-wire, unless your line will be very long.)—Dolomite. (They would act correctly for a short time, but if the air could gain admission, the watery vapour would be condensed, and dust would find its way in. That is why the tubes are closed.)—J. S. (You can tin them by first washing with acid, rinsing in water, and turning into a pot containing cream of tartar, grain tin, and boiling water, but preferably by dipping them into melted tin, or if galvanised, into melted zinc. The baths of molten metal should be covered with sal ammoniac, and the nails be placed on a sort of sieve for dipping.)—Anti. (What is it you mean ? If a clock-work train for paying out magnesium ribbon as fast as it burns, you can easily make one from a cheap American clock.)—H. A. (If you cannot refer to our back volumes, procure Graham's lectures on Breadmaking, 1s., of the Society of Arts.)—W. J. P. (See p. 100, No. 836. You can go as third or fourth, as soon as you can get a berth; but you will find some difficulty in that. The only way to put in the twelve months is to apply to the master or owners of a steam-vessel.)—F. B. (Is it too much trouble for you to refer to a dictionary ? As all such solutions depend for their action on the salt, not on the water—as much as the water will dissolve is put in—that is, they are "saturated" solutions. About 4oz. will be required, depending to a certain extent on the purity of the salt.)—Dav. Stewart. (See p. 81, number for March 31 last. We remember nothing else, and doubt whether the process is of much practical use.)—W. Blow. (They are constructed in the usual way, but are, of course, very small. The second query is too indefinite. Several have been given in back numbers, many of which can be had.)—Bull-dog. (Procure a tube of moist water-colour lampblack, and thin with weak solution of gum-arabic.)—

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

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FRIDAY, MAY 12, 1882.

LIGHTNING AND LIGHTNING CONDUCTORS.*

THE best method of protecting buildings from injury by lightning has been debated for years, but latterly a general consent has been given to the plan which provides a rod with points at the highest part, connects it with all the available metal-work of the roof, and then makes as perfect an electrical connection with the earth as is possible. Scarcely four months have passed since the issue of the report of the Lightning-rod Conference (see p. 441, Vol. XXXIV.), and we have the author of the first-mentioned work in the foot-note practically condemning the conclusions arrived at by the representative men who took part in the Conference. Major Parnell's book, apart from his hypothesis, will, however, be of use, as he has taken the trouble to collect a number of facts in reference to accidents from lightning without considering whether or not they support his views. The first part is a compilation of recorded facts and opinions, some of which are arranged in too unconnected a manner to be of any use; part the second is a superstructure of theory erected on the facts from the author's point of view, and the third part contains the author's recommendations. There is one advantage in reading Major Parnell's book, that when he comes to build up his theory he refers to the actual words of the authorities on which he bases his arguments, though it is awkward sometimes for the reader to be compelled to refer to the extract in order to arrive at Major Parnell's meaning. His case against lightning-rods is set out with some skill, though too much is made of points which have nothing to do with the question of the conductor itself; but his view may be gathered from the following passage:—"The advantages afforded by a lightning-rod appear to be summed up in the fact that, if it be in good condition, it tends by means of its point to furnish an outlet for any charge that may collect at the particular parts of the ground in contact with its root." Holding that view, he naturally considers that it is bad practice to lead the earth end of a rod away from the walls of a building, even when the object to be gained is a good connection with moist earth; for ordinary ground (moist earth) is not an accumulator of electricity like metal, and a rod so rooted taps a considerable extent of ground which has nothing to do with the protection of the building. The principal disadvantages appertaining to lightning conductors he enumerates thus: (1) The exposure of elevated metallic surface furnished by them; (2) their costliness; (3) the sources of failure to which, after erection, they are liable; (4) their tendency to disfigure the appearance of buildings. The last two "disadvantages" are both within control; cost is not an important factor, but it is essential to ascertain whether there is any disadvantage in exposing a metal rod capped with points which may be assumed to attract electricity from the clouds. Major Parnell holds that when a rod is well connected to the ground it constitutes a local plate, and the exposure of elevated metal must always be a great disadvantage, for it is impossible to estimate whether its tapping powers are on a par with its accumulative properties. In ground at no great distance from the rod a charge may accumulate, when the rod, owing to its metallic substance, extent, and elevation, becomes liable to be embraced in the explosion's line of least restraint. Thus, although itself a local plate, the rod accidentally acts as a local dielectric to the adjacent charged ground to which it is not connected, and instead of protecting the building positively attracts danger to it. The connecting of rods to water and gas mains is held to be simply giving them an additional outlet for the electricity tapped by them, and the building against which a rod so rooted is fixed is more exposed to injury than others; further, Major Parnell also holds that rods with roots laid in rivers, in wells, in moisture of any kind not immediately contiguous to the structure, are sources of danger to it, as the building thus "protected" is merely being utilised to tap the electricity of the water or moisture. Having demolished the rod by attacking its principle, it is only slaying the slain to attack the present system by pointing out the "disadvantage" of using copper, of the "expensive points," of the extension of the roots in the search for moist earth, and the risks run by the faults due to bad design and bad workmanship. The fact that the author does attack the details would appear to indicate that he has a lingering doubt as to the justice of his condemnation. The true function of lightning-rods is to prevent the building being struck, by presenting an easier path for the electricity; Major Parnell contends that their true function is to prevent explosions occurring at all, and he accordingly dispenses with the long stalk, which he holds causes the explosion, and adopts iron plates buried beneath the surface contiguous to the walls of the building, with points or short rods projecting about six inches above the surface of the ground. The instances recorded by Major Parnell in his table he afterwards groups, and in the fairest manner sets out those which tell against his view as well as those which apparently support him. In studying this question, it is obvious that a list of buildings to which lightning-rods have been fixed, and which have altogether escaped being struck, cannot be accepted as evidence, for it is impossible to prove that the buildings would have been struck if the rods had not been there. The most valuable cases are those in which buildings once struck have enjoyed a subsequent immunity after a rod has been fixed; for in them it is clear there is the liability to be struck. More important still are those cases in which buildings to which rods have been affixed have been struck more frequently since they were "protected"—though in those it is possible to imagine the rods were not in good order. It may be that the rods at the cathedral at Alatri, in Italy, were not of proper dimensions; but the fact is, that although the building has not been damaged, the rods have been struck five times in eight years; and in 1872, the water-pipes supplying the town, which passed about 11 yards from the earth-connections, were broken. The earth-connections, in this case, were 13ft. long, with points and copper wire twisted among them, the whole being buried in cinders. The cathedral stands on high ground, a solid calcareous rock being found a short depth beneath the surface. Father Secchi gave a description of this case, and attributed the failure of the rods to harmlessly discharge the electricity to defective earth-connection. In this case, however, it can scarcely be said that the rods attracted the lightning, as the cathedral had been frequently struck before, and that was the reason Father Secchi suggested the erection of the conductors. A clearer case is that of the Sorbonne, which was struck in September, 1880, shortly after the rods were erected, though it had never, so far as is known, been previously struck. As before, it was the rod that was struck, two out of six stems receiving the flash. In this instance, the main stalk was a rod of iron less than 6-10in. square, led into a pit at a great distance from the buildings. Here, it may be said, as is undoubtedly the case, that the rod was too small in sectional area, but it would also appear to be an instance of a rod attracting the lightning. The cathedral of Sienna, in Italy, although repeatedly damaged before the erection of the rod, has enjoyed immunity ever since. A similar history belongs to St. Mark's, Venice, which, prior to 1766, had been frequently struck and damaged. In that year a conductor was erected, and the building has not been struck since. Similar instances are on record; so that while it is clear rods do protect, and have protected, in certain cases, it is needful to inquire how they were erected before condemning them in those cases in which they failed in their mission. Major Parnell concludes that lightning-rods, owing to their roots and points, have a tendency to protect the constructions to which they are affixed, especially ships; but that owing to their stalks they have a tendency to injure constructions, and have frequently done so. To this last statement it will probably be replied—only when the conductor was not of a suitable kind, and was improperly erected. Major Parnell's work would have been incomplete without the practical measures he advocates; but we suspect that architects will pay little attention to directions which involve the abolition of all metalwork on the outside of their buildings, except near the ground, and which include the disuse of wooden roof coverings.

Amongst the means suggested by Major Parnell for avoiding lightning strokes, is the use of grates on the ground-floors of country houses, with wide vertical horns to sink into the soil, and numerous ornamental pointed projections on any portion above ground. His principal idea, however, is the use of the electric tap, instead of the conductor, which is formed of plates of iron, each ¼in. thick, 4ft. long by 6in. wide. Into that, 1in. from the edge, are to be riveted two wrought-iron rods ⅜in. in diameter, sharply pointed, and 12in. long. These plates are to be laid flat, at a depth of 6in. around the building, with one edge touching the wall, if possible, thus leaving the points projecting for 6in. at intervals of 2ft. These plates would be applied only to the prominent features of a building—*e.g.*, the tower of a church, and their cost is estimated at 1s. 6d. per foot run; but it is obvious that the electric taps might take the form of ornamental castings, with vertical webs for making the earth-connections. It must be confessed that Major Parnell's system is economical, as compared with the present arrangements; it remains to be proved whether it is equally efficient.

Of the second work mentioned in the foot-note there is little to say, save that it is intended by the translator to form an appendix to his treatise on lightning conductors. It is a classical pamphlet on the subject, issued under the authority of one of the most distinguished scientific bodies in the world. The two works may be studied together with advantage; for the French system, it is well known, provides the public buildings with a bristling array of conductors or points, presenting a large extent of metallic surface—in fact, a concentration of metal in the most elevated position; just where it ought not to be, according to Major Parnell. The information contained in the "pamphlet" comprises the substance of the various reports made to the Academy by experts since 1823, when the first was drawn up by M. Gay-Lussac. It is the orthodox view of the subject, and the systems described are expensive as compared with the cheap method of protection above described.

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* The Action of Lightning. By ARTHUR PARNELL, Major R.E. London: Crosby Lockwood and Co.

Information about Lightning Conductors issued by the Academy of Science of France, translated by R. ANDERSON. London: E. and F. N. Spon.

THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURAL, AND LODGMENT.[*]

By JOHN WATSON WARMAN,

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q. THE exception referred to is this. In 2-Manual Instruments that have not a large Pedal Organ it is extremely desirable that the Coupler Swell to Great be of the kind which I have termed a *Clear* one,—that is to say, of such a construction that when both it and the Coupler Great to Pedale are in Action together, yet that the Swell Organ shall *not* be united to the Pedale. This idea of a Clear Coupler occurred to the present writer at about the beginning of 1877: the real value of the device, in all Organs of the kind just mentioned, must be obvious on a moment's consideration, for while such a Pedale, supplemented *only* by the Great, will often furnish a really excellent Bass to the Swell and Great united, the same Pedale supplemented by the Swell as *well* as by the Great will be always very unpleasant, and sometimes actually intolerable (,—though it is only what hundreds of Organists have at the present time to submit to). It is of course, generally desirable (see *r*, next) that there be a distinct Coupler Swell to Pedale also provided,—for special or for extra powerful effects. See, at this point, what is said at *s*, next.

r. It will now be fully apprehended that when the foregoing expedient is adopted, the Participation of Nose with the *Great* Manual Key must be sacrificed; for the Clearance of the Coupling can obviously be secured only by the Pedal Key's being made to drive the Pallet Action of the Great Key *without* depressing the latter itself (because if an actual Key be put down, any Coupling in action with its Section *must* become acted upon also). A more particular description of the Clear Coupler will be found at 90, *r*, together with information as to the influence of such Coupler on the necessity for Key-Participation (see here at *p*, ante; and again at *s*, next). Along with this question of the structure of any Manual to Pedale Coupler there must often be considered that of the admission of or necessity for such Coupler *at all*;—as, for instance, when there are four Manuals present, the Solo to Pedale may occasionally be dispensed with; and where there are three Manuals, the Swell to Pedale may in some cases be sacrificed: on all these points see fully in *Departments* SCHEDULES and SPECIFICATIONS.

rr. It is to be noted that for any Manual that has another Manual *beneath* it, the treatment of causing the Pedal Coupling Sticker to act free of its Key-tail is strongly desirable under any circumstances whatever, in order that such higher Manual may be the more easily Removable for Access to the lower Manual. If the Nose of the Backfall, or Lever, or Square be not in actual contact with such Key-tail (see *o*, ante), but be raised above latter, of course such Pedal Coupling Sticker must be made longer accordingly.

rrr. An *Instance* of the Swell-to-Ped. Stickers' entering the Square-Noses of the regular Key-Action of such Swell occurs in the Hoddesdon Organ (see 60, *v*; and *m*, next).

r, *Bis*. That which has now been said as to the Man.-to-Ped. Sticker's being inserted into the Square or other Action Nose applies, of course, more especially to any Manual which has a second Manual placed under it,—the reason being the facilitation of access to such lower Manual. It thus follows that, for any Manual which is absolutely the *lowermost* one in any Organ, there does not exist so strong a reason for the aforesaid treatment of the Man.-to-Ped. Coupling Contact: and we may, in fact, lay down as a rule, that for such lowermost Manual the Man.-to-Ped. Sticker or other contact may be freely made against the *Key-tail* itself, *unless* a different treatment is required for the provision of the *Clear Coupler* just described, or else the Square or other Action *Nose* is for any other reason set *directly* on such Tails of lowest Keys;—for a moment's reflection will show that the Wiring of a Sticker into the under face of a Manual Key does not of itself furnish any real obstacle to the removal of such Key, while that, on the other hand, such a contact of Action with latter ensures its proper *Participation* (see *n*, ante), and this in a natural and easy manner. A few words must now be given for definite direction as to the precise *point of contact* to be observed for the Action of the Coupler Manual to Pedale when such contact is made against the *Keys* themselves.

rr, *Bis*. Of course, the best point, absolutely, for such contact would be exactly *beneath* the point of contact of the regular Action of the same Key to its Pallett; for then, while on the one hand the length—and consequent obstructiveness—of the Key would not require to be increased, on the other hand there could be no risk of the Coupling Action's causing a lifting of such Key fore-end (see *m*, ante). But such a treatment as this would obviously demand that either the Stickers should be *wireless*—so passing through a Register—or, that if wired, such wires did not extend *through* the Key; and, moreover, that if both sets of Stickers were so wired, the wires of *both* sets should be inserted in *one* single hole in each Key. Concerning these points, see fully hereafter in *Departments* COUPLING-ACTION and KEY-ACTION; it will be sufficient here to observe that neither of such Treatments can be relied on as being desirable or practicable in ordinary cases of Coupling-Actions.

Actually, therefore, the best remaining point of contact for the Coupling to Pedals, when made against the Key, will be the extreme [rear] *end* or tail of the latter this is, remember, speaking exclusively of any *Slope* or Wedge—see *z*, ante—which may exist beyond such point of contact; refer to *Treatment* 5,—at *r*, next, 7th parag.); and the contact of the regular Action to Pallett will then be set at *just inside* the Coupler contact, and as near to latter as is practicable without risk of fouling or of breaking one Wire-hole into the other. By this means there can be no possibility of the fore-lifting of the Key, mentioned a little back. With regard to more exact directions see in the future *PART DETAILED*; it will be sufficient here to define that the lateral distance between such two points of Action contact should not be greater than ⅜in., and that it should preferably be as much less than this as is practicable, but that it probably can never be less than ¼in.

But to the foregoing treatment, which involves a virtual elongation of the Key, there may frequently be objections,—such as that the Key may already be excessively long, or that uniformity in length with another Manual (see *g*, ante) is strongly called for, or that it is extremely desirable to secure a space immediately beyond the regular action point of that Key against which the Ped. Coupler acts directly.

The requirement most likely to have practical weight here is the last mentioned, as existent in the treatment described further on for the *Front Regulation* of the *Swell* Clavier. Turn, therefore, at this point to what is there said (comm. at *h*, next, 9th parag.), from which it will be at once seen, that if the Tail of the Great-Org. Key extends back beyond the Regular Action Sticker of such Key, the Sticker of the Action for Swell-to-Pedals will inevitably also be thrown rearward to a corresponding extent, and, as the Noses of the Squares or Backfalls of the regular Swell-Org. Action are still required to extend as far forward as the Great-Org. regular Stickers (assuming these latter to be present), the ultimate consequence must be an elongation of the said Nose of the Swell Square or Backfall,—itself involving an increase total in the size of the latter.

[Of course the preceeding constitutes a valid though not very forcible *objection* to the provision of Front Regulation for the Swell-Organ under such conditions: see at *h*, next, 10th parag.]

rrr, *Bis*. For these reasons the Builder should here act according to circumstances. Under all conditions the contact of the Coupler Man.-to-Ped., when made actually against the Key, should *preferably* be set either directly beneath, or just rearward beyond, the contact of the regular Action leading from the same Key; and if the coming into and out of coupling action be by means of a *Slope* (see again at *z*, ante), such Sloped portion will extend to the rearward of its own point of contact (see again at *r*, next, 7th parag.). But where the Key is of considerable length — so that there is no real danger of its fore-lifting—, and a Front Regulation of the Manual next above is really necessary or desirable (as when access to the Organ for interior Regulation is not easy), or where space beyond the Tails of the lower Keys is for any other purpose valuable—, then, it will often be the better treatment to set the *regular* Action contact at the extreme end of the Key, and the Pedals Coupler contact just forward of and inside of it; and any existent Sloping should in this case run inwards,—that is, forwards towards Player. Concerning the actual [plan] distance between the two Contacts, see what has been stated a little back (at *rr*, *Bis*, ante,—2nd parag.),—noting, that whenever the said Coupler contact is that which is the nearer one to the Player, the said distance should be as *contracted* as is possible, in order to diminish risk of the fore-lifting of the Key.

It will thus be seen that with the Pedals Coupler contact set beyond the Regular Action contact, the Length Total of the Key will be determined irrespective of the last named; but that with the less preferable treatment of the Coupling contact set inside the Regular contact, the said total length will be determined as entirely independent of the existence of such Coupler.

s. (7) *Coupler between Manuals.*—It is somewhat strange that the benefits of placing the Manual to Manual Coupler actually between the two sets of Keys should have been so little realised. The treatment was common enough some years ago (see *t*, ante and on), but is now looked upon with much disfavour,—quite wrongly, as the following list of only the chief of its advantages will show:—1, Less material is consumed; 2, Less workmanship involved; 3, Total weight or momentum lessened; 4, Greater quietness ensured when in action (if Coupler be properly constructed; see objection *D*); 5, Suitability for the requirements of a *Buffet* (particularly when latter is Reversed, in which case the *Backfall* form of Coupler often becomes impracticable from want of room); 6, Greater facility given for Removal of the Coupling mechanism; 7 (very important), Suitability for the application of a *Clear* Coupler,—on which point go over what has been said with No. 6 previous (comm. at *q*, ante), looking also at *r*, next; 8, Similar suitability, to some extent, for the provision of a *Part* Coupler (see Ex. 1, at *f*, next); 9, The rendering of Key-Participation sometimes less necessary (see *s*, next); 10, Such Participation of the Manual to *Manual* is at once ensured.

The objections that have at various times been brought against the having of a Coupler between two Manuals are:—(*A*) Interference with Slanting one of two sets of [Manual] Keys for the purpose of passing latter through the Stickers of the other such set; (*B*) Prevention of Access to some of the Manual Keys; (*C*) Want of Smoothness in the Coming-on of the Coupler while a Chord is put down on the Manual *to* which the Coupling is made; (*D*) Noise when the Coupler is *not* in Action.

t. A few words will dispose of these. *A* is rendered of no force by reason of a Device to be directly (at *z*, next) mentioned: and even without such expedient the Keys could be sharply [plan] Cranked so as to pass through the Stickers or the Trackers of the other Manual,—though such a Treatment is not to be advocated, because it throws the point of the Coupler-Contact *nearer* to the Key Mid-Pin (see *m*, ante). *B* is of no weight whatever; for, access to the *upper* of the two Manuals is obviously not affected at all by a Coupler beneath it, and as to the *lower* Manual it is equally manifest that under *any* circumstances the upper Keys must be removed to get at it, and that the taking away of the Coupling Mechanism itself will be the work of but a few seconds. *C* can exist only where the Coupling is not of a proper type; thus, the *Drumstick* form, if correctly constructed, comes on smoothly enough, whether any Keys be down or not. *D* can occur only where the Drumsticks are not properly hung; and even in such case rattling can be prevented by the simple expedient of keeping them *clear* of both the sets of Keys when the Coupler is not in Action (see *y*, ante).

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For further information on some different forms of Coupling-Actions see own future *Department;* also the EXEMPLARIES,—commencing at *d*, next.

(*To be continued.*)

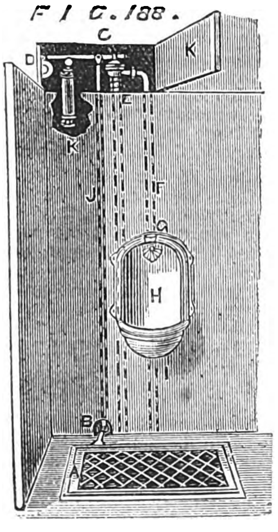
PRACTICAL NOTES ON PLUMBING.—XXXIII.*

By P. J. DAVIES, H.M.A.S.P., &c.

Cradle Urinals.

FIG. 188 represents a front view of the cradle urinal fixed against the wall, and with a valve E, worked with a rod J; the lever of the valve is kept from too suddenly closing by the use of the regulator K. It will be manifest to all practical men that any of the actuating arrangements of the water-valves belonging to either closets or urinals that have hitherto been described and illustrated, may be worked in with each other accordingly as circumstances may require, for instance: the door in Fig. 182 may be made to work the valve V, Fig. 173, or the lever D in Fig. 188, &c.

FIG. 188.



Before closing this chapter on door and seat action closets and urinals, it will be as well to mention that they are, as a rule, only fitted in places, and under circumstances where the users neglect, or cannot be depended upon, to pull the handles for flushing the basins, &c. They also are very useful in preventing waste where persons, mainly through negligence, will leave the handle up, and so leave the water to waste for days together.

It is of the greatest importance that the valves and pipes should be thoroughly washed and cleaned after fixing, to prevent the possibility of any dirt or other extraneous matter being deposited between the face and seating of the valve, so as to avoid any chance of leakage.

As some say that a change is as good as a holiday, for a time let us turn to

Fixing Soil-Pipes and Traps.

(See chapter XX.) This is according to promise when writing that chapter.

Fig. 189 is a plan of a water-closet. A is the trap; B the outlet, branched into the soil-pipe, S. This pipe is shown in this diagram at the left-hand corner of the w.c.; this position, however, is not compulsory, as it may be fixed at any other convenient part, at the discretion of the plumber, &c.

Fig. 190 represents a side elevation of the pipe and ᑌ-trap, as ordinarily fixed. The proper course to pursue in setting out such work as this, is—that having decided the position for the soil-pipe, as in the corner, Fig. 189, place the centre of the trap-dip (if for a valve-closet) 14in. from the back of the brick-work, as from A to H; but, on the other hand, if for a pan-closet, 12½in.: and, again, if the closet is less than 3ft. 6in. wide, place the trap 1in. out of the centre, as shown, the greatest distance being from F to A; or, in other words, keep the centre of the trap 1in. to the right of the centre of the closet, which will allow the dish and pull of the closet to come within the flap, and give a good rail to the closet seat. Next take the distance from the centre of the trap-dip to the back of the brickwork, allowing for the soil-pipe not going quite back (as shown) in the corner behind the soil-pipe; the most advisable plan is to take a short length of the soil-pipe and place it in the angle; then take the distance from the front of the pipe, as at J, to the centre of the trap (say this is 2ft. 6in.). Next is the fall; for this refer to Fig. 190; as a general rule it will be found that there is a 9in. joist to word between, as from the floor-line G to the ceiling-line C, so that there can be at least 4in. fall in the short length between I and J without the outlet-pipe being below the ceiling.

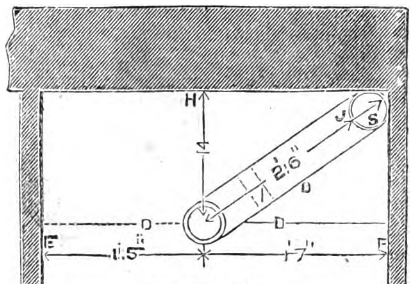
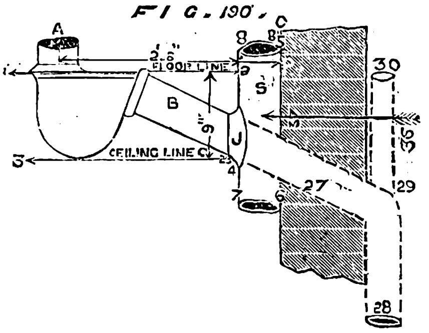


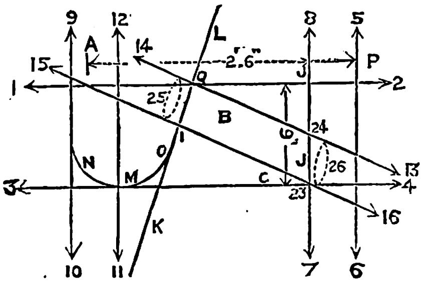
FIG. 189.

FIG. 190.



These distances being arranged, proceed to mark them on the floor or bench, as at Fig. 191, in the following manner:—Firstly, with the chalk-line snap the floor-line 1, 2, afterwards the ceiling-line 3, 4, 9in. from the floor-line (that is assuming it to be a 9in. joist), but if only a 7in. joist the ceiling-line must be only 7in., and so on in proportion. Now, with the square strike the back-line 5, 6, which must be square to the floor-line, because we are justified in assuming that the walls are thoroughly perpendicular and the floors horizontal; hence, the reason for the back-line being square to the floor-line. Now assume the soil-pipe to be a 4in. pipe, ⅛in. thick; strike the pipe-line, 7, 8, 4¼in. away from the line 5, 6, and parallel to it. This done, you have the floor and ceiling-lines, as also the soil-pipe lines.

FIG. 191.



Next, upon the floor-line, set back the distance from the centre of the dip to the front of the soil-pipe, which I have already said is 2ft. 6in., as from A to J, Figs. 189 and 190; then mark 2¼in. each side of the point A, Fig. 191, as at 9, 12; this will be for the dip lines 9, 10, 11, 12; draw these lines parallel to the wall or soil-pipe lines, and square to the floor-lines. Now take the trap and lay its top edge upon the floor-line, as illustrated at Q Y, Figs. 192 and 193; be assured that the top cheek lies level, which may be adjusted by placing a piece of ½in. or ¾in. board R, Fig. 193, under the trap, sufficient to allow for the flange 18; then, to be quite certain that you have the exact length for the outgo, place the heel of a small square W X, Fig. 192, upon the dip-line, and adjust the dip of the trap to the blade of the square. This done, you may be quite positive that your lengths are accurate. Next, with a blacklead pencil (see V, 19, Fig. 193) held plumb with the band of the trap, mark round the outgo as shown. The outgo of all traps should be straight, as at 20 and 21, Fig. 192. Now take the trap away, and with the straight-edge held to the straight part of the line marked, draw the line K L; this is your cutting line for the short length of pipe B, Figs. 192, 191, 190, 193, and 189; this done, draw the pipe lines, 13, 14, 15, 16, care being taken to get the proper points for the outlet of the trap as at Q I, Fig. 191. Of course, the points 23 and 24 must be taken from the meeting point of the ceiling-line with the pipe-line—that is, in cases where you wish to have all the fall you can get; but this is not always wanted. Now, having these lines 13, 14, 15, 16, lay the pipe as shown by the dotted lines 25 and 26, Fig. 191, and 23 and 24, Fig. 192, upon the lines, using the square as you did with the dip-pipe; or if it is a bend, as at 21, 24, 25, 26, Fig. 193, do likewise; then with a saw (a long panel saw is best) cut the lead pipe through and true to the lines L K and 7, 8. This will be the exact length for the outlet pipe, besides being cut true to suit both trap and pipe. Open the pipe S, Figs. 190, 191, 192; and to come up to a true round hole and face line for the branch pipe to enter, let the lead project ⅜th of an inch past the face, to receive the branch pipe as at 30, and the section 31, Fig. 192. I need not here explain the method of joint-making, nor the preparation of it, but assume that my readers are already efficient in that branch. Having everything soiled, lay the trap down in its place as before, upon the floor-line, and also the

FIG. 192.

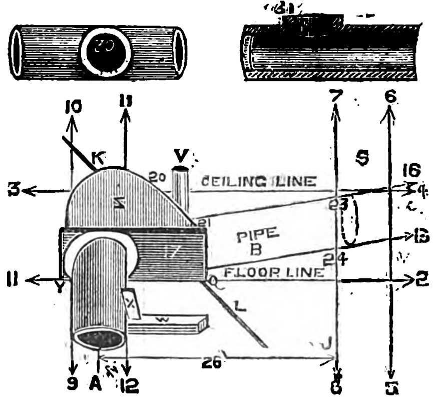
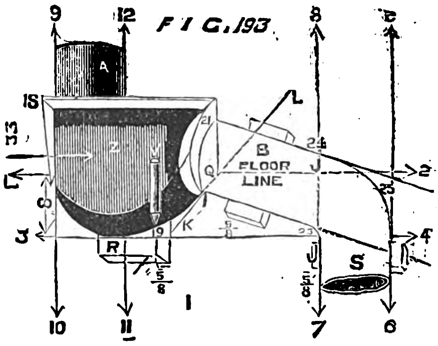


FIG. 193.



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out-go pipe as fitted; then mark the trap for shaving, shave it, and again lay it down; next, with a ladle half-full of solder, tack the trap to the out-go pipe, so as to fix it together; pick the whole up and fix it on its end in a position something like the illustration, Fig. 194. After the joint is wiped, as at I I, Fig. 190, lay it down again upon your lines and tack the branch joint 23, 24, Fig. 192; but be careful to block the pipes up to a level with the trap outgo, as shown at U T, Fig. 193; then pick up the trap, outgo-pipe, and soil-pipe in such a manner that the soil-pipe S will lie upon its back, as shown at P 6, Fig. 190. This position may be viewed by sighting along the arrow at 36, 37, Fig. 190. When the joint is made, solder on your tacks for supporting the soil-pipe; then fix it in its place.

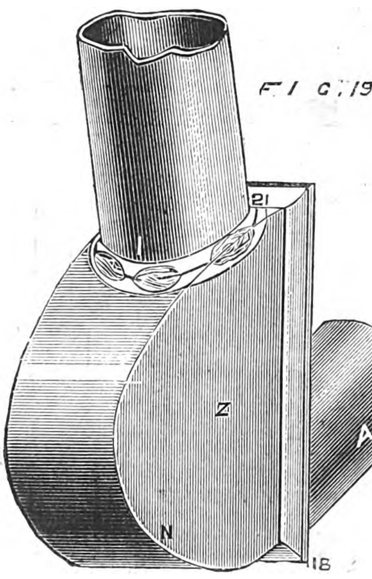
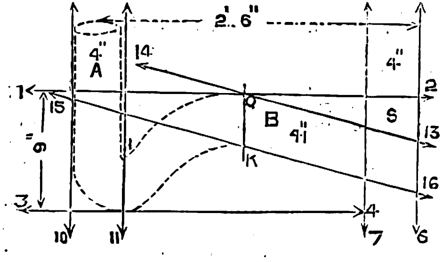


FIG. 194.

Fig. 195 is an illustration showing the same method for fixing the half ꙅ-trap. The lines are all the same excepting the outgo Q K, which must be struck straight across the outgo and the outlet-pipe, cut to the line Q K, as before; this joint may be made underhanded or upright.

FIG. 195.



After what has been described, the lines suitable for any kind of pipe-work may be easily arrived at, and the main thing is to be careful about your measurements and points.

WATCH-CLEANING AND REPAIRING.

By "A FELLOW-WORKMAN."

(*Continued from page* 188.)

Drawing a Hairspring.

DRAWING a hairspring comes under the heading of what jobbers generally call "doctoring a hairspring." Now, although I do not agree with "doctoring" as a rule, in some instances where the beginner has not the necessary means to keep a stock of hairsprings in hand, he would be glad to know a remedy of how to make the old hairspring do. I will try, therefore, to describe a simple tool by which I draw hairsprings. Fig. 49 is a side view of full size drawing. A is pair of pliers, B hairspring, C the graver (which I have drawn this way on purpose to show its face), D piece of brass plate, E is shaving coming from hairspring, F is a piece of wire for rest. Now look at Fig. 50, and you will see that the rest goes out, then up, then under the graver; the knob of the small drawer, same size as sketch, will do for handle. The graver should be about length shown. Do not press hard on your graver. There should be a little pin where the arrow points (Fig. 50) to keep the graver from slipping. The rest should be a little above the level of plate D. You must raise it gradually until your graver cuts to your satisfaction, and then fasten it.

FIG. 49.

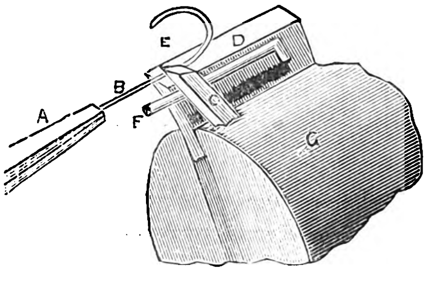
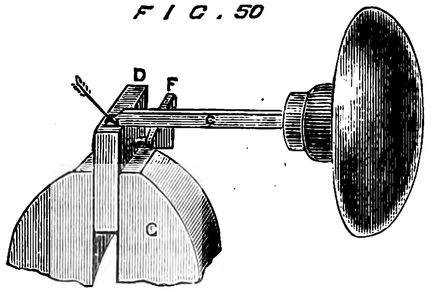


FIG. 50



(*To be continued.*)

THE USE OF STAINING FLUIDS IN VEGETABLE MICROSCOPY.[*]

IN bringing this subject before you this evening, it is not my intention to give a formal and original lecture on the use of staining fluids; although, as many of you know, I have, for many years past, made copious use of various reagents in the investigations in which I have been engaged. In the course of my work I have, no doubt, made use of staining fluids which, up to that time, had either not been used or not been referred to in published articles; but I feel very strongly that it is unwise and improper to claim or reclaim priority in any matter of manipulation or methods of research, and I will, therefore ask you to regard this paper as the best *résumé* of the subject I am able, with the time at my disposal, to bring before you.

Staining fluids are used by the microscopist for either of three purposes: 1st, in purely scientific investigation, chiefly to differentiate the living from the non-living, or for the purpose of discriminating between tissues which, unstained, so closely resemble each other as to be undistinguishable; 2nd, to allow of the more ready demonstration of different classes of tissues, as in transverse sections of wood-stems; and 3rd, to make pretty objects for show purposes.

We will take the first of these groups as our starting-point, as not only being more in accordance with the spirit, or what ought to be the spirit, of this society, but also because the use of staining fluids came into microscopy in connection with pure biological research: that their larger use in modern times lies in another direction is possibly a matter to be regretted. The first, or at all events nearly the first, staining fluid used was a solution of iodine for the purpose of demonstrating the presence or absence of starch in a vegetable tissue, and iodine solution is the first reagent with which the scientific phyto-microscopist should make himself familiar. For general purposes, an alkaline solution is preferable, and may be prepared by taking one grain of iodine, three grains of iodide of potassium, and dissolving them in one ounce of distilled water. The method of applying the test is well known to all but the merest beginner in microscopy, but may, perhaps, be mentioned. Suppose you have any thin section of plant-structure on the slide under observation; the section is probably immersed in water under a thin cover-glass, and you wish to apply the test without disturbing the section or even removing the slide from the stage of your microscope. Take a drop of the iodine solution on the end of a glass rod, which must be perfectly clean, place the drop of solution on the slide close to and touching one edge of the cover-glass, touch the opposite edge with a piece of blotting-paper, and as the paper absorbs the water on its side of the cover, the iodine solution will run under to replace it. With practice you can remove the water by the blotting-paper whilst the eye is applied to the microscope, and the reaction watched as it proceeds. It is hardly needful to add that the presence of starch is shown by a blue-violet colouration. The protoplasm matters in vegetable structures are coloured yellowish brown, as are also the woody tissues in a greater or lesser degree. The use of iodine, however, does not end in the yellow and the violet reactions of these three classes of tissues or substances respectively, for, as was known very long ago, it can be used in the detection of cellulose, the substance of which vegetable cell-walls are composed. The application of the test for that purpose is not so simple, but is by no means difficult. The experiment is more easily performed on a section which has not been immersed in water. Take an alcoholic solution of iodine (good sherry-coloured solution) and thoroughly stain the section, remove all surplus iodine solution and apply tolerably strong sulphuric acid (1 part acid to 2 or 3 water), wait a few seconds and if the experiment has been successfully performed you will notice that all the cellulose cell walls assume the blue violet colour characteristic of starch. The principle iodine reactions in vegetable microscopy, then, are—alkaline solution of iodine: starch stains blue violet; cellulose stains yellowish brown; protoplasm, wood, and cellulose stains darker brown. Iodine and sulphuric acid: Cellulose stains blue violet.

A modification of the iodine test, known as Schultz's test, has been recommended as a test for cellulose; but my personal experience of it is very limited. The solution is prepared as follows:—zinc is dissolved in hydrochloric acid, and the solution is allowed to evaporate in contact with metallic zinc, until it attains the consistency of a syrup; this syrup is then saturated with iodide of potassium, and iodine is last added.

Passing over tests, such as Millon's acid nitrate of mercury test, and the sulphuric acid and sugar tests for albuminoids, we will next notice the use of carmine as a staining fluid.

Probably no staining fluid, hardly any method of research, has made so much noise in the world as this. Brought prominently to the front many years ago by Dr. Beale, it has proved in his hands of great value, and may almost be said to form the foundation of his system of biological philosophy. Dr. Beale's method of preparing the fluid is as follows:—Take carmine 10 grains, strong liquid ammonia half a drachm, Price's glycerine two ounces, distilled water two ounces, alcohol ½oz. The carmine is to be placed in a test-tube, and the ammonia added to it. Upon applying the gentle heat of a spirit-lamp the carmine is dissolved. Boil it up for a few seconds, and allow it to cool before adding the other ingredients. Lastly, filter it, or allow it to stand, and decant off the clear solution. The solution should be neither too alkaline nor perfectly neutral. If the former, the colouring becomes too intense, and thus much of the soft or imperfectly-formed tissue is destroyed; if the latter, the uniform staining of formed and germinal matter mars the result. The permeating power of the solution may be increased by the addition of a little more water and alcohol. After the preparation has been properly stained, it should be removed to and washed in a solution of strong glycerine in half its bulk of water, and then transferred to an acid fluid composed of strong glycerine, one ounce; strong acetic acid, five drops; where it must remain three or four days to regain the volume it occupied when fresh. Beale's carmine fluid is not one which commends itself much to the mere preparer of pretty objects; but carefully-cut sections of soft-stem plants, carefully stained by various carmine fluids, are by no means to be despised by such as care only for the æsthetics of microscopy. It is to the micro-biologist, however, that carmine is the most useful; and although, to a certain extent, it has been superseded by aniline dyes, logwood solution, and other fluids, it is, to my mind, for certain purposes by far the most valuable reagent we have, and the permanence of its staining is far beyond that of any aniline dye.

The most important use of carmine staining fluid is in the differentiation of different portions of the protoplasmic matters in a cell or tissue, and upon the differential behaviour of these different portions of protoplasm Dr. Beale bases his theory of bioplasm, of germinal and formed matter. To use his own words:[*] "The matter which I have termed forming, living, or germinal matter, to which I have more recently given the name bioplasm, has been lately spoken of by others as protoplasm. . . . . The word 'protoplasm' would have been used by me, had the term been restricted to the matter of the tissues, which I termed living or germinal matter, and which I showed, in my lectures at the College of Physicians in 1861, underwent conversion into formed matters, and were concerned in forming all tissue. But under the term 'protoplasm' has been included the contractile tissue of muscle, the axis cylinder of the nerve-fibres, processes of nerve-cells, and many other textures which undoubtedly consist of formed material, and are entirely destitute of the properties which belong to my 'germinal matter' or 'bioplasm.' Moreover, the nucleus and nucleolus were by many writers considered to be distinct from the protoplasm. On the other hand, I showed that the nucleus and nucleolus were living. My bioplasm, germinal or living matter, therefore includes both nucleus and nucleolus, as well as some forms of the protoplasmic matter of authors." The proposition thus is, that what we are all in the habit of calling protoplasm really consists of a living and formative substance, which is bioplasm, and a substance which is formed out of (Dr. Beale would probably not say formed *by*) the bioplasm, and the problem is, to demonstrate the existence of these two forms of protoplasm.[*] The answer to the problem arises out of another proposition, "that all bioplasm is coloured red by an ammoniacal solution of carmine, while all formed material, notwithstanding it has been traversed by the alkaline colouring fluid, remains perfectly colourless. In practice certain precautions are necesssary, and the density and composition of the colouring-fluid must be slightly varied in special cases. But it is necessary that I should state distinctly that if the process be properly conducted, every kind of living or germinal matter or bioplasm receives and fixes the colour, while no kind of formed material known is stained under the same circumstances." It is, of course, no part of my duty to-night to express any opinion on the soundness of Dr. Beale's biological opinions, and, under any circumstances, it would be mere presumption on my part were I to attempt to do so. All I have to do is to point out that, for the purpose of clearly demonstrating various shades of difference in the constitution of "protoplasmic" masses in a cell, demonstrating nuclei and nucleoli, Beale's carmine fluid is a most valuable agent. It is a little troublesome to prepare, but will keep for years, and the stained preparations are extremely permanent. Various other preparations of carmine have been introduced into practice. Amongst the more recent ones may be given the following,[†] due to Prof. H. Grenacher, and extracted from the *Journal* of the Microscopical Society for 1879:—

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[*] A paper read before the Leeds Naturalists' Society, May 2nd, 1882, by HENRY POCKLINGTON, F.R.M.S.

[*] Bioplasm, 1872 ed.

Alum Carmine.—A 1 to 5 per cent. solution of common or ammonia alum in water is boiled for 10 to 20 minutes, with $\frac{1}{2}$ to 1 per cent. of powdered carmine, and the solution filtered when cold. The solution is of a rich red colour, inclining to purple, and when concentrated stains a section in five to ten minutes. Sections, when washed in water for a couple of minutes after staining, have a purple or lilac colour; the staining also is less diffuse, and more confined to the nuclei, than in the case of the ordinary solution of carmine or picro-carmine. It has also the advantage of not over-staining, even if a section be left in it for a whole day; and if it dries up by evaporation (in a watch-glass, for instance), the addition of a little water will render it once more fit for use, no precipitate being produced. It is advisable to add a few drops of some antiseptic to the solution. It will then keep for years.

Borax Carmine.—A one to two per cent. solution (aqueous) of borax is boiled with $\frac{1}{2}$ to $\frac{3}{4}$ per cent. of powdered carmine. To the dark purple solution acetic acid is continuously added, drop by drop, with constant shaking until a bright red colour is attained. It is then filtered, or, as it filters very slowly, allowed to stand and then decanted. This solution stains sections very rapidly, in from one-half to three minutes, but quite uniformly. If, however, they are washed with water, and placed in a watch-glass of from 50 to 70 per cent. of alcohol, containing a drop of hydrochloric acid, the colouring matter is removed from all parts of the tissue except the nuclei, which remain deeply stained.

Alcoholic Carmine.—To 50cc. of strong alcohol (60 to 80 per cent.) three or four drops of hydrocloric acid are added, as much powdered carmine as will lie on the point of a knife (the size of the knife is not stated—presumably a clasp knife or small dessert-knife is meant) is added, and the whole boiled for ten minutes, and filtered when cold. The exact proportion of carmine and acid depend upon the quality of the former. If a section placed in the fluid stains in five to ten minutes uniformly, there is not sufficient acid, and more must be added. If, after standing for some days, the solution assumes a yellowish red colour, too much acid has been added, and the excess must be neutralised by cautious addition of ammonia.

After staining, the sections must be rinsed in alcohol, *not* in water; also, if the solution has been too strong, it must be diluted with alcohol, as water precipitates the carmine.

Purpurin.—About as much purpurin as will lie on the point of a knife is boiled in 50cc. of glycerine. The latter may be concentrated, or have a little water added to it. The resulting orange-red, fluorescent solution is allowed to stand for two or three days and is then filtered. Unlike Ranvier's solution of purpurpin, it may be kept for months without precipitation.

All the above fluids are stated to be quite permanent in the case of balsam preparations; if glycerine be used as the mounting fluid, it should be slightly acidulated.

Logwood.—Another staining fluid of value in the examination of protoplasm is solution of logwood. I have used a preparation made by the formula published some years since by Prof. Arnold, of New York, with success. The solution is made as follows:—The ordinary extract of logwood is finely pulverised in a mortar, and about three times its bulk of powdered alum added; the two ingredients are well rubbed together and mixed with a small quantity of distilled water. The complete admixture of the hæmotoxylin is necessary, and this will require fifteen to twenty minutes' vigorous stirring. More water may now be poured on, and the solution, after filtration, should present a clear, somewhat dark violet colour. If dirty red is obtained, more alum must be incorporated, and the mixture again filtered. By always having an excess of both alum and hæmatoxylin in the mortar, a saturated solution can be obtained, which after filtration may be combined with alcohol, one ounce of the logwood fluid with two drachms of 75 per cent. alcohol. A much better colour is produced by allowing the mixture, after thorough trituration, to stand for several days before filtration and addition of alcohol. This stain colours very rapidly: the nucleus becomes a dark purple, and the remainder of the protoplasm a neutral tint. I have found the fluid extremely useful in the examination of growing points and the structure of ferns.

Aniline Dyes.—My experience of aniline staining fluids only dates back to about 1868, after which I made use of them for several years in the demonstration of the structural elements of plant-stems, and later also in the examination of protoplasmic matters. Aniline staining fluids generally have the merit of being easy to prepare and apply, but have the unfortunate fault of lack of permanency if much exposed to light. Mr. W. H. Jackson some years since[*] published a method by which magenta-stained specimens could, he thought, be made reasonably permanent. The process arose out of the following considerations. "Rosaniline or magenta is a triamine, and, therefore, with monobasic acids forms three salts, in which one, two, or three atoms of hydrogen are replaced by the acid radical. The tri-acid salts are obtained in the presence of an excess of acid, and are all colourless, or nearly so, for the most part having a dull reddish-brown tint (the mon-acid salts are brilliantly coloured). *All* sorts of rosaniline are soluble in alcohol, ether, glycerine, and chloroform, and in fluids containing more than a certain percentage of these substances. Some, *e.g.*, the mon-acetate, or mono-chloride, are soluble also in water or watery solution. Hence a stained tissue, plunged into water, loses a certain amount of colour, and is ultimately left in a most unsatisfactory condition. Moreover, under the influence of light, and in the presence of organic matter, some of the mon-acid salts undergo a decomposition by which a nearly colourless compound is formed, and the preparation thereby spoilt."

It was, therefore necessary to find either a stable mono-basic salt, or to obtain a proper preservative fluid. The latter condition could only be secured by employing a watery solution, as *all* magenta salts will dissolve in all the other media commonly employed. The first condition could be met by employing a mon-acid salt, insoluble and unchangeable, in the preservative fluid. The salt he preferred was the mono-tannate—the preservative a special syrup. A strong solution of tannic acid is prepared in water, a little crystallised magenta is dissolved in water, or Judson's dye, diluted, is placed into a separate vessel and the tannic acid added, drop by drop, shaking the test-tube from side to side after adding each drop, and taking care not to precipitate the magenta *completely*. The precipitate is allowed to settle, the fluid poured off, and the precipitate washed by decantation several times with cold water. It is finally allowed to partially dry, a drop of acetic acid added, and then alcohol drop by drop till it dissolves. The solution is pink, and stains very rapidly and quickly. The stained preparations are mounted in a fluid composed of a strong sugar-syrup, to which is added whilst it is hot, 3 to 4 per cent. of either sodium chloride or calcium chloride. As soon as the preparation is stained, it is washed with water, which sets the stain at once.

When using aniline dyes, chiefly magenta, somewhat extensively some eight or nine years since, in connection with the examination of stem-structure, I was much troubled with the readiness with which the dye was removed from portions of the structure if it was necessary to mount the specimen in in either glycerine or spirit-and-water, or balsam diluted with chloroform, and heated whilst the specimen was immersed in the medium. To some extent I removed the inconvenience by passing the section into oil of cloves or anise, immediately after its removal from the staining liquid. The essential oil, to a great extent, sets the stain, and prevents its being dissolved out with the mounting medium; but I have not found that this process at all lessens the liability of the preparation to fade on exposure to light. As, however, the working biologist preserves a very small proportion of his preparations, the value of magenta as a staining-fluid is only slightly lessened by its liability to fade.

The reaction of magenta on protoplasm is very similar to that of carmine—the nucleus and the nucleoli are stained more deeply than the other portion of the protoplasm; but it does not, within my experience, differentiate different portions of the protoplasm so sharply as carmine.

Magenta is very useful in the examination of stem-structures, as a very short immersion in the dilute dye suffices to deeply stain all the wood wedges and woody fibres; whilst the thinner parenchymatous tissues stain so slightly, that a momentary washing will remove the colour.

Aniline Blue and Violet.—These are useful in much the same way as magenta, and will be found valuable in the examination of bacteria and other low forms of vegetal life, as they are made much more conspicuous by its aid, and are more easily preserved as permanent objects. Magenta and aniline blue, or aniline green, are useful for the purpose of double staining sections of stems and preparations of leaves; but to this I will refer later.

Bismarck Brown.—This reagent, although used by various microscopists for some years, has only recently come into general notice.

L. F. Henneguy[*] having treated Paramecium aurelia with an aqueous solution of aniline brown, was surprised to see them assume a rather intense yellow-brown colour, and move rapidly about in the fluid. The colour first appeared in the vacuoles of the protoplasm, and then it invaded the protoplasm itself. The nucleus generally remains colourless, and thus becomes more visible than in the normal state. Infusoria thus coloured were kept for nearly fifteen days. All infusoria may be stained with aniline brown, but no other aniline colours employed by the author exhibited the same pro-property. They only stained the infusoria after death, and some of them are, in fact, poisonous.

Seeds of cress were sown on cotton soaked with a concentrated solution of the Bismarck brown and they sprouted. The young plants were strongly stained brown, but on crushing the tissues and examining them under the microscope, it was ascertained that the protoplasm of the cells was very feebly coloured. The vessels, on the contrary, showed a very deep brown staining up to the termination in the leaves. The mycelium of a mould which had been developed in a solution of Bismarck brown was clearly stained after having been washed in water, whilst it is known that the mycelium which forms in coloured solutions, such as picro-carmine, hæmatoxylin, &c., remains perfectly colourless. The author concludes that Bismarck brown possesses the property of colouring living protoplasm both in animals and plants.

I have endeavoured to confirm the author's statement on the latter point, but have not been able to come to any other conclusion than that Bismarck brown is not so toxic as other aniline dyes. If used in very strong solution, infusoria rapidly die when immersed in it. When used dilute they live for some time; but the examination of them with high powers has satisfied me that the only portions stained are the formed materials, notably the exterior of the organisms. The author cited above satisfied himself that the protoplasm was stained in Paramecium by crushing the creature, and causing the protoplasm to extrude, when it was seen to be stained. If this operation were performed whilst the creature was swimming in the staining fluid, it is possible that the staining of the extruded protoplasm was purely post-mortem. Experiments performed by myself on Paramecia removed from the staining fluid into clear water gave a purely negative result. I was not able to see any unformed unstained, protoplasm. Cyclosis will proceed in Vallisneria long after its immersion in the staining fluid; but the circulating cell-sap does not become stained so long as its gyration continues. The nucleated mass of protoplasm floating in it does frequently stain, as also do the other contents of the cell, but the purely living—*i.e.*, Beale's germinal matter—does not stain, with the exception of the nucleus (if it *be* unformed protoplasm). Dahlia, and B B B B violet, are said by M. Certes to have a similar selective staining effect on the nucleus, as also cyanin or chunolin blue; the latter, however, not staining the nucleus during life, although the infusorian continues to live in the dye, and is stained by it.

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[*] Apart from the question of nomenclature and its attendant theory, no biologist would, I think, dissent from this classification.

[†] Specially applicable to nuclei.

[*] *Quarterly Journal Micro. Science*, 1874.

[*] *Micro. Journal*, April, 1882.

Mr. J. M. Macfarlane recommends the use of saffronine for staining latex vessels, good preparations of which are notoriously difficult to procure. As a preliminary step, the preparations are placed in alcohol for a week to coagulate the latex, and after staining are washed in spirit. I have used Judson's blue dye successfully for the same purpose. Heliocin and naphthalin are recommended by the same author for staining cell contents.

Max Niggl uses indol as a reagent for lignified structures as follows:—Pure indol is dissolved in warm water. The section is moistened with this solution and covered with a cover-glass. The indol is then removed with blotting-paper, and a drop of dilute sulphuric acid (one to four) run in. The lignified cell-walls take a beautiful cherry-red, and the sclerenchymatous cells even a purple colour, which is retained by the preparation for some time.

Passing over the use of other aniline dyes than those named, most of which act in a similar manner to either magenta or aniline blue, I will refer a moment to methods of double staining.

The practice of double staining has become very common, and is much more favourably looked upon by microscopists generally than appeared to be the case when, some twelve or fourteen years since, I submitted one of my earliest double stains to some enthusiastic microscopists, and met with the compliment that they were pretty things for children to look at. I tried to set a fashion then, and feel very much disposed now to try and set it the other way, for I very much fear that the very beautiful specimens of double staining turned out by such masters of the art as Mr. Vance Smith and others, will turn many a budding microscopist into the ways of pleasure rather than of work. For class purposes, where it is desirable to demonstrate the several groups of tissues of which a stem is composed as clearly and sharply as possible, these methods of double and treble staining are useful, perhaps; but beyond that I am not prepared to go. I may add that it is at least seven years since I prepared a double stained object, except for temporary purposes, so that I may possibly in this, as in other things, be considered behind the age.

My earliest double stains were made with magenta and Judson's blue. The sections were stained first in the magenta, washed and transferred to the blue, slightly washed and mounted in balsam after passing through oil of cloves or anise. They were fairly successful and reasonably permanent. A better method is that which was published in the *American M. Micro. Journal*, in 1880. It is as follows:—A two-grain neutral solution of eosin is used, and in this the prepared sections are preserved until the operator is ready to use them. They keep perfectly well in this solution, and are always ready to undergo the final process, which requires but a very short time before they can be placed fully finished under the covering-glass. After taking them from the eosin solution, they should be passed through 95 per cent. alcohol, merely to wash off the superfluous colour, and then placed in half-grain solution of Nicholson's blue made neutral. The time required in the blue solution varies with different tissues, and in the nice adjustment of the time lies the whole success of the operation. Three or four sections of each kind are generally spoilt in determining the exact time required. A section is taken from the eosin, holding it lightly in a pair of forceps, rinsed off rapidly in alcohol, and then immersed in the blue still in the forceps, while ten can be counted with moderate haste. Then quickly place in the clean alcohol, and brush lightly with a camel's-hair brush. This immersion in clean alcohol seems to check the action of the blue instantly. It should then be examined under a 1in. objective, to determine whether the exact point where the blue and red remain distinct has been reached. If the blue has not occupied all the softer cells, another section should be taken, and put through the same process, counting twelve, and so on, until the proper point is reached; or, on the other hand, decreasing the count if the blue has impinged upon the red in the more dense tissue. Having thus determined the count for the sections of that particular material, the remainder of the sections are passed through the blue into the alcohol, merely counting off the immersion of each section. Then place the sections for a few moments in absolute alcohol, which seems to fix the colours, then through oil of cloves into benzole, and mount in dammar and benzole. It is sometimes advisable, with very delicate tissues, to merely rinse off the blue in 95 per cent. alcohol, and fix the colours at once in absolute alcohol; but every operator will learn the minor details for himself in the manipulation.

In order to secure fine specimens of double-stained herbaceous stems, or any preparation which contains chlorophyll, or other colouring matter, a preliminary bleaching process is essential. Alcohol will remove chlorophyll, but not very perfectly, and is apt to make the specimens very brittle. Solution of chlorinated lime decolours rapidly, but, unfortunately, also acts upon the tissues, and if they are delicate, rapidly destroys them. Labarragues solution of chlorinated soda, made by decomposing chlorinated lime with sodium carbonate, has been used, but is apt to form a scum, which attaches itself to the object, and is then difficult of removal. I have used free chlorine for bleaching purposes, passing the gas into the water in which the sections are immersed, or preparing an aqueous solution of chlorine beforehand, and placing the sections in small bottles of the solution, shaking them gently to and fro till decoloured; but this operation, unless performed out of doors or in a chimney opening, is apt to lead to premature sore throats and eyes, and in any case must be done with care. Perhaps the safest method of using chlorine for this purpose is to place the sections in a bottle of water, cork with a perforated cork, through which a glass tube leading to the bottom of the water has been passed. The glass tube should be U-shaped, the spare leg passing through the cork of a second bottle an inch or so; in the second bottle place a little chlorinated lime and water, adding a little sulphuric acid. The chlorine, as given off from the lime, will bubble through the water, charging it with the gas and decolouring the sections. When the gas has ceased to be given off, take the bottles containing the sections, cork it tightly, shake gently, and remove the sections. If the water retains much chlorine, cork the bottle and retain it for future use. Place the apparatus out of doors during the entire course of the experiment.

Instead of chlorinated lime, chlorate of potash, and strong sulphuric acid may preferably be used; but in that case place a safety tube through the cork of the vessel containing the chemicals.

I have now brought before you very hurriedly a few rambling notes on staining fluids, and hope such a discussion may follow as shall result in the increase of our knowledge all round, and conduce more to the interest of the meeting than this paper can possibly have done.

COD-LIVER OIL.

Of modern medicaments, there are few which have been so greatly improved, within recent years, as oils in general, and cod-liver oil in particular. Some of these products, as now supplied in druggists' shops, are so different from what were furnished under the same name, say 20 years ago, that one naturally asks whether they contain the same medicinal principles, or to what extent the proportions of these have been altered, if such a change has occurred. The course of this progress in respect to cod-liver oil has been recently traced by M. Carles, in a paper to a Bordeaux medical society, reported in the *Journal de Pharmacie*.

There is a palpable difference between the old cod-liver oil and the new, as regards smell and taste. Formerly the raw material consisted of livers which were always more or less corrupt, and mixed with blood and debris of viscera, and thrown pell mell into an old tun, putrid fermentation being trusted to bring out the fatty matters. This process was found, however, to yield too little, and the production was accordingly stimulated by heating the putrid residue at an open fire. The stronger the fire, the more abundant was the oil, but the darker, too, was its colour, and the greater its acridity, so that it only found favour with stomachs "the most courageous and experienced."

Yet when patients took this "brew," the system was generally benefited, and it required no great prophet to predict for the medicament a rapid success, when it should be properly prepared, and freed from all that made it disagreeable to the senses. Various attempts at this latter object were made. To deceive the smell, recourse was had to aromatic substances, oil of mint, bitter almonds, cinnamon, &c. But patients did not favour these contrivances, and they instinctively reverted to the natural oils, always preferring those that were less odorous and less coloured. The directions for improvement were thus indicated.

At one time the idea was entertained of treating these crude oils with potash for their acridity and acidity, and with bone-black for their smell and colour. But it was soon perceived that the action of these agents was too violent: the oil lost part of its medicinal qualities, the acridity persisted, and the predisposition to rancidity was increased by the chemical treatment.

It was soon understood that instead of seeking to destroy the colour of the brown oils, it would be better to prevent that colour forming, and since the oil only turned brown through putrefaction or fire, the possibility of improvement in this respect was considered.

The livers, deprived of blood and visceral debris, were treated soon after removal from the animal, and if heat was used to facilitate the escape of the oily substances from the liver cells, its action was carefully regulated by means of steam or the water bath. The apparatus was completely transformed; the old wooden tun, whose pores offered an inviolable hiding place to germs of putridity and rancidity, and defied all good cleaning, was replaced by metallic vessels tinned or enamelled, or by glass receivers.

Producers and consumers alike profited; the manufacturer found his deliveries steadily increase, and the patient at length possessed an oil not liable to alteration, pleasing to the eye, and not disagreeable to the taste and smell.

But have these modern oils, M. Carles asks, all the medicinal qualities of the barbarous original oils?

The superiority of the modern oils as regards facility in taking, is important; and of two similar medicaments, it will in general be found that that which causes less apprehension will have the most certain and distinct therapeutic effect.

The superior *digestibility* of these modern oils seems also to be established. Let anyone take every day alternately a spoonful of different kinds of oil, proceeding from the clearest to the brownest or conversely, and he will find that the eructations are more numerous, prolonged and disagreeable, the more coloured the oil; whereas with the clearest oils, these symptoms of difficult digestion are very rare or wholly absent. The laxative action on the intestines is manifested in the same sense.

Lastly, as regards *assimilability*, the following experiment is instructive:—Take 50 grammes of each of those oils, add 5 grammes of a sweet-bread maceration, and agitate; it will appear that the emulsion is more rapid, complete, and persistent, the clearer the oil. A regular series may be thus obtained from the clearest to the most coloured oils.

This phenomenon of coloration is also directly related to another character which is most variable in cod-liver oil—viz., *acidity*, which, perhaps, has hardly received the attention it deserves.

The acidity, in fact, increases proportionally to the intensity of the coloration. This consideration, of itself, is a weighty one in favour of the white oils. Everyone knows that the oils and butters of our tables suit the generality of stomachs when they are neutral, but become indigestible when they are acrid or acid. The same with medicaments; castor oil, *e.g.*, is a purgative always tolerated, if it be neutral, through expression from the seeds in the cold state, whereas it often causes vomiting, if it have acquired acridity and acidity, through pressure combined with heat.

To measure the degree of acidity of cod-liver oils, the author proceeded by two methods, acidimetry and saponification. In the former, 50 grammes of oil were put in a matrass of 200 cubic centimetres capacity; 100cc. of rectified spirit was added, and 20 drops of sensitised tincture of litmus. Through agitation, the fatty acids passed from the oil into the alcohol, and coloured the litmus red. With a dilute solution of caustic soda, the litmus is rendered blue again, and when, after lively agitation, the colour changes no more, one reads on the measuring-glass the quantity of alkaline liquor which is proportional to the acidity of the oil. In this way the acidity of cod-liver oil calculated in acetic acid (the force of which is well known in vinegar), varied from 0·01 to 1·80 per cent.; the lower extreme representing a white oil, and the higher a current type of brown oil.

Saponification gives a similar classification; but, still better, it brings quickly into relief the various general properties of cod-liver oils. Place in a number of parallel porcelain pots 150 grammes of each of the oils to be examined; pour carefully into each 50 grammes of a solution of caustic potash at 30° B, then work the mixture simultaneously in all the pots. If you then compare, you will observe that with the brown oils there is an immediate liberation of heat, accompanied by a strong smell, and that the whole solidifies in less than five minutes: whereas with the pure white oils the mixture remains liquid five hours, notwithstanding frequent agitation, and that it only gives a weak odour. With oils of intermediate hue, the same phenomena occur with variable intensity, and yield a curve which ascends regularly from the pure white oil to the extreme brown.

M. Carles has further a word to say on the chemical proportion of mineral elements in cod-liver oil. There are two of them which are generally brought into prominence—viz., iodine and phosphorus. Iodine has been found by certain chemists in cod-liver oils of all hues, while Delattre and Girardin have not observed a trace of it in oils of cod fished in spring. In many cases, there is little agreement as to the proportions of this metalloid, though it is a tradition that brown oils contain more of it than white. One reason of the disagreement (according to M. Carles) is, that the potash used in saponification of the oils is often not exempt from traces of iodine; secondly, the oils formerly analysed were not always of an absolute limpidity, and iodine is more abundant in the deposits than in the filtered oil.

In all cases, it appears, that when the oil is natural, and well filtered, and the potash used is pure, the proportion of iodine is extremely small (measured by tenths of a milligramme per cent.); hence it is rash to attribute to it a really therapeutic action.

The same uncertainty holds with regard to the presence and proportions of phosphorus; but it appears to the author illogical to attribute any medicinal action to this substance, since it exists in the oil in the state of calcareous phosphate, and its proportions never exceed a few centigrammes per cent.

En résumé :—

Through modifications of old methods of extraction, the barbarous oils of the past have given place to improved ones, of little colour, limpid, having a smell and taste by no means disagreeable, and suiting stomachs which willingly accept sardines, anchovy, &c.

Of these various oils, the modern natural white ones must be every way preferred to the empyreumatic brown.

Even apart from physical and sense-affecting properties, pure golden-green oils must be considered the best, because they are lighter for the stomach, their acidity is hardly sensible, and they are without acridity.

All varieties of the oil contain such infinitesimal quantities of iodine, doubtful traces of bromine, and small quantities of combined phosphorus, that one cannot recognise in any of these elements the cause of the tonic, reconstituting action of cod-liver oil.

The active principle seems to reside almost wholly in the particular fatty substance itself, which is found unaltered in pure oils.

Lastly, these pure modern oils are a product essentially assimilable, and their association with any other medicament can only injure their tolerability and therapeutic action.

MR. MOY'S LECTURE ON FLYING.*

THE lecturer commenced by remarking that it is now 99 years since the invention of balloons, and that there has been scarcely any practical improvement made in balloons during that time. Mr. Coxwell's plan of converting the balloon into a parachute for the purpose of effecting a safe and rapid descent, the invention of the trailing-rope for land, and drag for water, in order to keep the altitude constant, being the only inventions worth mentioning. He suggested that the weight of the net might be utilised and the net dispensed with by slightly adding to the thickness of the material, and providing loops to which to attach the ropes for the car, near the neck of the balloon.

Mr. Moy then spoke upon "dirigible balloons," which he said should be called "dirigible aërostats," and pointed out several important improvements which might be made in this form of vessel, showing that there was nothing to hinder a successful vessel being constructed of not less than 12 tons lifting power, with common coal-gas s. g. 420.

The lecturer then passed on to the subject of mechanical flight, and he said he would begin with facts.

1st. It is a fact that there are no examples in nature of flying by displacement.

2nd. Flying is entirely a mechanical operation.

3rd. The area of the plane is not the index of its sustaining power.

4th. Some birds fly for long intervals, without any exertion of mechanical force.

The two first facts being self-evident, he spoke upon the third and fourth, proving the third fact by means of his pendulum experiment with, first, a fixed plane, and secondly, a rotating plane.

The discussion was opened by Dr. Pole, F.R.S., who expressed himself very much pleased with the able manner in which the subject had been handled, and the sound mechanical views which had been expressed by the lecturer.

THE production of Bessemer steel rails amounted during last year to 1,023,740 tons, being an increase of 283,830 tons, or 38 per cent. on the output of 1880. Of these rails 594,419 tons were exported. Seventy per cent. of the Bessemer ingots made in 1881 were manufactured into rails. This is exactly the proportion which the one bore to the other in 1880.

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

THE PRESIDENT'S ADDRESS.

(*Concluded from p.* 191.)

Penetrating Power of Objectives—Depth of Vision.

THIS again is a subject which has long been obscure; very various opinions being held as to the true nature of what has been generally termed the "penetrating power" of an objective. By some it has been declared to be a defect in the construction of the objective—residual uncorrected spherical aberration, in fact; and by others as necessarily inconsistent with perfect definition, even with the best methods of construction; the approximately correct notion regarding it being that it decreased as the angle of aperture increased.

Professor Abbe, however, in a very valuable paper, placed the question on the scientific basis so long needed, showing that the total depth of vision in the microscope, i.e. the solid space which at one focus of the microscope is visible with sufficient distinctness, depends not merely on the depth of focus of the objective, but is the sum of that and the depth of accommodation by the eye.

The depth of focus (other conditions remaining the same) varies in inverse ratio to the magnifying power and also to the numercial aperture of the objective. Thus with a ¼in. and ⅛in of the same aperture the depth of focus of the former would be twice that of the latter, or if the powers are the same but the apertures are ·50 N.A. and 1·50 N.A., it would be as 2 to ·66.

The depth of accommodation depends upon a point which was entirely new to microscopists until developed by Professor Abbe—viz., the peculiar property of microscopical amplification, by virtue of which the linear amplification of the depth of an object is largely exaggerated, being equal to the square of the linear amplification laterally. Thus an object magnified, according to ordinary parlance, 100 linear diameters (i.e. in breadth) is magnified 10,000 linear diameters in depth. Now the depth of accommodation varies in inverse ratio to this depth-amplification, that is inversely to the square of the magnifying power, so that whilst large with the low powers, it decreases very rapidly and disproportionately as the power is increased.

The joint effect, therefore, of the diminution in the depth of focus and depth of accommodation is that the total depth of microscopical vision diminishes, not in the same ratio as the increase in the magnifying power, but at first in a much greater ratio. With the low powers we have considerable depth of vision, as it is then chiefly influenced by the large accommodation-depth. As we proceed to the medium powers (100-300) the accommodation-depth very rapidly diminishes, and becomes equal to that of the small depth of focus, so that the total depth of vision is necessarily small also. As the power is further increased, the accommodation-depth ceases to have any influence, and the depth of vision becomes principally depth of focus only. If, for instance, an amplification of 30 times is increased to 300, the depth is reduced not to 1-10 but to only 1-50 of its original amount; or taking the depth of vision with a power of 10 times to be 2 mm., with powers of 30, 100, 300, 1000, and 3000, it is only ·254, ·0273, ·0017, ·00091, and ·00026 mm.

The formula

$$\text{depth of vision} = n\left(\frac{L^2}{N^2}\lambda + \frac{L}{N}\frac{\omega}{a}\right)$$

shows at once how much the depth of vision may vary by change in the conditions—represented by the various factors in the formula—which make up the total effect, important among which, as will be seen from the form of the equation, is the refractive index n of the medium in which the object is mounted.

Micro-Stereoscopic Vision.

The determination of the depth of vision (in monocular observation) naturally throws great light also on the conditions for effective micro-stereoscopic vision. It is obviously only when an object can be completely seen in all three dimensions at one adjustment of the focus, that a true stereoscopic image of it can be obtained. So long as only a single layer of inappreciable depth is visible simultaneously with any distinctness, no stereoscopic apparatus, however perfect, can bring into view the form of the whole of the object.

Now with low powers we have large visual depth, so that objects of considerable thickness can be seen as solids. By reason, however, of the rapid decrease of the depth of vision to which I have referred, the thickness of the objects which can be seen in relief rapidly and disproportionately decreases as the power is increased, so that only very thin objects are suitable with even the medium powers, the absolute depth, in the case of an object magnified 300 times, not amounting to a hundredth of a millimetre. With still higher powers the images of solid objects (though the decrease in depth is no longer so irregular) necessarily approach more and more to simple plane sections, the absolute depth with a power of 1,000 times amounting only to a micro-millimetre. For medium and high powers, therefore, the only objects suitable for the stereoscopic binocular are those which present, within a small limit, a sufficiently characteristic structure, that is, which have sufficient salient points for stereoscopic effect. We can, however, increase the depth of vision by using narrow illuminating pencils, and by mounting the objects in some highly refractive substance. The above considerations also show the importance of using the lowest power sufficient to recognise the object.

Whilst the reduction in depth limits effective stereoscopic observation, Professor Abbe properly points out that there is a compensating advantage in ordinary microscopic observation, in that as the depth-perspective becomes more flattened the images of different planes stand out from each other with still greater distinctness, so that "with an increase of amplification the microscope acquires more and more the property of an optical microtome, which presents to the observer's eye, sections of the object of a fineness and sharpness that no instrument could produce by mechanical means."

Another novel point was the demonstration of the very material distinction between ordinary stereoscopic vision and that with the microscope. The perspective shortening of the lines and surfaces by oblique projection, which is an important element of solid vision with the naked eye, is wholly wanting in microscopical vision, in which we have only the other element, a relative displacement of successive layers in the image. That these displacements are seen in the microscope, depends entirely on the peculiar exaggeration in the amplification of the depth of an object which is not found in ordinary vision.

The paper "On the Conditions of Orthoscopic and Pseudoscopic Effects in the Binocular Microscope" is also a most useful contribution to the theory of micro-stereoscopic vision, establishing as it does the true criteria for both classes of effects, and at the same time clearing up a misconception that had arisen as to the supposed necessity for the rays from the two halves of the objective crossing in order to get proper orthoscopic effect. If the delineating pencils have been reflected an even number of times in the same plane, the rays must cross, but otherwise not.

Mounting-Media of High Refractive Indices.

To utilise the full benefit of immersion objectives, it is of course essential that the object should be mounted in a medium, the refractive index of which is not less than that of the immersion fluid; and down to a comparatively recent date Canada balsam was most commonly used for this purpose, particularly for diatoms.

Mr. Stephenson, however, pointed out that although by the use of the balsam we have attained our object so far as the aperture is concerned, yet we have done so at the expense of the visibility of the resultant image, which has become fainter by the nearer approximation to equality of the refractive indices of the diatomaceous silex and the balsam; the visibility of minute structures being proportional to the difference between the refractive indices of the object and the medium in which it is mounted. Instead of balsam, therefore, media of high refractive index should be employed; thus, as the refractive indices of diatomaceous silex and Canada balsam are respectively 1·43 and 1·54, the difference ·11 is the measure of the visibility of a diatom in balsam. Using a solution of phosphorus in bisulphide of carbon, the refractive index of which is 2·10, the difference is ·67, and the visibility of the diatoms is now more than six times as great as it was in the balsam.

Continuing his researches on this subject, and endeavouring to find the best media with high refractive indices, he has quite lately brought before the Society the utility of an aqueous fluid capable of being given the high refractive index of 1·68, viz., a solution of biniodide of mercury and iodide of potassium in distilled water. This more manageable and highly antiseptic medium appears likely to turn out to be of great use in the observation of many objects, as its strength can be diluted till the index of water is obtained. This is of advantage with such objects as muscular fibre, which are themselves of high refractive power, so that fluids of low refractive power must be made use of to obtain the required difference for more perfect visibility. The same communication also contains what was much wanted, detailed practical directions for mounting.

Anyone who has seen the diatoms and scales mounted in phosphorus by Mr. Stephenson's method, and exhibited at our meetings during the past and present sessions, cannot fail to have been struck by the great increase in their visibility as compared with those mounted in balsam, or to have recognised the fact, that the theoretical consideration by which their visibility was pronounced to be much increased was not unfounded.

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* Given at the meeting of the Balloon Society, on the 28th April, 1882.

[1] By Prof. P. MARTIN DUNCAN, M.B., Lond., F.R.S., &c. (Annual Meeting, 1882.)

In addition to the increase in visibility, there is also the fact that by means of such mounting fluids, the capacity of stereoscopic binoculars with the higher powers is considerably enhanced. True stereoscopic effect, as we have seen, requires a depth of vision not less than the thickness of the object under observation—a depth which, as already shown, increases in direct proportion with the increase in the refractive index (n) of the mounting fluid. If one object is in air when $n = 1{\cdot}0$, whilst another is in a solution of phosphorus, where $n = 2{\cdot}1$, the depth of vision will be more than doubled. Objects, therefore, that by reason of their thickness could only afford an unsatisfactory stereoscopic effect in air may be seen in full relief when mounted in phosphorus.

Here, again, the deductions of theory were remarkably verified by the recent exhibition of Surirella gemma, under the binocular, with a 1-25in. objective.

Relative Value of Objectives with Large and Small Apertures. ("All-Round Vision.")

I now come to a much-vexed question, that of the relative value, practically, of objectives of large and small apertures, in regard to which a great variety of opinions have been promulgated.

The oldest of these views was that which made the preference between the two kinds of objectives depend upon whether they were to be used for the "ordinary purposes of the biologist," or for the examination of diatoms or other lined objects. The objection to this view is, that it assumes the only function of a large aperture to be its resolving power, a much too-restricted notion, and one which deprives the working biologist of a most essential aid to his observations upon structure.

A more modern view errs in the opposite direction, and insists upon the universal superiority of large apertures, so that work done with small apertures will "have to be done over again."

There is again a third view, still more recently put forward, which goes much further than the preceding, and, according to which, it is impossible that wide apertures can give correct images. First on account of the unnatural "all-round vision" which it is extended is obtained with them, and secondly by reason of their supposed inherent defect in defining power, in consequence of the dissimilar images presented by the different parts of the enlarged area of the objective, with a confused image as the general resultant.

The want of exactness in the first two suggestions will sufficiently appear, when we have formulated the grounds upon which large apertures are shown to be indispensable for all observations upon minute structure for which high powers are necessary; but it will be desirable first to point out the erroneous interpretations upon which the third view (as to all-round vision and dissimilar images) has been founded, and for this purpose it will be necessary to refer to the paper by Dr. Royston-Pigott, F.R.S., in which the subject is dealt with.*

After reminding his readers that he had shown that spider-lines, miniatured down to the fourteenth part of the hundred-thousandth of an inch, were distinctly visible to ordinary good eyesight under proper microscopical manipulation (an experiment which, I may remark in passing, has not a satisfactory foundation), Dr. Pigott says:—"Under these circumstances it was interesting to know whether real objects could be detected by the microscope in the surprising degree of attenuation represented by the millionth." Minute particles of mercury were obtained by smashing some with a watch-spring, and they were mounted in petroleum under a thin cover. A vertical illuminator was used to converge rays downwards, through the objective, upon the preparation. In a darkened room minute discs become visible, and upon some of them clusters of minute black points were seen with a power of 1,000 diameters. Comparing them with a micrometer spider-line 1-10,000in. diameter, some of the points were found to be decidedly smaller. Under 1,000 diameters the particle was magnified one hundred times in the micrometric focus, and then appeared less than the spider-line. Its real diameter was therefore less than 1-100th of 1-10,000in., or less than the millionth of an inch, and the writer draws the conclusion that "real objects of unsuspected minuteness may be microscopically displayed as well as minute miniature images." To this part of Dr. Pigott's observations it may be pointed out that it has never been supposed, so far as I am aware, that there is any limit of visibility in the microscope other than that imposed by the sensibility of the observer's retina, the correction of the objective, and the illumination. The question of a limit of visibility is quite distinct from that of a limit of separation, just as in telescopic vision a single star is always visible, however small its visual angle, provided it is sufficiently bright, but a double-star requires a certain minimum aperture of the objective, dependent on the angular distance of both stars.

Discussing the variability of the blackness and thickness of the marginal annulus of refracting molecules, as exemplified in a glass spherule ·1in. diameter, and in the featherlets of the death's-head moth and plumelets of Hipparchus Janira with objectives of 20° Ang. Ap. power 200, and 140° Ang. Ap. power 800, he writes:—"If then the minute fibrillæ of the plume can be clearly distinguished as closely packed black lines at a visual angle of 20 seconds with a low aperture of 20°, this result is fatally opposed to the popular idea that very close lines, or very minute lines or bodies, can only be distinguished with large angular aperture. These lines were most sharply seen, though less than 1-80,000th inch thick." After noting the disappearance of distinctive shadows and consequent obliteration of structural molecules with excessive angular aperture, illustrating his meaning by the structure of Podura scales, with different stops and under very varying conditions, Dr. Pigott states that he has come to the conclusion that residuary aberration was not the only cause of the obstinate obscuration of minute crowded molecules in translucent organic forms, but that

"Excessive angular aperture, he found, attenuated margin . . . There is, it may be said, something unnatural in the mode of vision intrinsic to very high-angled glasses. It is undoubtedly true that such a glass presents an all-round vision. It really conveys visual rays from a given brilliant particle, at every inclination in azimuth and altitude, and this too at one and the same instant. To illustrate this position a minute die may be imagined the 1-100,000th inch broad. The highest angled objective really enables the observer to collect rays emanating from four sides and the top at the same instant. The human eye could at most view three sides at once. Doubtless the effect of this angular vision all round the corners, causes particles to look spherical, when sufficiently minute, even if cubical."

Now it is necessary to say plainly that this view is founded upon a fundamental error, "belonging," to use Professor Abbe's words, "to the venerable relics of the past *naïve* period of microscopical science, which was characterised by an unshaken conviction in the validity of the hypothesis that microscopical vision is in all essential respects the same thing as ordinary vision." The "all-round vision," by virtue of which we are supposed, when looking at a minute cube, to see at the same time the top and all the sides (with the result of rounding off the corners and angles!), does not really exist, as can be shown by the application of the simplest laws of geometrical image formation. The different obliquities of the rays in an objective of wide aperture cannot give rise to any all-round vision, for in the microscope there is no difference of perspective attendant upon oblique vision as with the naked eye. The difference of projection of successive layers which exists is ineffective, except in the case of binocular vision. This absence of perspective may be readily established by examining an object alternately by an axial and an oblique ray; it will be found that there is no shortening of the lines in the latter case, and no capacity in the microscope, therefore, for "all-round vision." Indeed, if this theory were correct, microscopical vision, even of plane objects and with very moderate apertures, would be entirely destroyed.

Equally mistaken is the second branch of the view which I am considering—viz., that a wide aperture must, in the nature of things, impair definition on account of the increase thereby produced in the dissimilar images received through the several parts of the objective. In support of this view, illustrations drawn from stereoscopic vision are adduced, which admittedly does depend upon the dissimilar images formed by the right and left-hand halves of the objective; but, as Professor Abbe has shown, the dissimilarity of images presented by an objective of wide aperture is a dissimilarity in the projection of successive layers only, and this is not effective unless we produce these images by different portions of the aperture separately and conduct them to different eyes, as in binocular microscopes. The sole effect of the wider aperture when the images are not so separated, is a reduction in the depth of vision—to confine us to the vision of thinner objects, not to impair the definition of what is seen when the objects are within the range of penetration.

If we pass to practical experience, we shall find that the principles which theory establishes are amply confirmed. All who have worked with wide-angled objectives cannot fail to have recognised the great fact of modern practical optics, the perfection of definition obtained with such glasses—a fact which has been verified by such authorities as Mr. Dallinger, who, so long ago as 1878, stated of a new ⅛in. homogeneous-immersion objective of the wide aperture of 1·25 that "the sharpness and brilliancy of the definition which this lens yields is absolutely unsurpassed in my experience."

The question of the power of resolution supposed to be possessed by small apertures can also be brought to a very simple practical test by those who believe in that view exhibiting here to the appreciative assemblage which they would have around them, say 75,000 lines to an inch resolved with the low apertures referred to!

We have seen that on the one hand the depth of vision decreases as the aperture is increased, and that on the other as the objects become smaller and smaller the similarity of their images increases with the increase in the aperture—the one representing a disadvantage attendant upon large aperture and the other an advantage—and bearing this in mind we are in a position to arrive at a correct view of the relative value of objectives with large and small apertures, which I take to be this:—

Both kinds of objectives are necessary for investigations into the structure of minute objects, and an observer, to be fully equipped, should provide himself with two objectives, one of moderate and one of wide aperture. The former would be used for the more general survey of the various parts of the object, and the latter for the subsequent examination of its minute structure. In searching, for instance, through a stratum of fluid for bacteria a wide aperture would be unnecessary, but when a particular bacterium is found, it is only that which will give us an accurate view of its flagellum.

But again, in the choice of the objectives, the proper relation between magnifying power and aperture must be maintained. For work with low powers it is useless to have large apertures. The structure of the objects for which such powers would be used is not sufficiently minute to require large apertures for their proper delineation, and we therefore expose ourselves to the disadvantage of very restricted penetration and the trouble of delicate manipulation, without any corresponding benefit.

On the other hand, it is equally useless to work with high powers (that is upon minute objects) with small apertures. We should have only an empty amplification—mere increase in the distance apart of the outlines, without any additional structure being made visible in consequence of the defect in aperture.

Whenever the subjects of our examination are so minute as to require high amplifications in order to be seen, then we must also have large apertures in order to obtain perfect delineation of the objects. Leaving now the theoretical questions, which, after all, have so important a bearing on our practical work, reference only need be made to the descriptions published in our Journal of new inventions in regard to mechanical and optical appliances (most of which have been exhibited at our meetings) to prove that great progress is being made in the designing, manufacture, and application of the microscope. Improved stands and eyepieces, new immersion lenses, stages, and swinging substages, more effective fine movements and elaborate accessory apparatus of all kinds, indicate not only the activity of mind and the abundance of the resources of the microscopical optician, but that these things are really required in a progressive science.

It is to be hoped that the possession of excellent instruments and convenient apparatus will incite many of the Fellows to undertake more careful researches into the minute details of organic nature, or amongst the very fascinating rocks which are being so beautifully cut and mounted by petrologists. It is true that the difficulty of getting upon a path of original research is very deterrent. The activity of Continental and American microscopists is indeed great, and it is always necessary, before committing one's-self to any statement, to search and prove its originality. Much microscopical research is quite beyond the powers of the man who has other avocations, and to whom the instrument is a pleasing, and none the less important, toy. Consider the paraphernalia required to study the microscopy of the details of a minute animal. It has to be put into hardening and water-absorbing solutions, then to be cut with microtomes, perhaps frozen in the first instance, then to be put into other solutions to be cleared and to have its fat got rid of, and then it has to be coloured once, twice, or thrice, and possibly to have some colour discharged. Finally, it has to be mounted in a medium. It is necessarily somewhat deterrent for a modest microscopist to read the excessively pronounced opinions of manipulators about the nature of the structure they discover in such complicated and altered organic matter, and to find that very contradictory opinions are published by different investigators about the nature of identical structures which have been differently prepared. It appears to many an amateur, who happens to investigate structures by disturbing their natural condition as little as possible, that he is, as it were, out of the field. He may find it necessary, even in examining the simplest section, to pay especial care to the illumination and centring, and to the application of particular powers. He is, of course, conscious of inferiority, when he knows that somebody merely puts a chemically-treated specimen under an objective without the least care about optics, and finds out, or thinks he finds out, the truth. But there are numerous opportunities for original research still to be met with in the structure of many of the commonest invertebrates and plants. The study of rocks is in its infancy, and there are many very interesting physical questions yet to be determined, and which can only be settled microscopically. Recondite manipulation is not much required in any of these researches, but rather a good knowledge of how to use the microscope as an instrument.

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*Proc. Roy. Soc., xxxi. (1881) pp. 260-78.

SCIENTIFIC NEWS.

COMET *a*, as will be seen elsewhere, has been picked up by several observers. The absence of moonlight now and next week will probably render the comet a more brilliant object. According to Dr. Kreutz, its position for Berlin midnight on May 12 will be R.A. 14m. 24s., N.P.D. 15° 33′; on May 13, R.A. 38m. 56s., N.P.D. 15° 53′. It is in the constellation Cepheus, above the horizon at considerable altitude all night, but it will scarcely be observable without a telescope until the end of the month. The position for Greenwich midnight on May 12 will be R.A. 16m. 22s., N. Dec. 74° 26′. Dr. Kreutz, M. Bigourdan, and Mr. Hind, all assign June 10 as the date of perihelion passage.

The death of Prof. Zöllner, the famous Leipsic physicist, is announced. He was only forty-eight.

The following candidates have been selected by the Council of the Royal Society, and will be elected on June 8th:—Prof. V. Ball, Dr. G. S. Brady, Dr. G. Buchanan, C. B. Clarke, Francis Darwin, Prof. W. Dittmar, Dr. W. H. Gaskell, R. T. Glazebrook, F. Ducane Godman, J. Hutchinson, Prof. A. Liversidge, Prof. J. Malet, W. D. Niven, R. H. Inglis Palgrave, and W. Weldon.

Amongst the papers to be read at the meeting of the Iron and Steel Institute, held on the 10th, 11th, and 12th inst., may be noted that of Mr. E. Richards on "Certain Physical Properties of Iron and Steel," that of Mr. W. Annable on "The Compression of Fluid Steel," that of Mr. Snelus on "The Chemical Composition and Testing of Steel Rails," and that of Mr. Jeans on "The Consumption and Economy of Fuel in Iron and Steel Manufacture."

At the last meeting of the Shorthand Society Mr. J. G. Petrie read a paper on "Reporting and Transcribing Machines." The Danish, Bartholomew, and Michela machines, and their capabilities, were minutely explained. The last-named machine is in use in the Italian Senate, but Mr. Petrie showed, by a careful analysis of the results, that what was attributed to it was mainly due to its work being checked by a large staff of reporters and revisers, while the reports, before appearing in print, are corrected by the speakers themselves. He did not believe that any of the existing machines could do better work than could be done with the old note-book and pen or pencil; at the same time he advocated, from actual experience, the use of the type-writer for the transcription of notes, as it not only got out the "copy" more expeditiously and legibly, but also afforded a salutary change from the drudgery of the pen.

Amongst the most interesting models shown at the Shipwrights' Exhibition is a half-model of a steel twin-screw steamship, designed for the Transatlantic trade by A. McMillan and Son. The length of this vessel is 600ft., breadth 70ft., and the gross tonnage is calculated to be 10,000 tons. The engines will represent an indicated power of 20,000 horses, and the estimated speed is 20 knots, or 23 miles an hour.

The *Stirling Castle* has frequently made 18½ knots on her voyage out to China, and ran from Hong Kong to Shangai in fifty hours, at an average of 17·4 knots. The maximum speed was 19 knots, but the average was reduced by the necessity for slowing and stopping in the river.

The *Alaska* made her last voyage from New York to Queenstown in 7 days 53 minutes, thus eclipsing her own performances, which were the previous quickest passages.

The buildings erected to accommodate the biological students working with Dr. Michael Foster and Mr. F. M. Balfour at Cambridge, are so crowded that a new floor is to be added to the central portion of the new museums. The system now practised is for the students to go through the laboratory work immediately after each lecture.

Prof. H. A. Nicholson has been appointed to the chair of Natural History in Aberdeen, vacant by the removal of Prof. Cossar Ewart to Edinburgh.

The Friday evening discourse during the meeting of the British Association will be delivered by Prof. H. N. Moseley, on "Pelagic Life."

The reports relative to the Exhibition of Gas, Electricity, &c., held under the auspices of the Glasgow Philosophical Society, have been published. They refer, amongst other things, to trials of gas-meters, gas-engines, hot-air engines, &c., which should prove of some value. The engine trials are accompanied by plates of indicator diagrams.

The shareholders in Mr. Keeley's "motor" have obtained judgment in the courts in the shape of an order to Mr. Keeley to disclose the secret of the principle of the machine to them. Keeley refuses to comply with the order, and unless he is frightened by the threat to commit for contempt, the shareholders will probably not even obtain a bit of the "secret" for their money—over a hundred thousand dollars.

On Friday next the Surrey Scientific and Literary Society will hold their last meeting of the session 1881-82 at the Gauden Hotel, Gauden-road (next to Clapham-road Station, L.C. and D R.). The subject for discussion is "The Physical Constitution of the Moon," and will be opened by Mr. H. Sadler, F.R.A.S. Any readers of the English Mechanic who may wish to attend, must apply for admission-cards to Mr. John Weale, hon. sec., 15, The Grove, Clapham-common, S.W.

The question of the vital resistance of trichinæ in salt pork has lately engaged some attention in France. After sundry experiments, M. Colin expressed the opinion that American salt pork, under the present conditions of sending and delays occurred, does not seem apt to transmit trichinosis, though consumed raw or after imperfect cooking. Still, in very recent pieces, or in large pieces badly impregnated, there might remain some live trichinæ; the danger he regarded as slight, but as requiring some care. M. Fourment lately made the following observation: A piece of American pork in Havre, found to contain cysts of trichinæ, was put in fine salt in a vessel which was then kept hermetically closed for a year; add to this the time elapsing from its original preparation, and we have about fifteen months of salting. Now, M. Fourment took small pieces of this lard, and after soaking them some time in water, gave them to mice. The animals fell ill and died, and trichinæ of both sexes were found in their intestines. Thus, in salt meat at least fifteen months old, these parasites may continue alive and capable of development.

The piano manufacturer in Stettin, M. René, who a short time ago improved the durability of pianos for tropical regions, by preparing the wood with ozone, has lately devised a "cell resonance arrangement" for pianos, which is said to be highly appreciated. Inferior pianos acquire thereby the fulness and strength of a grand. In place of the usual sounding-board, M. René uses a sound-chest, over which the strings are stretched, and which, like the resounding body in many-stringed instruments, consists of two arched resonance-plates; the vibration of the upper are communicated to the lower through bell-mouths. The two plates are bordered with hollow walls; the bell-mouths stand on a bridge on the lower plate, and are firmly pressed against the upper plate. The sound-tubes are further connected by a membrane and small resonance rods with the upper plate. We may here note a recent new application of electricity, in the electrical piano of Boudet. An ordinary instrument is provided with two sets of hammers. The upper, electrical series comes into action when certain keys are pressed, and the corresponding hammers go on striking the wire at a quick rate, so long as pressure continues, giving an organ-like effect.

A large development of the wood-carving industry has taken place in New York within the last ten years. Nearly six hundred carvers are now at work for two firms, and as many as a thousand accomplished artists find employment in the city, mostly on interior decoration of houses. A rapid immigration of skilled carvers from Europe has reduced the wages; but the average pay of good carvers is still from four to five dollars a day, and the very finest workmen, especially those possessing some secret processes of doing difficult work, earn as much as eight dollars a day (such a process is that of ebonising cherry-wood). Machinery is now used to cut away the rough parts of a piece of carving; a tool driven by steam-power cuts out the wood wherever it goes, and thus a skilful man blocks out in a rough way as much work a day as twenty men could have done formerly.

A remarkable magnetic storm has been lately experienced. M. Mascart has described to the French Academy its effects as observed at the Collége de France. Indications of its approach began about April 6th, but its beginning may be dated at 11.15 p.m. on the 13th. A great shock occurred in the night of the 16th, affecting all the three magnetic elements, and the needle being much agitated from 11.45 till midnight (an oscillation of 25′ was observed). A similar shock on the 20th; after which the storm gradually abated and disappeared.

It has been proved that caoutchouc is highly absorbent of certain gases, especially the light-yielding constituents of coal-gas. In a recent note to the Berlin Chemical Society, Herr Hempel shows, from experiments, that its absorption of carbonic acid and nitrous oxide, though small, is such as to forbid its use in some very exact gas analyses. The absorbent power may be shown to an audience by connecting a carbonic-acid generator, or nitrous oxide gasometer, by means of a long caoutchouc tube with a glass tube, which is inserted in coloured water. All air having been driven out by a strong current of the gas, and the admission of gas stopped, the coloured liquid gradually rises in the tube, indicating gas absorption. Herr Hempel says that caoutchouc stoppers, tubes, &c., which still retain full elasticity, may be kept long from deterioration if placed in a glass case (hermetically sealed) along with an open vessel of ordinary petroleum. Keeping in wooden boxes is bad; so is exposure to light. Old stoppers that have become hard may be softened very quickly by placing in a vessel with sulphide of carbon vapour. In course of time this action proves too strong, and the caoutchouc should be likewise brought into petroleum vapour.

In a recent lecture in Berlin, Dr. Werner Siemens expressed a wish that in all technical schools in Germany, chairs of "Electrotechnik" might be instituted for instruction of youth in electricity and its applications. This has now been realised in the Technical High School at Stuttgart. One term will be devoted to theoretical principles, the most important measuring instruments and measurement, electrolysis, illumination, and transmission of force, and a second to telegraphy (including railway signalling and telephone matters.) Practical exercises will follow up the lectures. In 1876 a professor of telegraphy was appointed in the Dresden Polytechnikum.

A regular telephone system has been arranged between the Brussels Observatory and the meteorological station at Ostende (about 78 miles), after highly successful experiments with the Rysselberghe improved telephone.

The background of the eye is known to be red; yet no effect of this red colour on sight seems to have been formerly noted. An observation bearing on this has been recently made by Signor Emery. While driving through the streets, and reading a paper, the sun's rays illuminating the sheet directly, he observed the letters to have a fiery red look, the sheet appearing white. When reading the paper under diffuse light, some solar rays came obliquely into one eye, and thereupon the letters appeared red, whereas they looked black each time he shaded his eye against sunlight with his hand or the border of his hat. He supposes that the strongly-illuminated background of the eye affects inductively with its red colour the parts of the retina receiving the image of the dark letters. He records some laboratory experiments in support of this explanation.

The absorption of volatile matters is a problem which is still imperfectly solved; the industrial means employed are often inadequate. According to M. Schlœsing, the main difficulty is with the volatile matters which are in the form of powders (solid or liquid) suspended in a gaseous medium, and are without that proper mobility by virtue of which gases are absorbed by reagents. He therefore recommends the simple plan of bringing them through heat to the gaseous state, which they have lost by cooling; or, better, to prevent the cooling. He gives several instances, one being the case of an air-current charged with liquid dust of sulphuric acid, and sent into a tube filled with fragments of marine salt. So long as the tube is cold, it yields a mixture of fumes of sulphuric and hydrochloric acid; but if heated to 350°, fumes of the latter acid alone are given out. The sulphuric acid is caused to take the gaseous state, and is precipitated on the salt. M. Schlœsing proposes to apply the principle to determination of the nitric acid in the atmosphere, proved to exist there only in combination with ammonia, as a very fine powder, which would be transformed into vapour about 100°. Thus one has only, further, to find a good absorbent.

It has been recently observed by M. de Chardonnet that a plate of rock crystal, silvered so that it is opaque, forms a kind of filter, which is permeable only by the dark rays of the ultra-violet, and may be used for photography without intervention of a single ray of visible light. Very white crown glass, or even the thin glass of St. Gobain, will do instead of the rock salt; some of the most refrangible rays are lost, but this is largely compensated by the extent of the surfaces of admission. The time of exposure is doubled in this mode of impression (it can hardly be called photography), effected in complete darkness.

Like the ports of Havre and Marseilles, that of Bordeaux has been lately provided with elevator-boats (*bateaux-elevateurs*) for discharging grain-laden vessels mechanically. These machines have undergone an important modification. The steam-motor is replaced by an electric one; thus the elevators can be used for discharge of grain by day, but at night they are transformed into electric lighthouses, giving several bright centres, which illuminate the port like daylight. These movable lighthouses will serve in nautical fêtes during the exhibition soon to be held at Bordeaux.

USEFUL AND SCIENTIFIC NOTES.

The Internal Heat of the Earth.—Apropos of some statements as to the heat experienced in the deep workings of the Adalbert silver mine in Bohemia, which has now reached a depth of 1,128 yards, Prof. Höfer, who resides near, says that "at the greatest depth—some 1,000 metres below the surface of the earth—the heat is anything but excessive, the temperature of the rock being 24·4° C.—75·9° Fahr.—and the temperature of the atmosphere 24·6° C.—76·3° Fahr.—so that the natural means of ventilation heretofore employed fully suffice for all purposes."

THE Government have resolved to co-operate with the other nations in establishing a chain of circumpolar magnetical and meteorological observatories. The locality selected for a British station is Fort Rae, in the north of Canada, and the general superintendence of the work will be intrusted to a committee of the Royal Society, the Royal Geographical Society being asked to co-operate as far as regards the promotion of their special studies. The *personnel* of the expedition has not yet been selected. The Swedes have chosen Wyde Bay, in West Spitzbergen, for the site of their station, which will be manned by thirteen attendants, and is established at the cost of Mr. L. O. Smith, a merchant, who has placed £3,333, or 60,000 crowns, at the disposal of the Academy of Science for the purpose.

THE largest increase in the make of steel ingots and rails in 1881 appears in the Cleveland district, where 264,986 tons of ingots were obtained with fourteen converters, being an advance of 120,986 tons on the production of the preceding year. Of these fourteen converters, four were working for only a part of the year, and two for only a few months.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

COMET, 1882, *a* (WELLS).

[20012.]—I HAD an exceedingly fine view of this comet last night, which is getting a brilliant telescopic object.

The tail (which appeared in the finder about 100′ long) was decidedly brighter and better defined on the side preceding the comet's motion, and also looked broader near the head, as if double. The nucleus was very small and stellar with the power used (about 120), and there seemed to be some detail as of a jet of light from it towards the sun, but this was not certainly made out. The telescope used was my new dialyte of 10in. aperture.

Herbert Ingall.

Champion-hill, S.E., May 8.

[20013.]—ON several occasions I have had the satisfaction of viewing this comet by means of my 8½in. silver-on-glass reflector, the first time being on April 20th. It does not seem to me to be increasing in brilliancy so much as I expected, seeing that it is, according to some accounts, to be so bright as to be seen during daylight. Judging from what I have seen of it, I am much afraid we shall be disappointed in this. I last saw it on Saturday evening at about 10.30, and to me it did not appear very much brighter than it did on April 20th. A small bright star could plainly be seen shining through the tail a little behind the nucleus. The field of my eyepiece would cover about 38 minutes; power 100. The comet was between 79 Draco and 16 Cepheus.

Berwick-on-Tweed. **L. J. Fleming.**

[20014.]—I HAD a very good view of the comet on Sunday night at 11 o'clock, through my equatorial; the head is large, tail wide, nucleus not very bright, the whole a nebulous-looking body. It is now just visible to the unassisted eye 14° below the Polar star to the right. R.A. 22·40h., D.N. 76·30°. **C. A. Bowdler.**

South Lambeth-road, May 9.

JUPITER'S RED SPOT.

[20015.]—ON the evening of May 3rd (only 27 days before the conjunction of Jupiter with the sun), I observed the preceding end of the great red spot on the planet's central meridian at 6h. 59m. Clouds came up before I could note the later phases of the transit, and also prevented my observing the white spot, which I had computed would be nearly central at 8h. 15m. Definition was very bad, the planet being low and much in the glare of sunlight.

This is the last observation which it will be possible to make before the reappearance of Jupiter, as a morning star next July.

Bristol, May 5th. **W. F. Denning.**

LEGAL REPLIES.

[20016.]—INHABITED HOUSE DUTY (46810).—I do not think "Landlord" would be liable to pay this duty in the case put, as the value of the house would be below £20 a year; but if he is so charged, he must appeal against the assessment; this being the only way of settling the question.

CLAUSE IN A WILL (46821).—The legacies to the eight children of the brothers became "vested," as we say, at the time of the testator's death, although the payment of them was postponed during the lifetime of the cousins. This being so, the increase in value of the shares in which the £500 was invested would become part of that corpus, and would, therefore, be added to the whole, and thus to each share as it fell in, and could not belong to the residuary legatees.

(46839).—The promise made by D., the father, seems to have been merely verbal, and without consideration, so that I do not see how it could be held binding upon him, and still less upon his son. But there may be some way of proceeding against E. in equity as a trustee who has received property out of which debt should be paid; but for this I must know the case more fully. Of course, A., the original debtor, remains liable, &c., to be sued, even in America.

Fred. Wetherfield, Solicitor.

2, Gresham-buildings, Guildhall.

MEDICAL REPLIES.

[20017.]—SICK CHILD (47762).—Unless this child is suffering from rheumatism in the elbow-joint, it has disease of the bones of the elbow-joint. For this adopt the general regimen described last week under the head "Scrofula." Local treatment needs a splint, on which the arm can be fixed so as to give perfect rest to the joint; and compound mercurial ointment, spread upon lint, should be applied so as to cover up the whole joint, and bound on either by strips of adhesive plaster casing it in, or by a narrow flannel bandage. The dressing should be renewed once a week, and the joint will want care for many months. Cod-liver oil may be given as freely as the child can digest it, and general medical treatment will be required. If the parents can afford it, consult an able medical man in the neighbourhood. **James Edmunds, M.D.**

Grafton-street, Bond-street.

THE BARLOW LENS.

[20018.]—As some difference of opinion evidently exists as to the use, form, and position of the Barlow lens, perhaps the following may be of use to our readers:—The Barlow lens is an achromatised negative or concave lens, placed *within* the converging rays of an o.g., not so far as to cut off any of the cone, but far enough to give due effect to the diverging rays produced by its own form. Four inches from the field-lens of e.p. is a good position for the usual forms supplied by the trade. A simple diagram, however, will show how far towards the o.g. it may be placed. It is important to remember that the nearer the o.g. the greater the increase of power. The Barlow lens, then, is an adjunct to the e.p., producing an increase of magnifying power without necessitating a corresponding increase of tube length. In the forms I have made (some hundreds) I have thought the best position was with the *concave* side to the eye. However, I see that one of our able contributors advises the reverse of this. As this gentleman is a user, possibly, he may correct me, and I shall be glad to alter my mode, for those who *use* are able to give valuable hints to those who *make*. Another able and versatile contributor adopts the same plan as myself; but, and I must confess myself beaten, he makes the crown-lens convex and the flint concave. Now, the old formula for an o.g. *reversed*—viz., 5 flint positive, and 3 crown negative—is the data from which the original lens was computed, the figures for curvature coming out with the rather denser flint used now. Thus: First surface flat; second surface convex; flint = 1. Third surface, concave, 1; fourth surface, concave, 1; crown. So that the combination is a plano-concave with contact curves, and is usually cemented to prevent loss of light by reflection as much as possible.

As many possessors of old-fashioned telescopes are debarred the use of that pain-saving appliance, the zenith e.p., on account of the old tubes being too short for their adaptation, I will suggest to them the addition of a tube to carry a Barlow lens attached to the zenith diagonal. This will, in many instances, lengthen the focus sufficiently to allow of the zenith e.p. being used without the expensive and often destructive cutting away of the eyepiece end of the instrument.

Prismatique.

TO "ORDERIC VITAL."

[20019.]—As I regard the method of figuring mirrors by diaphragms, I have no preference for either of the ratios you name.

G. Calver.

MICROSCOPY.

[20020.]—THERE must be many readers sorry that this subject is so little treated of. My purpose in writing at present is to call the attention of beginners to a very interesting and easy method of examining the circulation of blood in a tadpole's tail, and as the season for these animals is nearly over, those who wish to try it should do so at once. All that is required is to take a hollow slide, or make a little trough by converting four little strips of glass on one of the 3in. by 1in. slips, so as to make a shallow cell of such a size as will contain a tadpole covered with water. After placing the tadpole on its side in the cell, and covering with water, drop a small quantity of chloroform over its head. Let the quantity of chloroform be very small, and rather add to it if after a few seconds the tadpole is not quieted. In this method there is no pain to the tadpole, nor risk of bruising it as when it is put under pressure, and should too much chloroform have been given, it could not die in an easier way.

The tail ought to be examined carefully for the best part, and with a little search a place may be found where both a vein and an artery are in the field at one time, showing in the artery the regular pulsation, and in the vein the steady flow of blood, the pulsation being lost in the capillaries.

Volvox.

WENHAM'S NEW MICROSCOPE.

[20021.]—There is one point in connection with "Wenham's new microscope," which was entirely omitted in the description given of the instrument when exhibited at the Royal Microscopical Society; when recently described and illustrated in the English Mechanic; and now, again, when reviewed and criticised by "F.R.M.S." The point omitted is as to the source of the inspiration from which Mr. Wenham drew his design—a source which is upon record beyond the possibility of cavil or doubt, and is proved as follows:—

On Nov. 10, 1880, at the Royal Microscopical Society, Dr. W. B. Carpenter exhibited and fully described a small rough stand made for students' purposes by Mr. George Wale, and the record of the proceedings of that meeting will be found in the *Journal* of the Royal Microscopical Society for 1880, p. 1087. From that published record I extract the following paragraph:—

"Dr. Edmunds pointed out that this most useful microscope-stand would be vastly improved if only the arc upon which the body turns were so constructed that the centre of the circle of which the arc forms part, were made to coincide in position with the centre of the stage. The object would then undergo no movement of translation, either in rotating the stage or in turning the optical tube from the vertical to the horizontal. In rotating the stage, the object would turn upon the optic axis; in moving the tube into various degrees of obliquity from 0° to 90°, the object would rotate upon its horizontal axis. The result would be that, with a thin stage and a hemispherical lens in immersion contact with the under surface of the slide, all the complicated swinging substages, and other contrivances now upon the table might be swept away, and every angle of illumination could be got by merely inclining the body of the microscope upon its sustaining arc. There would only be needed a lamp on a level with the object, with a condenser at its focal distance standing upon the table in line between the lamp and the object."

If any further explanation of the description here given by Dr. Edmunds be needed, reference to p. 1046 of the same number of the *R. M. Journal* will show a woodcut of Mr. Wale's microscope then under discussion. But Dr. Edmunds' description is so lucid that there can be no question as to his priority of design in regard to the great new principle of microscopic construction, which "F.R.M.S." now tells us, that "Mr. Wenham has grasped," and about which in his last paragraph ("E. M.," page 195) he describes Mr. Wenham as "the inventor of the new microscope." The microscope made by Watson and devised by Mr. Moss, and published a few months since in the English Mechanic, is merely an earlier stand constructed to embody Dr. Edmunds' principle.

Rights of priority are decided by the date of publication, and on that ground only the merit of this important principle of construction is plainly due to Dr. Edmunds, and to him alone. But it can be evidenced that in thus indicating how Mr. Wale's microscope might be so easily transformed in principle, Dr. Edmunds did not contribute to the discussion a mere casual idea suggested by Mr. Wale's microscope. Dr. Edmunds had already thought out and planned a microscope-stand upon the principle of *making the object a central point undergoing no movement of translation, and of arranging the microscope to move about this point as a general centre.* And the drawings of that microscope made in 1878-9 by Dr. Edmunds show a stand far superior in simplicity and efficiency to either of those constructed by Mr. Watson or Mr. Wenham. But the question of priority of title does not turn upon ideas described in a private cabinet or elsewhere than in a scientific journal, and no more need be said on the matter.

The engraving of Watson's stand appeared in the *Journal* of the Royal Microscopical Society for June, 1881, more than six months after its principle had been enunciated by Dr. Edmunds. The engraving of Wenham's stand appeared in the *Journal* of the Royal Microscopical Society for April, 1882, about eighteen months afterwards. On comparing the engravings of the stands of Wale, Watson, and Wenham, their progressive genesis will be understood. Wale's arc had no relation to the object aimed at by Dr. Edmunds, but was transformable, so as to subserve that object roughly and imperfectly for a student's microscope. Watson's stand embodied Dr. Edmunds' principle ambitiously; but by making the horizontal axis of the object turn upon a lateral pivot instead of a meridian arc, Wenham transformed the Wale sliding arc upon the principle suggested by Dr. Edmunds, and baptised the transformed arc as a "sector," so as to shelve Mr. Wale altogether. The beautiful workmanship of Ross and Co., notwithstanding the "sector," proved a rickety and unmanageable contrivance, and, in order to get fairly good results out of "Wenham's new stand," he had to adopt a second cross motion in altitude consisting of Watson's lateral pivot.

Into the criticisms by "F.R.M.S.," upon the fine adjustment and other points I do not now enter, but when "F.R.M.S." says that a thoroughly efficient fine adjustment is a problem still unsolved, he shows that he is not familiar with the beautiful and perfectly efficient and durable fine adjustment upon Powell and Lealand's best stand—a fine adjustment which every critic knows to be first, and the rest nowhere. But the beautiful hand-fitting of Powell and Lealand's work cannot be multiplied indefinitely, and what we want is an equally good fine adjustment that is more generally applicable.

The design by means of which Mr. Wenham has carried out Dr. Edmunds's principle of construction is more fit for a furniture microscope than for scientific work. Its machinery is burdened with useless and rickety complications, and anyone understanding the geometry of the sphere as utilised by Dr. Edmunds for this principle of construction, will at once see that with the object centred upon a revolving stage, and *one* movement in altitude, all possible illuminations are at command. The duplication of the movement in altitude confers upon "Wenham's new microscope" an original feature, and adds, possibly, to its value for exhibition in a chemist's shop-window. But, otherwise, it entails only expense and instability.

Another F.R.M.S.

PROPERTIES OF LENSES, &c.

[20022.]—I am unable to give a definite reply to the queries of your correspondent "Lens," and must, therefore, refer him to "F.R.A.S.," or some other reader, competent to deal with such matters in a satisfactory way. I have endeavoured to answer such of his questions as seemed to fall in my line, and am glad if my two letters have been of service to him. Undoubtedly, the size of the focal image of a fixed star will vary with the quality of the instrument. I remember reading somewhere of Andrew Ross saying: "The more perfect the telescope, the less will be the size of the stellar image"—a remark which drew forth the observation, "Then in the most perfect telescope there will be no star at all." But, putting jokes aside, there is, I presume, a definite formula giving the magnitude of image due to a certain focus and aperture. What this is I shall be glad if "F. R. A. S." or Dr. Edmunds will tell us. Airy's book "On the Undulatory Theory" will, no doubt, go fully into such matters, but I and many others have not had the advantage of reading this masterly treatise.

With regard to the rider extracted by "E. C. A." from the "Cambridge Mathematical Tripos for 1881," there is no difficulty in the proof. It is not likely to interest very many; however, I send it. Let us put the literal rule into an algebraic form: R and F being the radius and focus of the large or "concave" mirror, r and f those of the smaller or "convex," and x their distance apart; then the rule says that $\sqrt{R^2 + 4r^2} + R - 2r = 4x$. To prove this, draw Fig. 1, representing the path of the rays. A ray, AB, parallel to the axis, striking the large mirror at B, is reflected so as to cut the axial ray in E, whose distance, DE, is half the radius DH, or the focal length F (= DE) is the half of R. Now, instead of the ray being allowed to cut the axis, it is intercepted at C by the convex mirror and reflected to the point D. Hence, the points D and E are conjugate foci of the mirror CF. Now, if GF be the radius of the small mirror, the distances DF, FE, and FG are connected by the relation 2 . EF . FD / (FD − FE) = FG. Or, putting the proper algebraical values [$EF = (R/2 - x)$, $FD = x$ and $FG = r$], we have $2x(R - 2x) / 4x - R = r$. Or $4x^2 - 2x(R - 2r) = Rr$. I shall not occupy space with the solution of this quadratic equation; but if any reader works it out, the answer will come out, $4x = (R - 2r) \pm \sqrt{R^2 + 4r^2}$, which is that required.

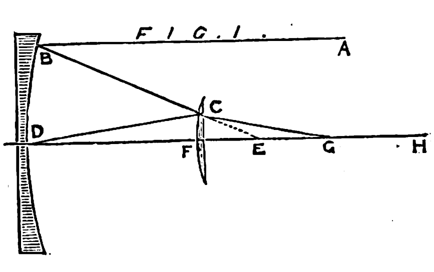


FIG. 1.

I fancy this would be more convenient if put in the following way, and though it is not so accurate, yet it will give the distance approximately, which is all the best rule can do:—Extracting the root of the second quantity to two terms only, it gives $R + 2r^2 / R$. Hence, the whole value is $2R - 2r(1 - r/R)$; or, dividing by 4, we have $x = R/2 - r/2(1 - r/R)$. Now, the semi-radii are the principal focal lengths of each of the mirrors, so that we may put $x = F - f(1 - f/F)$, or $(F - f) + f^2 / F$: or, the distance of the mirrors apart must equal the difference of their foci, increased by a quantity obtained by squaring the lesser focal length and dividing it by the greater.

In the Gregorian form, I find the distance apart should be the sum of the foci, diminished by eight times the square of the shorter focus divided by the longer.

Such rules for both instrruments can only furnish a rough guide for placing the small speculum; for it is assumed that the image is formed at the vertex of the large mirror, which, I need scarcely say, is not the case.

In response to Mr. Brashear's kind notice of my letters, may I be allowed to say that it is a source of much pleasure to me to find that my contributions are of some slight service to "our" Transatlantic friends; and to assure Mr. Brashear that I, and I am sure very many others, eagerly peruse his characteristic and instructive letters, and trust that he will favour us with his account of the practice of the famous American opticians, as soon as convenient. With his well-known success in extending the circulation of the English Mechanic, I hope he will be able to persuade Dr. Hastings to contribute to these columns. **Orderic Vital.**

THE NEW TELEPHONE RECEIVER—SMALL DYNAMO MACHINES.

[20023.]—According to your correspondent in last number, I am singularly unfortunate in my telephonic invention, as it had been previously publicly described. Will he please inform me where it is mentioned that the spiral was surrounded by three bobbins of insulated wire for the purpose of magnetising it, and receiving the inducted or microphone current? I think he is unfortunate, as his first letter does not mention anything about it, and his second letter is almost a repetition of the first, with the exception of the latter paragraph; and all they could do with it was to receive whistling and singing, which any simple receiver would do. The surrounding of the spiral with coils for the purpose as described above, is just as essential as a magnet is to the Bell telephone; and I beg to inform him that I never saw any account where the spiral was used before.

How much more unfortunate must be the patentee of this receiver?

To show how it is possible to make a small dynamo machine, I have made one which only weighs 6lb. 14oz. There is action and reaction; it will charge an electro-magnet, &c., quite as well, in proportion, as a large one. Will send more particulars later on.

George Tolman.

A SIMPLE BAROMETER.

[20024.]—The following is a description of a very simple and inexpensive barometer. Whether anything resembling this has ever been described before I cannot tell; but I have consulted all the books on Physics which I possess, and none of them contain any mention of it.

Take a glass tube about 7in. long, and about ⅜in. internal diameter, and draw out one end before the blowpipe to a point, leaving a very small orifice about 1-100 to 1-60 of an inch diameter. This end of the tube should not be quite sharp, but somewhat rounded, as in Fig. 1. A cork is prepared to fit tightly the wide end of the tube, and if the cork is made of *cork*, its sides and upper end should be greased or coated with paraffin, the lower end being left uncoated. A rubber cork would answer better. The tube should now be filled with distilled water, to the height indicated by the line (although the exact height is of no consequence), and the cork firmly inserted. The tube should be suspended with the point downwards near the window, and it should never be shaken. When the barometric pressure is low, indicating rain, a drop of water will appear at the orifice, and hang to the lower end of the tube. When the barometric pressure rises, the drop will disappear, and a bubble of air may sometimes be seen in the act of entering by the narrow opening. If more than one drop is extruded, of course they will fall, but one drop will always remain suspended. I have had a tube of this description hanging in my laboratory for two years, and I find its indications for rain and dry weather most unerring. The only error arises from extremely sudden rise of temperature, which will sometimes force a drop of water out by expansion, although the barometric pressure is high; but in that case the drop soon dries up: in the other case it hangs persistently, and will in many instances indicate the approach of rain thirty hours before the appearance of the storm. Before rain the drop does not dry up, because then the atmosphere is saturated with moisture. The sensitiveness of this weather-glass depends upon the difference of tension between the surrounding atmosphere and the air within the tube, the latter expanding or contracting according as the barometric pressure is low or high. Fig. 2 is simply a modification in which a glass phial is used with a perforated cork, through which passes a short piece of glass tubing with a narrow orifice at the lower end.

FIG. 1.

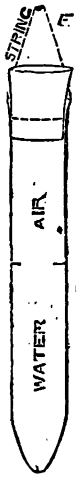
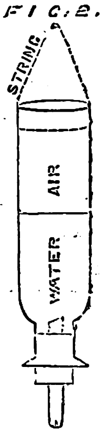


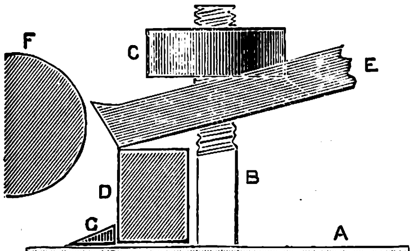
FIG. 2.



George Hay, M.D. Analytical Chemist.
Analytical Laboratory, 45, South Diamond-street,
Allegheny City, Pa., U.S., April 17th.

A MAKESHIFT.

[20025.]—THE accompanying sketch represents a rough and ready device, which being original (if anything is such under the sun), I venture to describe in the hope that it may prove of some use to beginners in turning, and who do not possess that amateur's delight, a slide-rest. I am myself a veriest tyro, the device being sufficient proof thereof. A is a piece of iron, say 4in. by 1½ by ¼, a hole through centre receives a ⅜ screw bolt 3in. long; B should be a tight fit in hole. This, with the requisite nut C, is the whole affair. Now, for its application as represented—D is cross section of arm of T-rest, E turning-tool, F the work. Now let the handle of tool be firmly pressed *upward* with one hand while the device is held in position with the other, so as to jam the tool as it were between D and C, when I think many a first attempt to turn a piece of metal in a common lathe will result in encouragement instead of despair. Note—the nut C should be a loose fit so as to be easily adjusted, all being in position and without disturbance by a touch of the thumb of the hand holding the device. A stop, as at G, may perhaps give a steadier hold, but I have not found it necessary, more adjustability being possible without it.



C. O.

LATHE MATTERS.

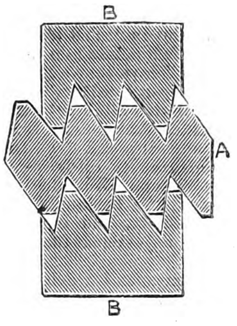
[20026.]—IT would seem, from recent correspondence, that others concur in my opinion respecting the value of a list of dimensions of lathe parts. May I reiterate my request to Mr. Evans to furnish a table of the dimensions of the apparatus he has so ably described. Now that we are to have a series of articles on pattern-making, such a table will be all the more valuable.

I should like to hear more about the lathe with slide-rest in front of the bed. Can Mr. Storey or others furnish further particulars.

Orderic Vital.

ORNAMENTAL SLIDE-REST.

[20027.]—As "M. A.," letter 19980, still does not seem to understand the principle on which the divided nut of my slide-rest acts, I give an exaggerated section of the nut and screw—A is the screw and B B the nut: the small triangular spaces left unshaded give room for tightening, and are formed by first cutting both screw and nut full and sharp, and then taking off the tops of the thread in both. I think anyone can see how the threads wedge into each other on drawing the halves of the nut together. In practice, the top of thread of steel screw should be rounded off so as not to cut a step in the thread of nut, which would prevent the wedge action, and both should be cut deeper and coarser than a Whitworth screw of same diameter. With regard to the query I asked "M.A.," of course I knew perfectly well that practically the dilemma of tapping the holes in the halves of the nut was easily explained and got over; I only asked it to show him how my not having fully gone into the minutiæ of fitting my nut and screw had exposed me to his criticism. "M. A." gives me a very good answer to my insinuation of his quoting Mr. Evans.



F. W. G.

CUTTING-FRAME.

[20028.]—THE cutting-frame illustrated by C. E. Sibley (No. 20005) is very similar to the wheel-cutting frame described by me in the number for April 14th, with the exception of the swivelling arrangement, which is perfectly useless for the purpose of cutting oblique gears, as when using it set obliquely, it would require a special slide to move it, the motion of the slide-rest not being available in that position. But when using it as a fly-cutter, in turning spirals, of course this mode of setting it at an angle is useful, though, for my own part, I prefer another tool. In the illustration there does not appear to be nearly room enough between the circular cutter and the driving-pulley, and in cutting anything of a good-sized wheel, the driving-pulley, if sufficiently large to give power, would touch the top of wheel to be cut. This, of course, is a mere matter of detail in making, and could be easily remedied; but it is against using this as a fly-cutter vertically that the chief objection lies. I made two or three instruments formerly, of different proportions, very much after this pattern, to be used as fly-cutters, and discarded them all in favour of the one I illustrated in the number for April 7th, for one very grave fault, and that is, that when using it vertically, to ornament any work that has a raised moulding or collar at one end, the end screws, and part of head through which they pass, come against the work, or perhaps the chuck, and prevent you commencing your ornamentation close up to the collar. The driving-pulley also must be very small, to allow the tool-point to touch the work. In these respects I have found my pattern much more convenient, and it is just as easily made; and anyone who wishes can make the head swivel round, by substituting a binding-screw for the pin which keeps the head on the square shank.

F. W. G.

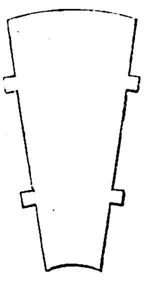
IRON MOULDING.—No. III.

[20029.]—IN my last letter the spindle, loamboard, and guide were ready for the moulder to commence the building of one of the four blades. Suppose the boss to be 3ft. diameter, a base-plate will be required, 7ft. long, 4ft. broad at one end, running to 2ft. at the other. The inner or narrow end of plate will be placed against the bearing or guide that has been built at the bottom of boss, and the centre of broad end of plate will be laid down opposite to the centre line on outside bearing, taking care to have a firm bed underneath, so as it will not sink with the weight of building. (For plan of plate see sketch.) Before any building is done, the boss and bearing at the bottom is coated with parting blackwash, made with clean water and blacking. Some building loam, made from floor sand and clay-water, is now put round the edge of plate, and a 4in. or 9in. wall is built, leaving some of the joints at the back or end wall open, to allow the steam to escape when drying, and the gas when casting. In the inside of the wall bricks are put, but no loam, keeping them a little apart, and filling the space with cinders or small coke, which are rammed tight into the joints so as to keep the bricks firm. The cinders also serve as a channel to carry off the steam and gas; and by so building the mould does not require so much drying as it would if built solid. This kind of building is what is called dry building. The loamboard is now let down the guide to see that the bricks on the face of the building are ½in. clear of the face of the loam board or sweep. Another row of brick is now built along the face, always keeping them ½in. clear of the board: then the wall is carried all round, keeping the end and back wall perpendicular; after that the dry building is repeated same as last course. Each course is now built in the same manner, till the wall is about 9in. broad, when no more dry-building will be necessary; the remainder will be built solid with brick and loam, so as to have it strong. Each course of brick that comes against the boss is rubbed with, and bedded in, red loam, having ¾in. on the face of brick. Where the blade joins the boss, loam bricks are built in so as the sharp edge can be rubbed off and the one rounded into the other.

Loam brick is made of loam in the same manner as common brick is made of clay. Red or facing loam is made of coarse sand and clay-water ground in a mill. The best sand for loam moulding comes from Lough Neagh, Ireland. It is coarse and open, not given to crack when dried, or scab when casting. The North of Ireland contains large quantities of red sand and rotten-rock, which is suitable for any kind of moulding. Large quantities leave several ports as ballast.

Having the brickwork of one blade finished, and looking at the outside end, it will have the appearance of Fig. 2. The angles that are formed by each course of brick being kept further back, so as to be clear of the loamboard coming down the guide, are filled up with loam brick cut the shape, so that when the facing-loam is put on there will be an equal thickness all over the face, which by so doing insures a level and correct surface. Having got the surface of the building made parallel with the travel of the loamboard, a thin coat of soft loam is first put on, so as it will adhere to the face of the building. Afterwards, a second coat is put on more stiff than the first one; then, for the third and finishing coat, soft loam is taken (after having been put through a sieve to extract any pebbles or foreign matter that it may contain) and spread over the surface. The face of the board is now made clean, and brought down the guide as steady as possible. The loamboard is now placed on the guide over the centre line, and along the edge of the board a line is drawn on the face of the blade, which will run to the centre of boss: and for the present the face of the blade is finished. The building of the other three blades is performed in the same manner (as the blades are to be lifted from their bed and baked in the oven); at the bottom of boss, where the bearing is, a joint is required down to the base-plate, and some paper or parting sand put on, so that when the blades are lifted they will part from each other without breaking.

FIG. 1.



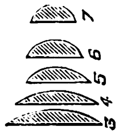


FIG. 2.

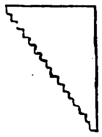
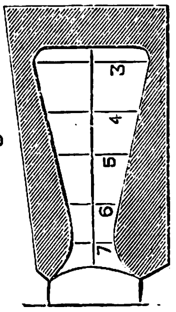


FIG. 8.

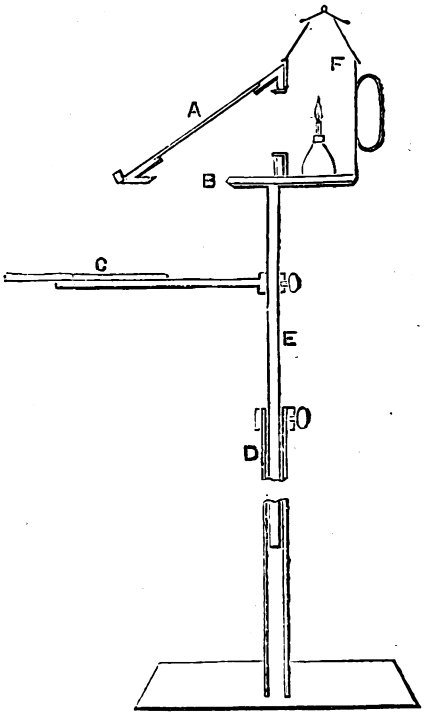


When the fourth blade is built, the first one will be stiff and ready to commence anew. At the top and bottom of the boss there are two portions of the blade that could not be swept; this the moulder makes good with his trowel, so as to have it in harmony with the finished portion. The pattern-maker now supplies three pieces of wood, which are called sections. Figs. 3, 4, 5, 6, 7, and Fig. 8 show sections and their positions on the mould. Where the sections are to be placed, a notch is cut, or the point of a nail is driven into the face of loamboard, so as to form a line on which the sections are placed. When in their place sand is rammed firmly between each, and pared off level with the back and sides. A little care is required so as to have the curve as regular and graceful as possible. When finished it forms a pattern for blade. The sections are then taken out, and the space filled up with sand. The same process is gone through with the remaining blades.

Foundry.

SKETCHING WITH THE TELESCOPE.

[20030.]—I SEND you a drawing of a device I have made for sketching with the telescope. It does not need a detailed description. The principle



is that light from the lamp is transmitted through the sketching paper at A, A being a piece of glass. The opening B is for the passage of reflected light to a book placed on C. B may be closed when desired by a paper or metal slide. The drawing is about ¼ of the size. This stand is cheap, being made of thin wood, and the stem of a piece of wrought-iron pipe, with sliding rod and tightening screw. I do not know that my device is new, but I think it is here. I use a fine 8¼in. reflector by your genial correspondent Mr. Brashear. It is excellent in workmanship and defining power. Of my observatory I hope to be able to write at some future time.

Francis G. du Pont.

Wilmington, Delaware, U.S.A.

TWO-MANUAL AMERICAN ORGAN.

[20031.]—I SEND, according to promise, the details of a scheme for a two-manual reed organ, which I have nearly completed. I may commence by saying I had no knowledge how the larger kind of instruments are constructed by the makers; so I only had my own devices and the ENGLISH MECHANIC to work upon. It was required to place a two-manual action in a case, whose revolving cover is shown at K, Fig. 1, with three or four sets of reeds on the top manual, four or five on the bottom, and whose top manual could be placed as close as possible to the lower one. Fig. 1 shows a section of the action from front to back. It is not drawn exact to scale, as the sizes are so small. The bottom-board B occupies the full play size (Fig. 4)—viz., 51in. by 20in., and carries the tube-boards and bellows in the usual position, and also the stop-action at the sides; and slides on bearers fixed to the case. The bellows are of the usual description, only the ratio between reservoirs and feeder size was increased in favour of the latter, with the idea of getting better expression. Reservoir 50in. by 25in., with a 7½in. fall, and having two 24lb. springs; and feeders 22in. by 24in. with an 8in. fall, and having a 9lb. spring to each. The webbing is attached in such a position that it travels 6in. only. The following stops were decided on, and labelled thus: (the numbers correspond to those on Fig. 1).

LOWER MANUAL.

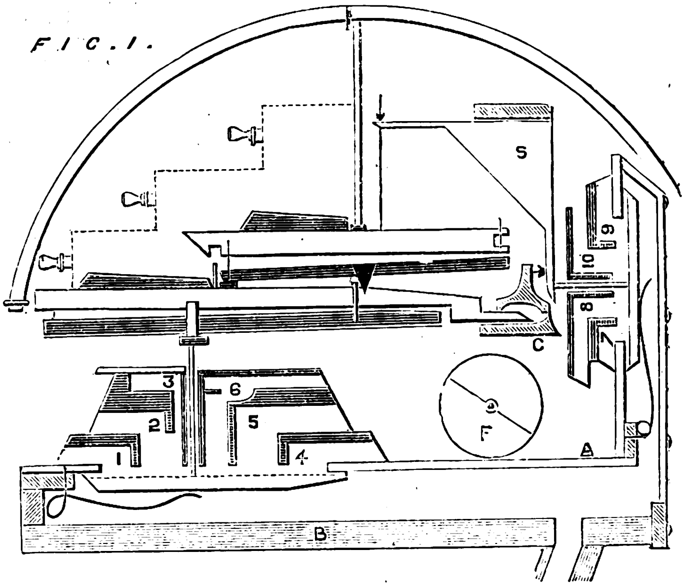
1.	Diapason ..	.. 8ft.	5	octaves
2.	Vox Celeste	.. 8ft.	3	,,
3.	Dulciana ..	.. 4ft.	5	,,
4.	Bourdon ..	.. 16ft.	5	,,
5.	Trumpet ..	.. 16ft.	4	,,
6.	Hautboy ..	.. 8ft.	5	,,

UPPER MANUAL.

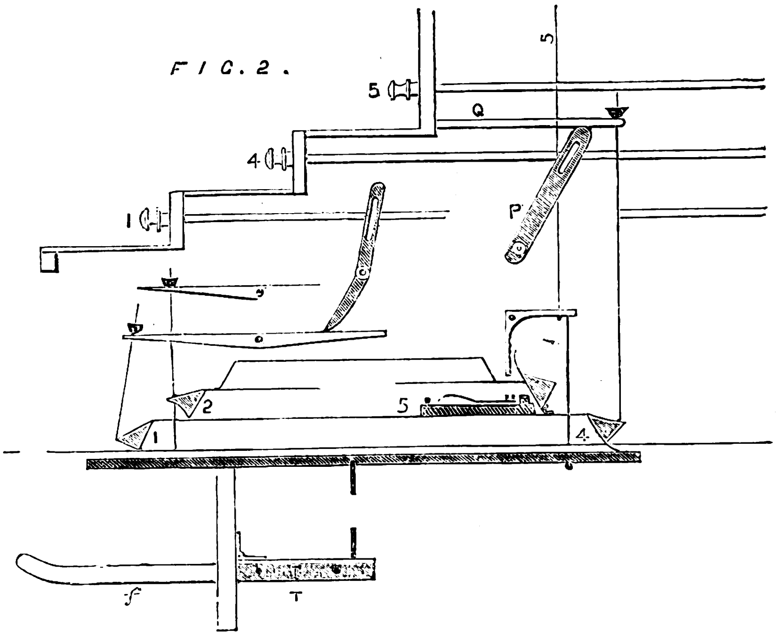
7.	Principal ..	.. 4ft.	5	,,
8.	Vox Humana	.. 16ft.	3	,,
9.	Gamba ..	.. 8ft.	5	,,
10.	Piccolo ..	.. 2ft.	3	,,
11.	Coupler.			
12.	Tremolo.			

Two Knee-swells.
Two footirons for full organ.

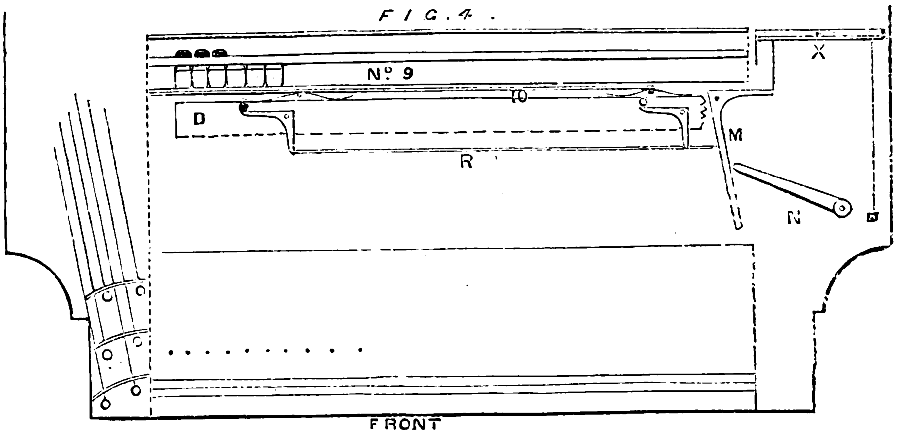
F I C . I .



F I C . 2 .



F I C . 4 .



The soundboard A is cut in two portions, and fixed over the bottom board at right angles to each other as shown; the horizontal portion carrying the lower manual reeds, and the vertical portion the upper.

The reeds used were the Munroe, except Nos. 5 and 10, which are ordinary harmonium reeds. The Munroe reeds are simply excellent in workmanship and disposition; in fact, good-tempered enough to please every one. I should say, as it seems impossible to break them with bending. I have a scratch set which have undergone some curious contortions since being in my possession. They are also of shorter scale than some at the bass end, which is an advantage in a large board. The tube-boards shown had of course to be made (no joke, by the bye, for it is a very tedious job). Having selected the reeds and arranged them, the tubes were cut as follows:—A row of holes was made to form the back-end of the tubes, and the remaining portion was removed with a dovetail saw and a ¼in. firmer chisel. Having served all the registers this fashion, I made a spindle working through a table vertically, and carrying a small circular saw, which would cut the groove to receive the reed, the screw-cap which fastened the saw being the same size as the tube. Great care and good tackle were requisite to glue these tube-boards together, and to the soundboards. The voicing in the reeds was done for me, in the principal sets; the rest I managed myself in making the tubes—for a great difference can be made in the tone by this means. I will try to describe the bending, &c., in the different registers. No. 1, tubes ordinary size, the reed bent and twisted as described in a former volume, by Elève and another correspondent; No. 2, ditto, more bend, consequently softer; No. 3, less bend, tubes vertical and only ⅓ the usual size, and also fastened down in a stuffed box—therefore, very soft; but they seem to waste a lot of wind in this position, and are rather sluggish in speech. No. 4 same as No. 1, but the position in the board alters the tone. No. 5, harmonium reeds, a thin set which required no filing down, but I was devoutly thankful when finished, as they were a lot of trouble. The frames of these reeds had a slot formed at the tip end, and a round-headed screw was placed in the tube-board before glueing up, to receive them; the heel end being fastened down by another screw. The tongue was much bent at the tip, but no twist, and the tone is very strong and rapid. No. 6, tube double the length, and one-half the size of No. 1; the reed is inserted heel first, so that the wind strikes the tip first; no bending, but a little twist; very reedy, quiet tone, and very delicate touch, which latter rather surprised me, as, being so far from the wind, I was afraid they would be sluggish. No. 7 as No. 1. No. 8, tubes one-half the size, the bending and twisting confined to near the tip. No. 9 as No. 1, only less bend, more twist, tone more cutting. No. 10, harmonium reeds screwed on merely, but the tone is a failure, and they will be removed, and replaced by American reeds in tubes, as shown. The two manuals are fastened together at the ends by thin plates, and slide in position from the front on one bearer at each end. Nos. 1 and 9 were tuned with the keys in their place, and the remainder of the tuning was done by means of the plungers.

The lower keys rest on the plungers in the usual manner, only they have a ⅜in. wood pin projecting the thickness of the key-frame, in order to clear the plungers when drawn forward, and the latter are provided with a screw-button.

The upper keys are suspended, by means of a tapped wire, from the set of squares S, which, in turn, rest on the plungers of the upper soundboard. These tapped wires are not fixed in the squares, but fit tightly in a dovetail notch cut in each, so that they can be drawn out and replaced easily.

I suppose, when Mr. Fryer looks at these sketches, he will say it is an utter impossibility to get at the reeds, as he creates such a large mountain out of so small a mole-hill in his letter (46296, p. 157) about the sketch I suggested for "Beta's" alteration. For my own part, I appreciate the advantage of sitting comfortably in front of the instrument during tuning, &c. (and this "&c." is a considerable portion), to performing acrobatic feats in endeavours to get at the reeds. In "Beta's" case, if he can get at his present back row under existing conditions, so will he likewise be able to get at any additional row or rows (if he has the necessary space on his soundboard) with the tubes facing him, by means of a reed-hook bent at right angles on itself; or, supposing he cannot get at them so, he may remove his keyboard and complete his tuning by the plungers. In case of muting through dust the arrangement is not so good as might be; but if this is the only difficulty for the alteration job, "Beta" will be happy. In the present action shown, the keyboards can be removed, and any given reed got at, and all replaced in five minutes. I must, however, except No. 5, as they are screwed in (see Fig. 2), and the mute-valve opens the opposite way to the others. By unscrewing the back board to the upper manual its pallets may be easily got at, and the lower manual pallets partially so. At the tail-end of the lower manual keys is situated the coupler C. It consists of a set of squares hinged to a rail, and provided with a regulating screw-button. The rail D (Fig. 4) travels from front to back by means of its stop, which, when drawn, pulls the lever N forward, and pushes the large square M and the connecting-rod R to the left, and so, by means of the two small squares, presses the coupler in position, as shown in section, Fig. 1. When released, the coupler is forced forward by the springs about ⅜in. so that it does not touch the upper manual squares, but rides idly on the tail-piece of the lower keys. This form of coupler is simple and effective, easily regulated, and so far as I know, new. If Mr. Warman, or any gentleman who knows, should notice this, I should like to hear their opinion of it as it stands on paper.

Fig. 2 shows part of the lower manual stop-action. It is the ordinary bent lever, or a modification of it. When No. 4, say, is drawn, it pulls the lever P upright, which in turn raises lever Q, which lifts the tapped wire running to its stop-valve. Lying across the soundboard, just under the stop-valves, is a wood table H, hinged, and at back, which is raised by the rod W coming from the lower table T, which is hinged to the case on the side of the blow-pedal, and to which is pivotted the foot-iron *f*. This is for full organ to lower manual, and raises any or all the stop-valves by suitable stickers coming from them. At X, Fig. 4, will be, say, another, which opens the upper manual stop-valves, and also couplers. This is worked by a square, not shown, from the other foot-iron, Fig. 3, stop-action to one of the upper manual registers. I do not think these require further explanation.

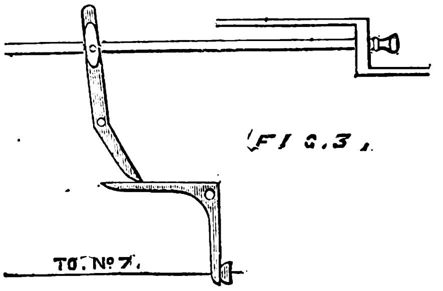


FIG. 3.

The stop-rods are worked in the position shown on the plan, Fig. 4, to the left, which not only clears the manual action, but allows room between the rods for the bent levers, squares, &c., as no given rod falls on a vertical line with any other one. At *f*, Fig. 1, will be seen the position occupied by the fan tremolo. The driving-fan in its box is placed under the right-hand stop-action, and a wire runs from it to hook into the fan-card mounted on a slight frame, which merely rests on the soundboard, and can be removed instantly by unhooking the wire. The swells are not shown, and are not yet made, but the rods to work them from the knee-levers are run lengthways under the bottom-board. If there is any point I could further explain, I should be happy to do so.

Thanks to Mr. W. H. Davies for his kindly help in explaining the method of making the keyboards, as with it and the few special tools he mentions, I made a passable job of them. There is, however, one fault I can mention—viz., matching the ivories, or rather failing to do so. I presume it requires experience or taste, as the colours do not seem to show out until they are polished. Also, commercially, they were a failure, as the time they consumed was rather out of proportion to the prices quoted by makers. But I suppose I should allow a little for experience gained, as it is worth possessing.

If anyone asked my opinion on the utility of placing harmonium reeds on suction, I should side with friend "Organon," and say, Don't, as although a different tone can be got by this means, the extra trouble involved is not compensated by the result. If that gentleman, who has kindly assisted me by his advice on several occasions, or any of "ours" who are interested in the question, would care to come and see this instrument, I shall be pleased to see them. Joiner.

GRINDING AND POLISHING GLASS SPECULA.

[20032.]—Through a mistake of the wood-engraver, the order and numbering of the stops in Fig. 2, p. 129, have been altered from what I drew them, to the creating of a little confusion between Fig. 2 and the tabulated arrangement of the stops, &c., which occurs a little lower down the column, and the letter-press description of Fig. 2 has had to be altered to make it correct with the Fig.; but as we have to begin our testings with the largest zone, it is most natural to call the stop for this zone No. 1, and the others Nos. 2, 3, 4, 5, as they decrease in size of zone. I shall, therefore, adhere in my future descriptions to my original arrangement, and which is preserved in the tabulated arrangement of "No. of stop, Dia. of zone, Aberration," which is about the middle of the first column, p. 129.

In Fig. 4, p. 129, the arrow-head on the metal J is put on the perpendicular side; it would be better on the sloping part where the divisions are, so as to be more easily seen with the divisions through the eyeglass. On the elastic band G there is represented what appears like a capstan-headed pin, with two levers projecting from it. Now, I had intended all this to represent only the knot in the elastic band, with the two ends carelessly projecting. I mention this lest the amateur should think there is something mysterious there that I have forgot to describe. I do not wish to blame the wood-engraver. Perhaps if I had been more careful in my drawing, I might have saved at least all this paragraph.

I must now describe the lamp. It is represented in Fig. 1, which is a little over one-half the size of mine. It is an ordinary ½in. burner, with a brass tube substituted for the glass chimney; it is just large enough to fit in where the glass chimney originally fitted. It is squeezed flat just opposite the flame, something like the glass chimney for the duplex lamp; this allows the broadway of the flame more room, and also the front edge to be flattened, to allow the plate B to lie flat against it; this front edge is filed flat for this purpose also. It is well to squeeze the tube flat a little higher than is actually wanted, and then to file off the bottom till the squeezed-in part fits on or touches the dome though which the flame comes. I may just observe that round the chimney, when in use in testing, a thick cardboard, the thicker the better, is put with a bit of wire round it to keep it together. This is seen well in Fig. 3, p. 129, and here at C, C, C, C, this is to protect the face, especially the forehead and eye, from the great heat of the lamp when testing. This cardboard tube simply rests at the back on the brass wire with the milled head at the end, that raises and lowers the wick. To find out where the hole is to be made, so as to be opposite the brightest part of the flame, the amateur must put the glass chimney on and get a good flame. He must then get a pair of compasses and put one leg on some known point on the lamp 4in. or 5in. below the edgeway of the flame. The other leg he must bring opposite the brightest part of the flame. Now put the light out and put on the flattened and filed brass chimney, and with the one leg of the compasses on the same known point below the flame on the lamp stand and the other against the filed part of the brass chimney, make a mark. This is, of course, opposite where the brightest part of the flame comes. Now make a triangular hole so that the lower angle is on the mark made by the compasses. This hole is shown by dotted lines at B, because it is, as it were, seen through the plate B. Now the inside of the lower angle must be filed with a small smooth three-square file, as seen in section at D. On the front of the chimney over this hole is put a brass plate. It will do less than a 32in. thick. It moves on a rivet which is seen at the right-hand end. The brass plate is filed flat at the back, and the rivet is on a level with the lower angle of the hole in the chimney. Through this brass plate is a hole with the top edge straight, and on a line with the centre of the rivet, and bevelled inwards as seen in section at D, so that this edge becomes a knife-edge as we call it, and like the lower sides and angle of the triangular hole in the chimney; thus when the part F, which is about 3in. long, and which should be made as light as possible, of the plate B is lowered, a small triangular hole is formed of any size required. This is a great convenience, as the amateur simply lowers the end F till he gets the smallest hole that gives the amount of light he can see the shadings with. Thus he easily gets the right size of hole for a partially-polished surface, such as he will have to test upon during the first part of his polishing. The hole he will naturally decrease as the polish increases, and without any trouble he will find the size of hole to test a silvered surface, which hole being of necessity very much smaller than for the plain glass surface is so much more severe as a test. Thus, when he commences his testings, after the first half hour's polishing he requires a much larger hole than when the whole of the emery marks are out; but this need not trouble him, as it would if he used holes in thin metal plates, for then he ought to have several sizes to suit the advancing polish, if he wishes to test to the greatest nicety.

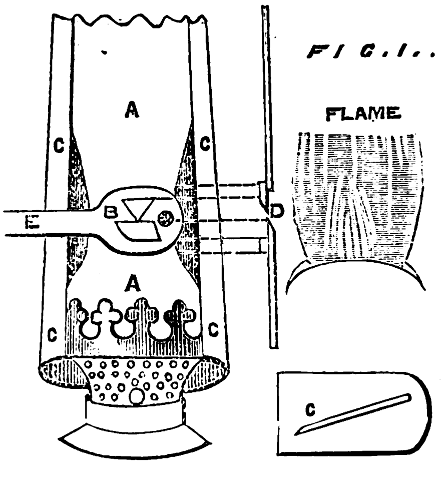


FIG. 1.

I got tired of all this loss of time, and soon devised the above artificial iris, which, although it takes longer to make in the first instance, saves its time over and over again, and then it is always ready for any testings; and another advantage I have found is, that we do not get a long hole, if I may so call it, like we are apt to get by pushing a needle through a thin sheet of metal. Now, this long hole is very detrimental to exact testing, because the focus of the inside edge of the hole would be different to the focus of the outside edge of the hole, and it takes some care to avoid getting a somewhat long hole. This can be easily seen by using a high-power Coddington lens; then we must be very careful not to get a little bit of dirt in the hole of the thin metal; in fact, it wants careful keeping to avoid damaging the hole in one way or another, and altogether is a lot of trouble—all of which is avoided by the artificial iris, which is easily kept clean and ready at any moment; another great convenience is that by opening it to its full extent by raising F, we have a large hole to find the focus with, and fix this focus on the edge of the shutter, and without any further alteration except lowering F, we get our hole in the same place to the exact size we require. I have found the artificial iris a great convenience to me through the immense number of testings I have had to go through for the numerous experiments I have been making to investigate the laws of the whole process. But if anyone thinks the hole through the thin metal plate the best for him, he can get very thin copper—as thin, if not thinner, than notepaper, and by grinding a fine needle on an oilstone to a long point, extending for ½in. from the end, he can make a very fine hole, and, in fact, he will want several sizes if he is to properly test from the commencement; these sizes he can make by pushing the point of the needle further through the metal. Let him examine under a microscope the point of the finest needle, and he will find that only just the point is small, that it suddenly thickens, and that to a size too large for his finest testings; let him hold it nearly flat on the oilstone; and rub it along, turning it round as he grinds, and then examine again under the microscope, and he will see he is getting a longer cone that regularly enlarges from the end to about ½in. up. This is the kind of punch he requires; this is the way I did it till I got tired, and made the artificial iris. If the amateur decides to make one also, he might get the help of a clock or watchmaker for a trifle, just in any part he may feel himself unable to do. I can only tell him that when he once gets it he will not give it up on any account, and return to the old punched holes; but every one has a way, and his way he makes do for himself, and he often likes it best with all its disadvantages. Now, by letting every one be fully persuaded in his own mind as to what is the best way to him in performing any operation, and not pressing on one another what we may think the best way, we may all be pleased, and gradually be brought to see the best in everything.

I will now only briefly describe the way the testing is carried out, as it has been ventilated to some extent in back numbers. In Fig. 1, p. 128, the speculum S is seen in position for testing, the triangles at the back must not be taken off for testing: the amateur must simply rest the studs of the triangles against the board A. Of course, if he works his speculum above the polisher, he will have no triangles at its back, he will simply rest his speculum against the board. The amateur must rest the speculum trough on some firm support, say some strong table, and about twice the focal length of the speculum from the further edge of another table on which the measuring apparatus and lamp are placed; light the lamp, and elevate the lever F of the iris so as to open the hole to its full extent; turn up the flame, and look down the chimney, and see that the hole is nearly opposite the edge, about as shown in section at G. By this means he will get much more light than from the flat side of the flame. Now let him look with one eye from before the front of the speculum at the lamp, and see that the hole is fully illuminated; if not, turn the wick up a little, or turn the lamp on its base to bring the flame to the centre of the hole, especially the lower angle where the small hole will be formed. Now put a sheet of white paper on the measuring apparatus, Fig. 3, p. 129 over F, and extending to the lamp, and as high and low and broad as he likes. Now throw the image of the hole on this paper, by first looking into the speculum and moving the trough about, till he sees the reflection of the hole just on the right, but touching the reflected image of his head. Now he must move his head from the speculum towards the measuring apparatus, keeping his eye on the reflected image of the hole in the lamp; he will by this means see to about where the focus would go to; thus, after two or three trials and alterings of the trough, he will be able to get the image on the paper; he can now easily, while standing by the trough and watching the image on the paper, move it by moving the trough, so that it shall be brought as high as the hole, and about over where the edge of the shutter should be—*i.e.*, about 1½in. from the hole; now he must go to the paper and see if the image of the hole is well-defined when he puts the paper about opposite the middle of the chimney; if it is not, he can either move the lamp and measuring apparatus, or the speculum-trough backwards or forwards till he gets the image well defined, but being careful to finally bring it to its right place beside the chimney. He must now examine the image and see that the lower angle of the hole (the upper in the image) has the brightest part of the flame over it. He may have to turn the lamp on its base to bring this about, or raise the flame, though the flame need be no higher than to show the lower angle the brightest. The amateur can now take away the paper and commence his testings by putting the shutter opposite the middle of the chimney, and so as to just touch the image; now, let him sit on a chair behind the measuring-apparatus, and looking along the edge of the shutter, up and down, till he sees the face of the speculum as one blaze of light, he may have to move the shutter to the left out of the way of the image, by unscrewing the shutter-screw before he thus sees the light from the speculum, the shutter having been too much over the image. He must now lower the lever F of the iris, and cut off the light till it is only just enough to see the shadings when the shutter is passed across the cone of rays from the speculum: the smaller the hole he can do with, the more delicate the testing (he must not lean on the table or touch it in any way while testing). Supposing the amateur has thoroughly mastered what I explained in my two previous letters, he can now commence the testing by putting the index line N, Fig. 4, p. 129, to ·063 (this, of course, supposes a 6in. speculum 60in. focus)—i.e., about 6⅓-100ths further from the speculum than ·0, which is reckoned from the arrowhead on the divided scale. He must put the stop No. 1 against the speculum, and now adjust the shutter by the adjusting-screw till the shadings come on equally and simultaneously on both sides of the zone, as the shutter is passed from left to right by the shutter-screw; now take No. 1 stop off and put on No. 2, and move the index to ·042, and pass the shutter from left to right, and if the shadings come on equally as before this zone is right. In like manner proceed with the other stops, as given on p. 129 middle of 1st col. If all the zones answer well to this test, the speculum cannot be far wrong. Of course I am supposing there are no rings that can be seen when the shutter is passed across the cone of rays without stops, and that the amateur has gained some little experience by experimenting for himself for his own pleasure and information, all which may be done in his workshop, where perhaps he has a fire to keep the air at the proper temperature for the pitch. But we must now proceed to a little more severe testing, and this cannot be done in a place where there is a fire, for the currents of air will interfere fearfully with all exact testings. I always finish my testing, *i.e.*, for the last three or four half-hour's polishings, down the cellar, which is wonderfully free from currents, and will give the same indications over and over again; whereas, when tested in the workshop, or a room where there is a fire, the indications will appear to vary. The fact is, it is the currents of air that are passing, first over one side of the zone and then over the other, while testing, that prevent exact testing. To show this to the amateur, let him try the following experiments in his workshop, or a room where there is a fire:—Let him set the index to ·063, as in the previous testing, set the shutter to No. 1 stop carefully; now put on No. 2 stop, and, by the measuring-screw, put the shutter to cut off both sides, as near as he can judge, alike; now let him examine the index reading, and most likely it will not be ·042. Let him try to set the shutter again, and most likely he will not get the same reading as before; thus let him test his ability to find the exact focus of all the other zones in a room where the air is not perfectly even in temperature, and he will at once feel the evil of currents of air, although he may not be able to see them; but let him now try the same series of experiments down the cellar, or anywhere where the air is perfectly still, and he will be much pleased with the greater constancy of the readings. Of course, as he gets more practice, he will get much more expert. He will find the greatest difficulty with the small zones in getting their exact focus. This I accomplish in the following easy way: I find that with the smallest zone, No. 5 stop, I can always tell a difference of shading if the shutter be more than 2-100in. from its actual focus, but not nearer than this with absolute certainty: so I proceed as follows: I put the index 2-100in. on that side the supposed focus that is nearest to the speculum; I pass the shutter across, and if I cannot detect any difference in the shadings I know the supposed focus is not too long. I then put the index to 2-100in. from the supposed focus on its other side. I pass the shutter across, and if I cannot detect any difference in the shadings, then I know the supposed focus is not too short; therefore it is right, being not too short nor too long. But suppose in the last testing the shading comes on a little more on the right side of the zone than on the left, then the supposed focus is too short, and the real focus is somewhere between the supposed focus and the first testing. I alter in my mind the supposed focus to a little shorter, and commence again to test as before; thus I soon get with great exactness the correct focus. I always test thus the smaller zones, and when in the cellar get wonderfully consistent readings. I may just observe that I do not trouble to have a table in the cellar, but use a low, firm bench, and go on my knees on a cushion. I have a small lantern to take the readings and see my way about. Now, to study the accuracy that this mode of testing the zonal foci produces for celestial observation, let us suppose that A is a spherical speculum, and B is

12345
A ·····
O C O
B 10 9 8 7 6

the amateur's speculum, and that the spherical aberration of A, when tested on a celestial object for the five zones, is represented by 1, 2, 3, 4, 5; 1 being of course the focus of the outside zone, 5 the centre. Now, the aberration of B, if a parabola, when tested at the centre of curvature, would be 4 times the above amount of from 1 to 5, and would be represented by the distance of 10 to 6; 6 being the outside zone focus, 10 the centre. We will suppose the amateur has not quite corrected his speculum, that he has made the mistake of ¼ the whole amount—i.e., the outside ray is not long enough, it is only brought to 7 instead of to 6, and with ordinary care any amateur ought not to be out more than this. Now, when this speculum is tested on a celestial object, it would have its outside ray-focus shorter than its centre by about ¼ the whole spherical aberration—viz., at 4 instead of at 5, all the intermediate rays would be between 4 and 5; in other words, as the whole spherical aberration is about 1-50th in., the undetected aberration would be only about 1-200th in., and this is much nearer than an ordinary amateur would be able to test to on a celestial object. The fact is, a far greater enemy is flexure than aberration, and one that is far more difficult to overcome. I am now trying experiments to overcome flexure, or rather, to avoid it, with the two specula Messrs. Chance Brothers kindly supplied me with, and with a very thin one only ¼in. thick—of course, all 6in. diameter—so that the comparison may be direct, and therefore easy and certain. Now, the ¼in. speculum shows the weak point of every kind of support to a fearful extent. I hope to let all know the results, when I have finished satisfactorily my experiments.

I hope to finish in my next letter the Foucault's testings. If I have omitted any point or written in a way not quite plain to any, I hope I shall receive intimation of the same direct from them, and at once, so that it may be included in my next, which I wish to be my last on this part of the subject; as I know many want now the practical making and working of the machine.

H. A. Wassell.

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FRENCH EXPRESS LOCOMOTIVES.

[20033.]—The express locomotives now employed on the "Chemins de Fer de l'Ouest" and "Chemins de Fer du Nord" present some remarkable particularities. These two railway companies are the only ones in France who have adopted the inside-cylinder engine for fast passenger traffic. They are also those upon which most of the French inside-cylinders types are to be found. The inside-cylinders locomotives in France were introduced from England. They do not differ greatly from those employed in England. They were first used there for goods traffic. The prototype was a six-wheeled goods engine of that type made by Sharp many years ago, and in which the dispositions of the "Sphynx" type had been fully embodied. The wheels were all under the barrel. Many locomotives for regular passenger traffic were built after that fashion, keeping the long boiler along with inside machinery of the "Sphynx" type. But the engines we purpose to examine to-day greatly differ from this old type. Those of the Western line have not their equivalent in English practice, whilst the Northern of France's locomotives have a great resemblance with most English locomotives of the modern standard practice.

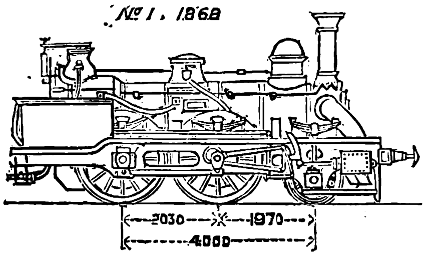
The types of the Western of France numbered 1, 2, and 3 on the sketches are met with on the lines of Normandy and Brittany. It is, I dare say, over twenty years since the first began to work. The Northern engines are more recent, and their first appearance does not date further back than 1870. Both sorts of engines merit a detailed description.

We shall begin with the Western engines. They have all been turned out from the "Société de Construction des Batignolles," Paris (late Ernest Gouin and Co.). This is to be accounted for by the proximity of the railway to these works. The three types have common features.

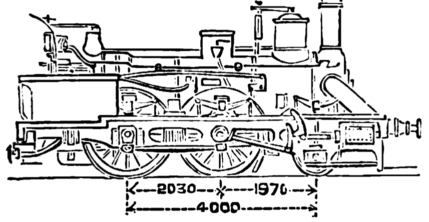
Railway Company	Western.			Northern.	
Numbers in Sketches	1.	2.	3.	6.	7.
Engineer	M. Mayer.			M. Delebecque.	
Builders	Société Ernest Gouin.			Société Alsacienne.	
First date of construction	1857.			1874.	
Cylinders—					
Diameter	420 (16½in.)			432 (17in.)	
Stroke	560 (22in.)		600 (23·6in.)	610 (24in.)	
Centre to centre	980 (38·58in.)			760 (2ft. 6in.)	
Wheels—					
Leading	1120 (3ft. 8in.)	1000 (39⅜in.)	1280 (4ft. 2·3in.)	1300 (4ft. 3·1in.)	1010 (2 off bogie)
Coupled	1910 (6ft. 2·6in.)	1800 (5ft. 10⅞in.)	1900 (6ft. 2·9in.)	2100	2100 (6ft. 10·6in.)
Total wheel-base	4000 (13ft. 1½in.)		4400 (12ft. 5.2in.)	5500 (18ft.)	6320 (20ft. 8·2in.)
Centre to centre of axles—					
First, leading to second	1970 (6ft. 3·2in.)		2150 (7ft. 1in.)	2910 (9ft. 6·5in.)	1800 (5ft. 10⅞in.)
Second to third	2030 (6ft. 8·1in.)		2250 (7ft. 4½in.)	2590 (8ft. 2·4in.)	1930
Third to fourth	0		0	0	2590 (8ft. 2·4in.)
Diameter of barrel (int.)	1170mm· (3ft. 10·4in.)			1225 (4ft. 0in.)	
Working-pressure	9 atmospheres.			8·5at. (125lb. sq. in.)	10at. (147lb. sq. in.)
Grate—					
Length	1180 (3ft. 9·1in.)	1224 (4ft.)	1624 (5ft. 4in.)	2270 (7ft. 5·3in.)	
Width	1050 (3ft. 4in.)	1074 (3ft. 6in.)	1078 (3ft. 6·4in.)	1023 (3ft. 4in.)	
Heights of firebox	1410 (4ft. 7·2in.)	,,	1150 and 1130	1580 and 810	3ft 3·7in & 5ft 2·1in.
Tubes—					
Number	156			201	
Diameter	50 (2in.)			45 (1⅞in.)	
Length	4000 (13ft. 1½in.)		3850 (12ft. 7·8in.)	3500 (11ft. 5·8in.)	
Heating surface—					
Firebox	6·43m²	7·37	6·98	8·75 m²	94·2 sq. ft.
Tubes	85·33	98·02	94·55	90·60 (ins.)	1069·4 (outs.)
Total	91·76 (986)	105·39 (1130)	101·53 (1086 sq. ft.)	99·35	1163·6
Grate area	1·321m² (11 sq. ft.)	1·24m² (13·5 sq. ft.)	1·78m² (16·5 sq. ft.)	20330 m²	25 sq. ft.
Weight of centre of boiler	1920 (6ft. 3½in.)		,,	2130 (7ft.)	
Weight in working order—					
On first axle	11·1 tons	8 tons	11·15 tons	10·4	14·4 (bogie)
On second axle	11·4 ,,	13 ,,	12·45 ,,	13·5	13·6
On third axle	11·5 ,,	13 ,,	12·45 ,,	13·5	13·6
Total	34·0 ,,	34 ,,	36·05 ,,	37·4	41·6

1st. The employment of outside frames only, save a slab placed in the plane of symmetry of the engine and riveted to the motion-plate, and at the other end to the staying plate in front of firebox.

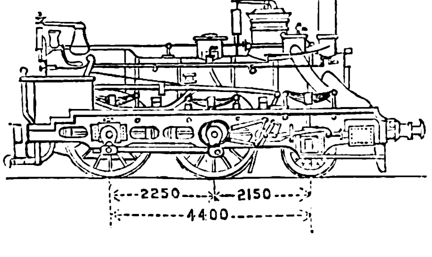
No. 1, 1868.



No. 2. 1874.



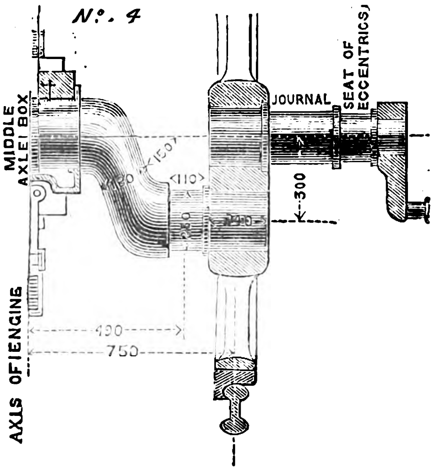
No. 3. 1878.



This slab embraces an axle-box on the crank axle, which is relieved from part of the weight thereon by a spring. This middle axle-box also steadies the said axle.

2nd. The valve-gear is wholly outside, the steam-chest being outside. The valves are easily examined and repaired if necessary. The links in 1 and 2 are of the shifting type, and disposed as in the "Sphynx" engine. In No. 3, however, the link adopted is Allan's with a special modification. The eccentrics sheaves are keyed behind the outside crank of the driving-axle. The whole appearance of the frame and its machinery reminds us of the goods locomotives built in 1855 by the late M. C. Polonceau for the Paris and Orleans Railway, and also of some Austrian engines. The difference between 1 and 2 or 3 lies on the adoption in the two last locomotives of the Martin's crank-axle, which is shown in Fig. 4. It is not unlike the Baldwin crank axle used in Early American engines.

No. 4.

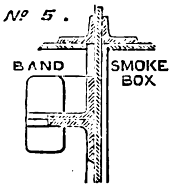


Here there is, so to speak, no proper crank. The axle is simply bent. It allows of bringing the crank-pin nearer the driving-wheel, and is very safe.

The difference between 2 and 3 is easily perceived: in 3 the firebox is enlarged considerably, and extends over the trailing-wheels. In the recent engines of the Western Company, all the stuffing-boxes have Duterne-Dallot's metallic packing, all screwed work in the live steam is adjusted from outside by means of nuts, cleverly contrived. This avoids corrosion of these moving parts.

The boilers of these three types are not very different. The connection between barrel and smokebox is illustrated in Fig. 5. They all have domes against the smokebox, a thing which is no longer the practice of the other railway companies in France. They now prefer the dome on the middle of the barrel. The regulators are of the slide type, but this principle is differently carried out in each engine, though in all the motion is imparted horizontally to the slide by an outside rod. In the first, a bell-crank changes the direction of the motion, and moves the slide as in English engines; in the second, the slide is kept horizontal, the same in the third, but the slide is outside the dome—a dome now favourite with French engineers, as it admits of repairing the regulator without disturbing too many things. We shall find the same arrangement on the Northern engines with a slight difference.

No. 5.



Upon the whole, these engines look very handsome in their appearance: but I object to a want of proper stiffness in the frames. It must be admitted, on the other hand, the dispositions of the cylinders allows of getting them as big as is desired without having to fear a limitation in the size of the steamchests, or to pinch fractions of an inch here and there, in order to get a proper length of journal—a thing which is often detrimental to the strength of the already and inherently weak crank-axle.

The dimensions are found in a special table hereafter. I have said somewhere else that these engines have the cylinder power rather less than it ought to be when the adhesion is considered. The tractive power is = 42² × 600 × 6 / 1,910 = 3,310, and the wheels — driving and trailing — bear 24,900 kilog. available for adhesion, so that 3,310 / 24,900 = 1 / 7·5. Those who know the nature of the traffic will readily admit that the cylinder power is rather small, and that it might have been increased, without exaggeration, to 4,200 kilog., especially when the general disposition afforded means to adopt larger cylinders. The position of the cylinders is not beneath the smokebox, but well forward in advance of it. This favours a good distribution of the weight. The maximum speed is 70 kilometres an hour; or 43 miles.

Turning now to the engines of the Northern of France, we shall find that the present type with a bogie is the result of successive transformations necessitated by the traffic during these last twelve years.

At the time of the Franco-German war the increase of traffic was such that the Crampton locomotive could no longer do for the passenger traffic on main lines. Some four-coupled expresses were then built at Mühlhausen by Kœchlin. These engines constituted a wide departure from the current practice of the Northern Railway. I am sorry I cannot send you sketch of these engines, as I cannot trust my memory to make one. However, I can describe them pretty exactly. They had outside frames just the same as the preceding engines of the Western, only the steamchests were, as in England, between the cylinders. The boiler had a dome over the firebox, but the regulator was in a box against the smokebox, as was usual in French practice. The leading dimensions are as follows:—Cylinders, 432mm. diameter by 610 stroke; heating-surface-firebox, 10 sq. meters; tubes, 81·62—total, 91·62; pressure 9 atmospheres, driving-wheel, 2,100 mm.; weight in working order, 35,610 kilogrammes, with the following repartition: leading, 10,105; driving, 14,000; trailing, 11,505; tubes, 3,170 mm., long.

If you compare these few particulars with those of the most recent engines, you will find the reasons that led to the following transformation. In the subsequent engines, built about 1874, the firebox was longer, and built after Belpaire's design. The grate now enlarged was carried over the trailing axle. The outside frame was kept, but an inside one was added, embracing the two inside axle-boxes of the driving-axle, just as in English practice. The cylinders are cast with a saddle on top, to carry the smokebox, which is cylindrical. The dome was shifted towards the middle of the barrel. The appearance of these engines is very much like some built some years ago for the Great Northern Railway, under the superintendence of Mr. A. Sturrock; all the more, they have also their leading-axle under the cylinders.

The necessity of having express trains on the branches where there are sharp curves led to the adoption of a bogie. This did not alter much the general design of the engine. which is now a little heavier than the preceding. They can pass easily over curves eight chains radius. All engines of this description are fitted with Smith-Hardy vacuum brake.

Upon the whole, these engines form a type which approximates English practice nearer than any other that had been done previously in France. The bogie engines have six-wheeled tenders. Their speed can easily attain fifty miles an hour, and no doubt they have to work the fastest trains from Paris to Calais, such as the English Mail, which has to be forwarded at a speed of not less than 47 miles an hour, stoppages deducted.

4. The bogie is of the old English type, with central pin. It is assisted in its displacements or kept in position by sliding pieces upon which the weight of the fore part of the engine rests transmitted through sockets fitting into hemispherical balls fixed to the cylinders.

The table on previous page gives the dimensions of all the engines described above.

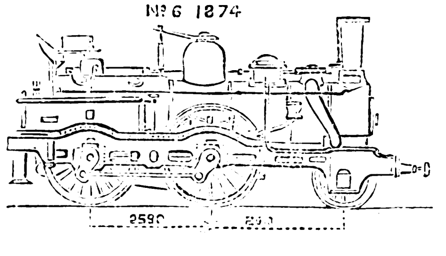
GENERAL REMARKS.

All inside-cylinder engines in France have the smoke-box made cylindrical, and resting upon a saddle cast with the cylinders just as in American practice. The diameter of the smokebox is that of the nearest barrel-plate. In engine 6 the thickness of boiler-plate is 13·5mm., and in No. 7 it is 14·5mm. These two last engines have a box shifting link. All the engines above described are fitted with the Lechatelier counterpressure brake. The latest Northern engine has a compensating arrangement for the springs made, not of a beam, but of two bell-cranks and suitable rods, as shown in sketch. The Northern engines have 2 Friedsmann's injectors.

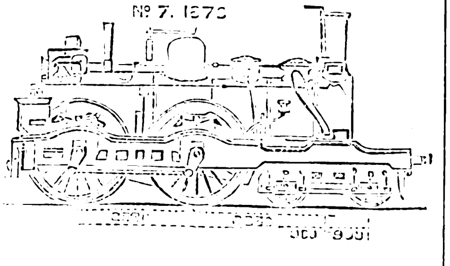
Ed. Gobert, B.Sc.

Heskey-street, Nottingham, 15 April.

Nº 6 1874



Nº 7. 1873



GRADIENTS ON L.B. AND S.C.R.

[20034.]—THE gradients on the L.B. & S.C.R. have often been asked for, as well as those of other lines; but the difficulty in giving them is the inordinate amount of space they take up when engraved. I therefore send these gradients in another way, which avoids encroaching on valuable space, and at the same time gives all needful information. Readers can easily draw the sections for themselves from these figures. The particulars are as follows, and it must be understood that each gradient continues from one point to the next, where a change is noted:—Starting from London-bridge station the line is level to 1¼m., where it begins to rise 1 in 4,744; 2¼m., 1 in 1,820 down; 3m., 1 in 100 up; 5½m., level; 6m., 1 in 2,571 up; 6½m., 1 in 660 up; 7½m., level; 8¼m., 1 in 660 down; 9¼m., 1 in 264 up; 17¼m., level; 18¼m., 1 in 264 down; 25¼m., 1 in 660 up; 26¼m., 1 in 440 up; 26¾m., 1 in 377 up; 27¼m., 1 in 264 up; 31¾m., 1 in 264 down; 37¼m., 1 in 213 down; 37¾m., 1 in 330 down; 38¼m., 1 in 264 down; 39½m., 1 in 528 up; 40m., 1 in 264 up; 41m., 1 in 1,328 up; 42½m., 1 in 264 up; 45¾m., 1 in 264 down; 50m., to Brighton station, level.

I hope some other correspondents will give the gradients of other lines in the same way. We have had the G.W. and G.N., I now give the L.B.S.C. I should be glad to have the L. & N.W., L. & S.W., and Midland, so that we might compare locomotive work, about which so much has been written in these pages. Mr. C. E. Stretton once kindly promised the Midland to Leicester, but was deterred by the space required. Perhaps he will be good enough to give us the information in the manner above illustrated, many readers would greatly appreciate his trouble. **C. R. M.**

Wellington, N.Z., March 25th.

ERRATUM.—Page 195 (Letter 20004).—"Railway Brakes—The Westinghouse Automatic Vacuum."—By a slight printer's error, the word *vacuum* has been omitted in the fourth line of my letter, page 195, 20004. It should read that "the Westinghouse patent, No. 1735 . . ., is the earliest in relation to the Automatic *Vacuum* Brakes."—CLEMENT E. STRETTON.

ERRATUM.—"Telectroscope."—In my letter on this subject I am made to say that selenium has a resistance 10 per cent. that of iron, it should be 10^9, that is 1,000,000,000 that of iron.—L. L. B. A.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[31095.]—**G.N. Locomotives (U.Q.)**—Looking over back volumes, I accidentally came across "Caledonian's" query, previously overlooked, and not yet answered. Old No. 1 on G.N.R. was one of Sharp's passenger engines of the favourite type in use on many English lines—notably, L.B. and S.C., S.E., G.E., L. and N.W., &c. I sent a rough tracing of it, which appears on page 435, Vol. XXX.; but I had then mislaid the dimensions. The driving-wheels were 5ft. 6in. diameter (single), leading and trailing, 3ft. 6in.; cylinders, 15in. by 20in.; heating-surface 748 sq. ft.; double framing. Some of these were rebuilt as tank engines. Old Nos. 223-228 were coupled express engines, with 6ft. 6in. wheels, and cylinders 16½in. by 22in., built by Hawthorn, of Newcastle.—C. R. M., N.Z.

[46378.]—**Bevil Wheels.**—I should advise you to let a 6in. wheel work into a 3in. one. The other arrangement proposed would necessitate (1) a considerable increase of weight, (2) double the circumferential velocity, (3) a great increase of friction, and consequently an increase of power required to work the machine.—KRAUTBRACK.

[46497.]—**Fortified British Cities.**—Carlisle is an old fortified city, and its walls are, I believe, intact to the present day. When the Pretender invaded England in 1745 it was taken by his forces and garrisoned by nearly 500 men. On the retreat of his forces to Scotland, it was besieged by the English army, under the Duke of Cumberland, and for seven or eight days both sides cannonaded each other, ending in the surrender of the place to the Duke, on Dec. 30th, 1745, the garrison, and prisoners. This was the last siege of a town in Great Britain. An old work (dated 1750), says, its walls are so thick that three men can walk abreast, and they are well planted with cannon. It has three gates. Penrith was also a fortified town.—CUMBERLAND.

[46497.]—**Fortified Cities.**—The ancient fortifications or town walls of Leicester were built in the time of the Saxons, and some portions may be traced to this day. A drawing in the Leicester Museum shows a considerable length of the wall, which was removed only a few years ago for the purpose of erecting houses in Bonner's-lane; there were four or more gates in the walls, and circular turrets or towers at each angle. The walls were chiefly built with rough blocks of granite grouted together, and the foundations, which were of a great thickness, are frequently met with in excavating for new works. Throsby, in his "History of Leicester," says Ethelfreda, a Princess of Mercia, has the reputation of extending and repairing the walls of Leicester about the year 901, after it had been desolated by the Danes. Matthew Paris called these walls (which lay in ruins in his time) like forest rocks, indissoluble; indeed, iron crowbars and immense labour are now required to remove portions frequently come across. The almost total destruction of the walls and the castle happened in the reign of Henry II. I shall be pleased to give any further information required.—JAS. FRANK SMITH.

[46500.]—**Cement for Cards.**—If the cards are of cloth, I believe the best makes are cemented with rubber—that is, indiarubber dissolved in bisulphide of carbon, or the soft rubber spread on between, and the layers pressed together. If leather cards, they will, no doubt, be cemented by glue, into which some tannin has been stirred; but leather cards are, I think, used in single thicknesses. A piece of cloth card I had was certainly made by spreading the softened rubber-sheet between the cloths and pressing them well into it.—E. G. M.

[46503.]—**Jamming of Tapered Journals.**—I have to apologise to "Glatton," page 178; but being much occupied, his request escaped notice until this evening. In the first place, I must confess that I don't know what is the meaning of "the angle of repose," as relates to a swiftly revolving mandrel. But were I fitting one up, I should much prefer to make A B D = 8°, than the angle A B C. I don't feel competent to say at what precise angle hardened steel would stick; nor do you state what amount of pressure would be put upon it to make it stick. The pressure of the work in a lathe, acting usually in the reverse direction, I would use a taper of say ⅛in. to 1in. of length in conjunction with a tapered shoulder.—J. J. A., Liverpool.

[46506.]—**French Polish.**—No help for scratched work but to scrape and repolish. Patches may be repolished, but it will need a skilful hand. Consult the papers on "French Polishing" in Nos. 814, 816.—T. P.

[46514.]—**Wood-Turning.**—I don't know how the professional turners do it, but I should mount the vase in the centres, and clear out all but a centre pillar of wood, which could be removed when the hollow was cut out sufficiently.—A NOVICE.

[46524.]—**Air-Pump.**—You might get about 15lb. with a tall column of mercury, but doubtful if you get more. Supposing you mean to work on the principle of the trompe, you won't get so much.—G. M.

[46528.]—**M.R. Locos.**—Seeing that loco. engineers would hesitate before they expressed a definite opinion as to whether the bogie should lead or trail, "F. C. B." will understand that no answer can be given to his question. I think, however, he may take it that where the engine has a tender or is intended for fast traffic the majority of engineers would prefer the bogie to lead.—S. R.

[46532.]—**Confervæ on Portland Cement.**—Coat the Portland with silicate of soda, or else put in some snails to keep the confervæ down.—T. P.

[46544.]—**Glass Rendered Dim.**—If you cannot clean it with strong potash solution, try weak solution of sulphuric acid.—C. K.

[46613.]—**Organ.**—The felt I use is the best table felt about ⅛in. thick, but a *best* plain felt which can be obtained at any carpet warehouse will answer. The advantage of felt over two or three thicknesses of leather is that its keeps it elasticity so much longer. 2. The wind-bar is usually fixed into the ends of the wind-chest, but is not glued to the bars; it is screwed to the thick bars, and a strip of leather is glued to the wind-bar and soundboard. 3. If your Open Diapason is voiced quietly, make the C C in wood 4½ by 3¾, and cut the mouth one-third; but if it is voiced strongly, cut the mouth one-half in height, and give wind to correspond. It should be a difficult matter to tell where the metal ends and the wood begins. 4. None at all; I never use them. Neither are they necessary, and much less useful. I have built many one-manual organs for chambers, and never felt the want of runners, *alias* "castors," and I would not like to build a two-manual organ with independent pedal organ on castors for anyone. In every case they do more harm than good. The use of them implies either bad design or bad workmanship.—J. DRESSER.

[46618].—**Connecting Bourdon Stop with Pedals.**—How long is it since "G. E. S." read

the ENGLISH MECHANIC? "Adept," I am sorry to say, left us more than 10 years since, and "J. D." changed his signature more than eight years ago. If "G. E. S." will give some idea as to the size of his organ, and the height he can allow for his Bourdons, I will help him. Cut the CCC boards 8ft. 2in. long, and the block 3½in.; the CC 4ft. 2in. long, the block 3in.—J. DRESSER.

[46629.] — **Chemical.** — Ammonium chloride could be purified by re-sublimation. The process may easily be conducted by placing the chemical in an earthenware jar, inverting a larger one over it, and applying heat. Any dealer in chemical apparatus will supply you with a book of labels for laboratory.—W. B. A.

[46646.]—**Marking-Ink.**—Some such colouring matter as archil, or an aniline colour, is added to marking ink to give it body. Add to your formula ¼oz. archil. A better ink I prepare by precipitating silver carbonate, dissolving in tartaric acid and ammonia, and adding about 10 per cent. gum and 25 per cent. archil. Requires a warm iron over the marked linen.—W. B. A.

[46670.]—**To Gelatine Paper.**—Have you tried polishing your glass before use with finely-powdered French chalk? I think it will effect your purpose.—W. B. A.

[46672.]—**Binding Screws.**—To. MR. LANCASTER.—I shall be greatly obliged if you will favour me with the instructions for making the above that you offer.—CRUX.

[46680.] — **Horizontal Escapement.** — If "Working Blacksmith" practises the rule, as given on p. 182, of putting horizontal escapement in beat, I have no doubt he will at some time or other find himself at sea. For instance, we will suppose he has got hold of a watch which has had a new cylinder, and the balance not put on in its proper place, then "Working Blacksmith," I am afraid, will find his watch as far out of beat as ever. Now I think I can give a more definite system of putting horizontal watches in beat than that. For instance, in putting the balance, bring the face of cylinder opposite 'scape-wheel jewel; then put your hairspring pin in stud, leaving it slack enough to enable you to draw the spring either way. Then, with a pair of fine-pointed watch tweezers, very gently press forward the fourth wheel (that is the wheel next the 'scape wheel), keeping your eye fixed on one of the balance arms, at the same time noticing where the arm starts from. If you have been fortunate enough to get the watch in beat, which sometimes happens, you will see the balance-arm move an equal distance on each side from where it started from. In case it should not do so, and you have more draw on the right than the left, let out the spring a little; work in this manner until you have the lift or draw equal. Then put your pin in tight, and you will find your watch in perfect beat. The same rule applies to verge and lever work, with the exception of what is called fourth wheel in lever and Geneve watches, is the contrate or crown wheel in verge watches.—THIRDS' PRACTICAL WATCHMAKER.

[46686.]—**Organ Reeds.**—"Wits' End" had better get some one who knows his work to put the oboe back into the swell. If he came into my shop and put a reed pipe to his mouth, he would soon find the 5s. fine laid on for so doing. No one but a person totally ignorant of reed work would attempt to do such a trick as poor "Wits' End" has done, and many a good organ is spoiled by such clever performances.—J. DRESSER.

[46690.] — **Waterproofing Fabrics.** — On several occasions lately queries have been sent to the "E.M." asking how to render clothing material waterproof, and in replies directions have been given either to use linseed-oil and size, or to soak the articles in solution of alum and lead acetate. As the whole subject of waterproofing ordinary cloth or linen fabrics seems to me of great importance, I would venture to call the attention of our readers to that small portion of the subject which has come within the scope of my own knowledge, to give suggestions, and to ask information. I think that, to get a waterproof garment few would like to spoil their coats with linseed-oil, to stiffen them with size into the similitude of a "sou'-wester" cape, or to subject themselves to the chance of poisoning by the use of lead. The great desideratum is a process by which ordinary cloth may be made waterproof, or even unwettable without damaging its appearance, rendering its use unpleasant or harmful, or hindering the free passage of air through its pores. The objection to indiarubber is, of course, that it is heavy, stops perspiration, and is not adapted to be worn in both wet and dry weather. A patent was taken out in 1875 by a Frenchman for waterproofing fabrics by passing them from a roller through a bath of paraffin dissolved in carbon bisulphide or naphtha, and then, after pressing between rollers to remove excess of liquid, driving off the solvent in a hot chamber, and so leaving paraffin in the fibres of the cloth. I should imagine that there are several objections to this process; but I suggest that something similar might be done by way of trial by the querists, and I shall be glad to learn the result. It seems to me that it is by no means impossible to get a practical process of waterproofing goods so that water shall roll off them without wetting, and also air pass freely through the pores. In the animal creation many aquatic birds have oily feathers and can dive under water without a wetting; and in the vegetable creation many plants have leaves covered with delicate hairs which throw off the rain. And even water itself supports small globules, owing to what is called "surface-tension." How would it be to manufacture a fabric of a hairy nature, and partially saturate the pores with some unobjectionable oil. —KERUX.

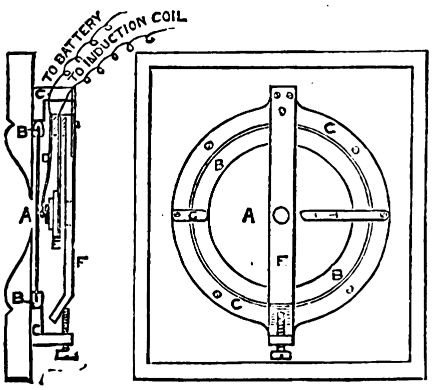
[46699.]—**Shellac Cement.**—I consider shellac useless for this purpose. The following answers well: Place some isinglass in a wide-mouthed bottle. Put the bottle in boiling water, and add sufficient acetic acid drop by drop until the whole forms a stiff paste. Stir well, and, when required for use, place bottle in hot water until contents are softened. Apply to glass with a camel-hair pencil. —W. B. A.

[46700.]—**Intensity Coil.**—When making my first intensity coil I obtained similar results. The sticking of the break's hammer to the core was caused through imperfect insulation of the two sets of tinfoil forming the condenser. Examine your condenser in this direction. The reason why the "breaker" does not vibrate when the condenser is detached may be—too great a stiffness of the hammer-spring, too great a distance between the core and hammer, or imperfect metallic contact between "breaker" and regulating-screw when the hammer is at rest. The points of contact should be amalgamated, or, still better, consist of small platinum wire and disc soldered to regulating-screw and "breaker."—KRAUTBRACK.

[46702.]—**Drills.**—Drills for iron and brass are different from each other, as the latter has its bevelled edge at a sharper angle than the former. They may be set by grinding the flat side on a grindstone and then finishing on an oilstone. To harden them it is necessary to first heat them in a clear fire. When of an even red cherry tint they should be taken out and plunged into a vessel for about ½in. down; then count ten, and immerse the rest of the drill, then rub them on an oilstone.—BEETLE CRUSHERS.

[46704.]—**Blake Transmitter.**—The carbon is not fixed to the diaphragm in the Blake transmitter. This instrument was fully described and illustrated in Vol. XXXI., No. 781, page 14, ENGLISH MECHANIC. If "Practical Amateur" finds any difficulty in getting the copy of "E.M." to which I refer, I shall be happy to lend him one I have, if he will give his name and address. I have recently made a pair of the above form of transmitters, which give splendid results, but they are rather difficult for an amateur to construct.—J. P. M.

[46704.]—**Blake Transmitter.**—There is no electrical connection between the microphone and the diaphragm; the latter simply vibrates from the action of soundwaves. Any other substance but iron may be used; but experiment proves iron the best for this kind of transmitter. I send back and sectional views, which I hope will be useful.



A, diaphragm; B B, indiarubber band surrounding diaphragm; C C, cast-iron ring, screwed on to case; D, fine spring, tipped with a bead of platinum; E, microphone, sunk in brass cap and suspended by piece of watch-spring; F, micrometer adjustment; G, small stiff piece bent brass, pressing upon indiarubber band to keep diaphragm in position; H, stiff spring, the end covered with indiarubber, pressing firmly upon diaphragm, near centre, to control vibrations. The springs, D and E, and adjustment-bar, F, are insulated from each other by pieces of vulcanite. The current flows thus: from C of battery to spring D, thence by contact through microphone E, through primary-wire of induction-coil to Z of battery, and thence to C of battery, completing the circuit. The secondary-wire goes, of course, one end to line, the other to earth or return wire. If this is not found sufficiently clear, shall be glad to assist you further.—YOSHI.

[46713.]—**Bleaching Clothes.**—The following recipe, which I saw the other day, may prove useful:—Take 4 pounds washing-soda, and put it into 1 gallon boiling water. Boil the whole half an hour. Then add 1 pound chloride of lime free from lumps. Strain when cold, and keep in corked bottles. A teacupful is sufficient for a large wash. —W. B. A.

[46715.]—**Photographic.**—(1) I should advise "Semper Fidelis" to purchase a handbook on the production of opals. (2) A cloth bellows may be easily made at a trifling cost, by any amateur; cut some thin cardboard to the length required, and mitered at the ends; glue on with thin glue on to Italian cloth or black twill. For a bellows for camera 7¼in. by 4½in., ⅝in. will be about the right width; if larger, wider in proportion. Let each piece be about ⅛in. apart, leave about 3in. of cloth longer than required, and arrange the cardboard so that the inner joint will be at the top of bellows, and the outer one at the bottom, or you will have a thick and ugly joint. Now glue together, leaving the cardboard outside; then cut another piece of cloth and glue the bellows with very thin glue and put the cloth on, working well into the blank spaces with the fingers; put on one side till nearly set, then fold and place under a weight. A much nicer appearance will be obtained if the outside is thin leather instead of cloth.—JAMES PARKINSON.

[46715.] — **Photographic.** — I have made a camera bellows, which works well, as below. Cut some cardboard into strips (1) the size, when placed together, of the bellows required. Take the pieces required (2) for, say, the bottom of bellows. Lay them on a table (3), paste together by sticking brown paper over the whole. Proceed the same for the other sides. Place them in position. Glue brown paper over the whole, and upon that one thickness of black twilled calico. The apparatus will last a long time and work well.—W. B. A.

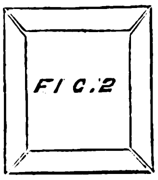


FIG. 2

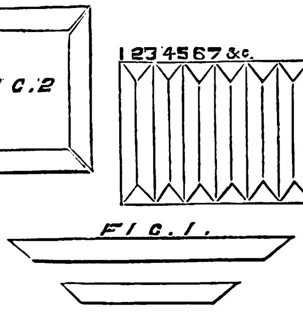
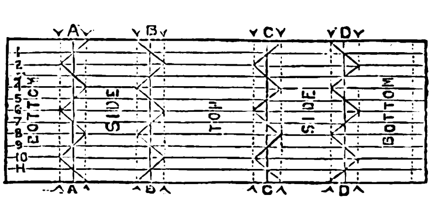


FIG. 1.

[46715.]—**Photographic.**—1. Opal plates are prepared in the same manner as any other dry plate; the difference is in the glass opal being used instead of plain glass. 2. To make a camera bellows, obtain a piece of black twill of the required size, and glue thereto a piece of brown paper, dry, and rule lines as per sketch. The lines numbered 1, 2, 3, &c., should be an inch apart. The others, *a a*, *b b*, *c c*, and *d d*, must, of course, be at a distance corresponding to the lengths of the sides, top, and bottom of camera. The dotted lines *v v v v* are an inch distant from the last. Now fold as follows:—1. towards you; 2. back; 3. towards you, and so on till all are folded; rub the creases well down, and again spread your bellows out flat. Now fold *a a*, *b b*, *c c*, *d d* (the brown paper being uppermost) all towards you, crease well and again spread out flat; now fold the diagonal lines all inwards, and pinch them with a pair of nippers, blacken the brown paper with some dead black varnish, glue the two ends *x* and *x* together, and I fancy you will have but little difficulty in finding the way to coax the bellows into shutting up. If "Semper Fidelis" finds any difficulty about this



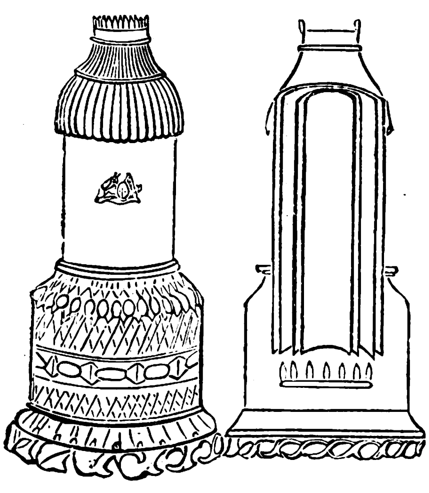
job, and will advertise his address, I will send him a piece already folded as a pattern for him to work by.—GLOWWORM.

[46732.]—**Microscopic Fungi.**—"L. L." will find in No. 836, Vol. XXXIII., page 84, directions for mounting leaf fungi as opaque objects; he must, however, take care that before putting them into the cells they are thoroughly dry. I keep mine between blotting-paper for two or three months before mounting.—T. W. W.

[46741.]—**Landscape Photography and Dry Plates.**—If "Holiday Work" will make an emulsion after the following formula, I think he will have just what he requires:—Ammonium bromide, 36gr.; idodide potass, 4gr.; chloride ammonium, 2gr.; gelatine, 70gr.; water, 1oz.; nit. silver, 65gr.; water, 1oz. Emulsify at about 90° F., and keep at same temperature for one hour, wash, filter, and coat plates. I find this very little quicker than wet collodion, and a splendid quality of plate.—GLOWWORM.

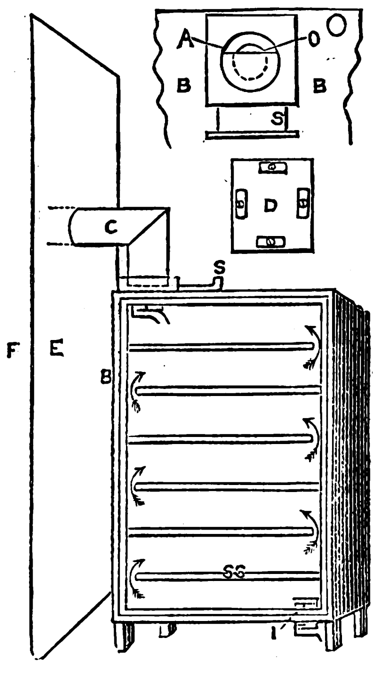
[46745.]—**Stopping Teeth.**—"Murano" has evidently overdone his stopping. The correct thing is to place a tiny crystal of pure carbolic acid on cotton wool, introduce it into the offending tooth, then (if you like), a little collodionised wool, and over all a small piece of cotton wool saturated with a solution of gum-mastic in ether. This is the treatment practised in one of our largest provincial hospitals.—W. B. A.

[46746.]—**Balmer's and Phillip's Gas-Stoves.**—It was recommended as the best means of altering an old stove. A description was then given. I now send a drawing of one I have in use. A round ring of jets are made to burn between two sheet air space cylinders, as shown. It will be seen that there is a large amount of heated surface by this arrangement. The cylinders are screwed together at bottom, and a row of holes punched round opposite to the burner-jets.—THE GAS-MAN.



[46765.]—**Periosteal Rheumatism.**—That means an affection of the bones; there is also nervous and muscular rheumatism. I think I have fifty remedies for my complaint, and I have tried most of them without effect. I have had the best professional advice, have even tried to form a diagnosis of my case to help them; they without exception say it is either a sprain or rheumatism. As the complaint did not kill me I left them, and get on as well as I can. But now I'll say what I think is the matter with both of us: it is the liver that causes all this pain. Professor Huxley says: "The liver is the largest glandular organ in the body, weighing 50oz., which lies in the right side of the body, immediately below the diaphragm, &c.; it lies edgeways and fits into the diaphragm, while its lower surface touches the intestines and right kidney." I find it impossible to lie on my right side; it causes immense pain in back and right arm. I was told to forsake malt or alcoholic liquors, and try milk diet; it made me worse, and brought on a fit of piles, which I got rid of with much trouble. What people call a stitch in the side proceeds from inflammation of the liver; it adheres to the diaphragm and affects the breathing. Our case is enlargement of the liver. What's the remedy? Purgatives? Alas! no: they will only serve to increase the production of secretions, and excite the organ when it should be less active. I only say what I know. The less we eat and drink the better, and take plenty of exercise. I cannot advise further at present. The Turks have great respect for the liver. A cadi addressed Layard as "Friend of my heart and joy of my liver."—FIDDLER.

[46747.]—**Rapid Drying-Box.**—I send desired sketch with pleasure. The letters correspond. A, opening for tin chimney; B, box; C, chimney, which should be forced into opening in strawboard screen, entirely covering a fireplace; D, light-tight door, omitted in sketch; E, screen; F, fireplace; I, air inlet; O, air outlet; S, sliding shutter; S S, shelves. The edges of the shelves, and inside of door, must be covered with felt or flannel, to insure proper current of air, the direction of which is shown by arrows. The box should be used after the fire is out, in a fireplace with a good draught. In summer a Bunsen should be burnt in the grate, to create draught.—GELATINO-BROMIDE.



[46753.]—**A Water-Closet Nuisance.**—If "Silence" will get a short piece of indiarubber hose-pipe and force it on to nose of ball-tap and leave it so long that it may reach to within an inch of bottom of cistern, it will stop all sound as soon as the water rises to above end of hose-pipe. I have proved it often.—A. RICKABBY, Newcastle-on-Tyne.

[46773.]—**Prince of Wales Harp.**—If Mr. Worley will observe the following instructions he will be able to make a Prince of Wales harp that will be far superior to those sold in the shops. Presuming that Mr. Worley is acquainted with the shape of these instruments, I propose that he should make a strong frame of the shape required of good dry beech ¾in. thick. The longest side of this frame should be 18in. and the shortest 15in. The width of the frame should be 12in. The width of the pieces forming the two sides of the frame should be 1½in., and the end pieces 2in. wide. The bottom of the soundboard should be of dry beech ⅜in. thick, planed smooth on both sides, and firmly secured to the frame with hot glue and a few good screws. The upper part of the soundboard may be made of dry beech not more than ¼in. thick before planed. This also should be firmly secured to the frame with good hot glue, but before securing, drill six holes of 1in. diameter, three in a row about 1in. apart in the centre. When this is firmly secured to the frame, place two bridges about 1in. from the ends of the frame, one at each end; cut a small groove in each of the bridges, which should be made of hard wood ¼in. thick and ½in. wide, and glued firmly to the upper portion of the soundboard. In each groove place a piece of thick iron wire, which should be perfectly straight. Secure 18 steel pins a little beyond the bridge towards the edge of the straight portion, or bottom of the soundboard. This will serve to fasten the ends of the wires to. At the other end, which is slanting, fix eighteen good pianoforte pegs ½in. from the bridge. The instrument is now ready for wiring. The wire used should be fine steel wire, such as is employed for the higher treble notes in a pianoforte. In the instrument described there will be eighteen wires, and consequently eighteen notes. The lowest note should be tuned in unison with the 4th or G string on the violin. These eighteen notes will make a compass of a little more than two octaves, excluding the semitones. If any semitones are required, it will be necessary either to reduce the compass or otherwise to increase the width over 12in. The pegs and pins should be placed ½in. apart, in order to allow room for the fingers in playing. Should Mr. Worley require further explanation or information, I will gladly comply with his request, and do my best to help him.—G. FRYER.

[46818.]—**Putting Chain in Watch.**—If you look at the bottom or large part of the fusee, you see a slot cut in the groove where the chain runs, and in this groove there should be a pin, and on this pin you must hook your chain. If you look at the outside of barrel you will see a small hole, this is for the other end of the chain. Take the movements in your left hand, with the pin in fusee and hold barrel upwards, so that they may be easily got at; now hook the V hook (it generally has tail or spike) in the barrel. Place the thumb of your left hand lightly on the hook to keep it from dropping out; let the chain hang straight between the two plates; now take your pliers or a key, turn the arbor backwards, keep your thumb on the barrel to guide the chain and steady it. When you have got chain on barrel, with the exception of about half an inch, take your tweezers and put U-hook under the pillar and hook it on to the fusee; now turn the arbor and allow watch to run down: now put on ratchet, and set up about half a turn; now put on regulator, next balance, get it in beat, &c. I did not give this in my article—I did not think of it. If there is anything else I forgot, I will explain if asked.—A FELLOW-WORKMAN.

[46819.]—**Telescope.**—"Aqua Fortis" is very strong. He asks, "Why are not telescopes made with concave eye-lenses, and the definition would be improved." As to the object being seen erect, that is of no importance in astronomical telescopes. Now, telescopes are made with convex eye-lenses, because the definition is better than with concave. The field is larger, &c. In fact, I would advise "A. F.," as Sterne advised the possible questioners as to the pedigree of "Uncle Tickletoby's mare," to "Read, read, read." I will suggest to "A. F." "Herschel, on the Telescope" (Adam and Chas. Black, Endinburgh, publishers) for a start. It would take up a lot of space, more than our Editor could spare, to go right back to "A. F."; it is a long story.—PRISMATIQUE.

[46823.]—**Watch.**—To "FELLOW-WORKMAN." If you cannot fit a crystal to your bezel in its present form, you will not (in my opinion), be able to fit it at all, as any alteration in the height of the bezel (which would, of course, be necessary), would spoil the look of the watch. You might possibly get a crystal sufficiently concave to clear the hands, &c. Try Stockall, 6 and 8, Clerkenwell-road, or, M. Cohen, Kirkgate, Leeds. —A FELLOW-WORKMAN.

[46823.]—**To "A Fellow-Workman."**—I have sent full instructions for weakening hair-springs, which is in hands of Editor. "Ted Arthur," I think, will succeed with the said instructions.—A FELLOW-WORKMAN.

[46832.]—**Value of Lease.**—Not having seen the property, I should say the present value of "Farmer's" 18 years' lease, to pay 7 per cent. (which it should do), would be £2,600; but if only calculated on the 6 per cent. rate, the present value would be £2,790.—THOMAS WISE, 83, North-street, Clapham-common, S.W.

[46833.]—**Bumping Noise in Engine.**—Most likely your flywheel is not keyed on tight. Cure for this is to cut a key-groove in the shaft, and make a key that will fit both that and the key-way in the boss of the wheel itself.—J. K. P.

[46833.]—**Bumping Noise in Engine.**—I would recommend you to take off the cover of the valve-chest, and ascertain if she does not commence to "open her ports" when the crank is on, or after it has passed the "dead centres." In order to work smoothly, the cylinder should begin to take steam before reaching the dead centres.—J. J. A., Liverpool.

[46840.]—**Organ Reeds.**—I had written another reply to "Wit's End" before I saw this query. As the pipes were in good order when in the swell, it is evident that the wind supply is now insufficient. I should say put them back into the swell, and leave well alone.—J. DRESSER.

[46843.]—**Gas-Inspectors.**—You must first get the Justices of the Peace in general or quarter sessions assembled to adopt the Sales of Gas Acts, 22 and 23 Vic., cap. 66, and order the standard holders, &c., necessary. A 5½ft. holder costs £30 or £35. They can, if the Act is adopted, determine where and when the inspector shall attend to test meters. You should read the book by the late chief inspector of Edinburgh (Mr. Ferrier), which may be had from McKenzie and Suthren, Leith, for 6½d. —A. M. T.

THE New South Wales South-West Railway is now open as far as Carrathpool, or 320 miles in a continuous line from Sydney.

THE electric conductivity of phosphor bronze is given as two and a half times that of iron and steel, and one-third that of copper.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, "C. R. M.," N.Z., has replied to 31095.

46215. Stamping Ink, p. 625.
46219. Viola, 625.
46233. Magnets, 626.
46236. Watch Mandrel, 626.
46239. Movable Hand Drilling Machine, 626.
46244. Differential Calculus, 626.
46254. Parasol Rods, 626.
46264. Panoramas, 626.
46265. Dumbleton's Screw-Cutter for the Lathe, 626.
46266. Lathe Division Plate, 626.
46270. Jeweller's Plate-Glass Cases, 626.
46274. Process Printing, 626.
46275. Press Tools, 626.
46276. Newtonian Telescope, 626.
46279. Visibility of Nebulæ, 626.
46280. Microscope Stand, 626.
46287. Paper Box-Making, 626.

46495. Silicate Paint, p. 90.
46502. Proportioning Slide Valves, 91.
46505. Movable Stage for Theatrical Performances, 91.
46508. Lime-burning, 91.
46521. Emigration—South Africa, 91.
46522. Oil-Extraction by Carbon Disulphide, 91.
46523. L. and N.W. Engines, 91.
46525. Botanical, 91.
46527. Memorandum Tablets, 91.
46545. Purification of Water, 92.
46546. Moulds for Glass, 92.
46549. Science Questions, 92.

QUERIES.

[46846.]—**Engineering.**—Would any reader of the "E. M." kindly inform me if an examination has to be passed before a person can become an engineer, either mechanical or civil, and if so, what are the subjects?—SEAWEED.

[46847.]—**Equation.**—The following equation appeared in your journal some time ago for solution as an adfected quadratic; but in my opinion the attempts then made to solve the problem as a *quadratic* were all unsatisfactory, while some of them were decidedly illegitimate. Moreover, the equation having hitherto (as far as I am aware) been considered insolvable as a quadratic by the usual means of completing the square, and the only solution I have ever yet been able to obtain from a large circle of mathematical friends has been that of a factor struck out from an expression involving higher powers than a quadratic. I beg, therefore, to submit the following solution as satisfying the conditions of the equation as an adfected quadratic:—

$$x + y + z = 11. \quad (1)$$
$$x^2 + y^2 + z^2 = 49. \quad (2)$$
$$zy = 3x(z - y). \quad (3)$$

Subtracting (2) from the square of (1) and reducing, we obtain—

$$xy + xz + zy = 36. \quad (a)$$

Subtracting (3) from this, we get—

$$2zx - xy = 18. \quad \therefore zx = 9 + \frac{xy}{2}. \quad (b)$$

$$\text{From (3) } zx - xy = \frac{zy}{3}. \quad (c)$$

$$\text{From } (a) \; zx + xy = 36 - zy. \quad (d)$$

Substituting the value of zx from (b) in (c) and (d), we get—

$$9 - \frac{xy}{2} = \frac{zy}{3} \quad (E)$$

$$9 + \frac{3}{2}xy = 36 - zy.$$

Multiplying these together—

$$81 + 9xy - \frac{3}{4}x^2y^2 = 12zy - \frac{z^2y^2}{3}.$$

$$\text{Then } \frac{x^2y^2}{4} - 3xy = \frac{z^2y^2}{9} - 4zy + 27.$$

Completing the squares of both sides—

$$\frac{x^2y^2}{4} - 3xy + 9 = \frac{z^2y^2}{9} - 4zy + 36.$$

$$\therefore \frac{xy}{2} - 3 = \frac{zy}{3} - 6$$

$$\frac{xy}{2} = \frac{zy}{3} - 3.$$

Substituting this value of $\frac{xy}{2}$ in (E), we get—

$$9 - \left(\frac{zy}{3} - 3\right) = \frac{zy}{3}, \; \frac{2}{3}zy = 12, \; zy = 18.$$

From which the values of x, y, and z are readily found.—J. LANE DAVIES.

[46848.]—**Watch Repairing.**—Will "Fellow Workman," or any other correspondent, kindly inform me how to get the fusee chain on barrel? The watch is one of the old style, having a worm instead of a ratchet-wheel. I have tried putting the chain on whilst top-plate was off, but it always slipped off the barrel when putting the plate on. Also, how to lacquer brass dial for clock-face?—A. RIGG.

[46849.]—**Bent Timber Trade.**—I have a small wheelwright's business which I am desirous of further extending, but as it is situated in a small provincial town, there is very little chance of doing this locally. I should, therefore, be glad if some kind reader would suggest something which could easily be manufactured, and for which there is a good market in London, or any other large city. I have steam-power, and labour and materials are cheap; distance from town 100 miles. My own idea was to go into the bent timber trade, shafts, felloes, &c., for the London market; but I have been told this is already overdone. Can anyone say is this so? Any information or advice will be appreciated by one—ANXIOUS TO GET ON.

[46850.]—**Electro-Magnet.**—Will some fellow-reader kindly answer the following?—Last week I purchased an electro-magnet about 2½in. long, with core ½in. in diam. I found that it would not work even with three pint bichromate cells, newly charged, so I took it to pieces and found that upon one limb there were seven coils (about 125ft.) of silk-covered wire, while upon the other there were only three coils. Was this the cause of the magnet not working? If not, what power would be necessary to work such a magnet? Also, what power would be necessary to work it if each limb were wound with an equal number of coils?—PERPLEXED.

[46851.]—**Queensland.**—Would any of your kind correspondents give a few hints on this colony? What prospects are there for a mechanic with a fair knowledge of marine and land engines and general work, with second-class engineer's certificate? Would he be likely to find employment?—FARQUHAR.

[46852.]—**Swollen Glands.**—To DR. EDMUNDS.—Having, for about a year past, been annoyed with swollen glands on the right side of the neck, I should feel much obliged for any information which would lead to their permanent removal. I am 18 years of age, of fair complexion, and enjoying good health.—INQUIRER.

[46853.]—**Bunions or Enlarged Toe-joints.**—Will "Homeo, Nyborg, Denmark," kindly advise me as to the best means to apply to a bunion or enlarged toe-joint. I have them on both large toes. Curiously the one on the left foot I never felt, whilst the one on the right foot of late years has taken to grow a hard skin on the top with a dark centre. This, I found on carefully paring down, was coagulated blood. In doing it, I made it bleed very slightly, and it was perfectly easy for a week or so. Now it is again growing the hard skin, and is most painful when touched. Any suggestion for relief will be gratefully received by—S. J. M.

[46854.]—**Mechanical Action.**—I have two bottle batteries, usual construction, in left-hand back corner of a large case, and I want an arrangement that will prevent the lid of case being closed until the rods of cells are drawn up, to work automatically by the pushing down of the rods. It should also be so constructed that the lid accidentally falling down will not injure the cells.—S. J. M.

[46855.]—**Cayenne Feeding of Canaries.**—Will some reader give a few hints on the above?—AN OLD SUBSCRIBER.

[46856.]—**Electrotypy.**—I have some plaster casts about 6in. diam., nearly flat, which I have been trying to reproduce in copper by electro-deposition; to do which, I made up a couple of Daniell cells, thus—I fitted into two half-gallon pickle jars, copper cylinders filling the inner circumference, porous pots 7×2½, zinc cylinders 1in. dia., unamalgamated in porous pots, exciting liquid, rain-water, and provision is made to keep the copper solution saturated. The plaster casts I coated to saturation with boiled oil, and when dry, carefully covered with black lead, Nixey's, and put into the depositing bath, composed of four parts saturated copper solution, and one part water, to which one-tenth (by measure) of sulphuric acid had been added (Sprague). I coupled up the cells intensity form, and left them—expecting to find a nice deposit of copper on the casts in the morning; but, to my disgust, found only a slight sandy deposit near the supporting-wire, and my porous pots nearly empty. I filled them up again, and in a few hours they were again in the same condition. Now, I can account for the non-deposition on the casts in a measure, owing to the blacklead being bad, or using too much battery-power, or perhaps both combined; but I can't account for the exosmose. I also tried dispensing with the battery by placing the porous pot into the depositing bath (after saturation), and connecting the cast up with the zinc, but could get no further deposit. I have been pretty successful in depositing gold, silver, and alkaline copper; but this is my first attempt at the black lead business in a sulphate solution, and I never have had exosmose occur before.—DISPART.

[46857.]—**Cheap Form of Battery.**—Will your correspondent, H. E. Hawkins, kindly supply the following particulars concerning his battery? viz.:—How he conducts his connection-wire from the iron borings, and how many hours each day, and for how many days the lamp would burn to give a good light? as I presume he has given it a fair trial. My Swan lamp is about 2½in. in diam., and I had an opportunity lately of trying how many ordinary quart cells of bichromate it would take to get a good light, and found it would take 50, and they soon exhausted themselves. So I had to abandon the idea on account of the cost. If Mr. Hawkins will give me the required information, or any other that may be of service to me in lighting my lamp for, say, two hours each evening, I shall be exceedingly obliged to him.—H. M.

[46858.]—**Organ Playing.**—I am a good hymn-tune player, having a fair knowledge of music and time; but being almost entirely self-taught, I am not able to execute pieces upon the organ as quickly as is requisite. I shall, therefore, be glad to know what would be best course for me to follow in practising, what music I should practise, and study? Am not afraid of working, but want some kind fellow-reader to put me in right groove. I have a small Estey organ, no pedals.—POOR QUILL DRIVER.

[46859.]—**Indigo Blue Dyeing—Read, Holliday, and Son's Process.**—Would some of "ours" kindly inform me as to the above process, and in what manner it differs from woad vats?—BLACKWATER.

[46860.]—**Wills and Trustees.**—To MR. WETHERFIELD.—Querist has a small family of girls, in whose favour he wishes to make his will. Unfortunately, what he has to leave them is but small—consisting of furniture and a few hundreds—saved by means of life-insurance. Querist would wish the money kept intact, the interest to be devoted to their support, and the principal divided share and share alike when all are married, but has no one whom he could ask to act as trustee—a generally thankless and troublesome office. Would Mr. Wetherfield kindly say if the Court of Chancery would act in such a case? If so, what officer should be named, with any other information likely to be useful in carrying out the object in view? Querist has been told by some friends that it would be a very expensive mode of protecting their interest, counsel having to be employed at every hand's turn. But to set against that there would be the perfect safety of their small property.—H. NOLAN.

[46861.]—**Cockroaches.**—To what tribe do these belong? I know their names, Blatta orientalis, but I want further information as to their classification. Do they belong to the locust tribe, Gryllus, and to the Neuroptera? In what respect do they differ from the Coleoptera? A friend of mine examined the wings with the microscope, and found them folded back. Why cannot they, and other insects which have wings, fly?—BRICKWALL.

[46862.]—**Telegraph.**—I have an electric telegraph; it runs a distance of about sixty yards. They work pretty fair at a distance of about half-a-dozen yards, but, at the full distance, the needles only move slightly. I have used No. 26 cotton-covered copper wire for inside the telegraphs. I also used the same varnished for the conducting-wires. Does this offer too much resistance? What size should I use for the telegraphs, and what size for the conducting-wires? Why should a fine wire offer more resistance when in a line than it should when wound in an induction-coil where there is a stronger current?—A. H. B., Olney.

[46863.]—**Painting on Silk.**—I have to paint a banner of red silk. The subject is simply a scroll and lettering in gold and silver. Will some of our able correspondents kindly give me full information as to preparing the silk, the kinds of paints to use, and the method of silvering and gilding the letters, and very much oblige—ARTIST.

[46864.]—**Canvas Canoe.**—I have made a light canvas canoe, 9ft. long, 2ft. beam, and 1ft. deep, but I find that I cannot sit in it without about half a cwt. of ballast, as it is too high out of the water. I should be much obliged if some kind friend would tell me where the fault lies. Is it because the canoe is too large? I weigh about nine stone, and I think it would hold two persons of my weight; but I only want it to hold one. I should like to make it smaller if someone would be so kind as to give me the dimensions of a canoe which would carry me without any ballast. Every time I have used it I have had to fill two bags with gravel and put them in the bottom of the canoe; but that was rather too much trouble, as I have to carry it some distance to the water.—ROB ROY.

[46865.]—**Cod-Liver Oil.**—A child aged eighteen months suddenly refuses to take the above, after having taken it about two months with good results. We know of no means of getting it into him now but during the time that he is crying, as he closes his teeth firmly as soon as it is within smelling distance. I would like to know if we may expect it to do him the same amount of good when forced into him in this way. Or I would be glad of any hints as to mixing it or otherwise, so as to induce him to take it as before.—LEEDS.

[46866.]—**Photographic.**—I shall be greatly obliged if some reader of the "E. M." will kindly answer the following questions:—(1) What is the principal cause of want of density when using dry plates? Is it possibly want of sufficient emulsion on the plates? (2) What is the least quantity of emulsion required to coat a quarter-plate? (3) In most formulæ for emulsions in which heat is employed to increase sensitiveness, the washing has to be done after heating. Will washing before heating in any way change the nature of the emulsion? Is one thickness of deep ruby glass sufficient for a dark-room lantern when using rapid dry-plates? If not, what further protection should be used? (5) Is there any means of removing light fog from an emulsion, or from fogged plates? (6) Can anyone supply me with a good formula for dry plates, suitable for landscape? I gather from what I have read that rapid plates are by no means suitable.—L. C. N.

[46867.]—**Bichromate Battery and Intensity Coil.**—Many thanks to J. M. Stocks and G. Tolman for their answers to my query. By intensity coil I meant, could I make one to increase my battery-power equal to sixty bichromate cells? Also, does the solution lose its strength by exposure to the air, as I made a fresh solution on Saturday, and on the Tuesday following (May 2nd), when I tried it, the current was only about half as strong; or, if that form of battery is unfit for lighting, would G. Tolman, or any other kind reader suggest a better? Would the battery described by H. E. Hawkins in No. 891 of the "E. M." be better, and also, would H. E. Hawkins, or any kind reader, give me the length of platinised silver strips, and how to connect the currents.—JACK IN A FIX.

[46868.]—**Auctioneers' Responsibilities.**—To MR. F. WETHERFIELD.—I shall feel obliged if a correspondent will kindly give me legal advice as follows:—I placed an article in the hands of an auctioneer for sale, which was not sold; but while in his possession, on or before day of sale, a part of the article was broken and rendered incomplete. I refused to take it away, and sent him a claim for full value of the article. Should I sue him for the whole, or only part of the article broken, providing I can have the part replaced? Can he charge for warehouse-room under the circumstances.—J. CURTIS?

[46869.]—**Carbon, Resistance of.**—Wishing to construct a set of resistances less cumbersome than the Post-office coils, out of powdered carbon, I should be glad of suggestions. Can any one say the best diameter and lengths for the ebonite tubes for the purpose, and give their opinions as to how they think they will answer? I should feel much obliged for references in the "E. M.," or other works, to articles on carbon, particularly to the one written, I think, by "Sigma," where he says, "carbon possesses the little-known quality of diminishing its resistance with pressure."—M.M.I.Sc.S.

[46870.]—**Triple Star in Monoceros**.—On the 15th March, with my 2¼in Bateman, I picked up a beautiful triplet in Monoceros, in about R.A. 6h. 15m., and 7° 0′ S. The components are probably of the 6, 8, and 9 mags., and their position angles [illegible], 305°, and 2′5′, 7′. As I have only seen this star on two occasions, and as I fail to recognise it by either Webb's "Celestial Objects," or Proctor's "Smaller Atlas," will any of "ours" give the name and particulars of it? I don't think it is 11 Mono., as the angles do not agree. I may say, for the guidance of beginners, who, like myself, have these cheap telescopes, they can, when the weather will admit, easily see the companions to Rigel and Polaris, and divide such stars as λ Orionis, γ Leonis, &c., with power 70, and ϵ^1 and ϵ^2 Lyræ with 115 dia.—T. TINDALE, Gateshead.

[46871.]—**Platinised Silver Plates for Smee's Battery**.—Will Mr. Lancaster or Mr. Tolman inform me how the plates are platinised? I have some silver plates, 13 by 9, that have become useless on account of the platinum wearing off, and they have, up to the present, defied all attempts on my part to give them the dead black colour they had on them when they first came into my possession. I have been told it is done with heat and a brush, and that, when done by heat, they give better results than when platinised by the battery process. The plates are very thick, one weighing about 7oz. A cheap and good method will be of great service to—OLD SUB.

[46872.]—**Staining(?) Walnut**.—On sandpapering a walnut worktable I found that the lid was made up of several pieces, which were of different colours. The difference in colour was not noticeable until I took off the polish with the sandpaper. Will someone tell me how to treat the lid so that when repolished it may appear as one piece, as it originally did? Should the lighter pieces be stained? And if so, what stain is used?—POLISHER.

[46873.]—**Tempering Wagon Springs**.—What is the best and safest way of tempering railway wagon springs?—ANXIOUS ENQUIRER.

[46874.]—**Australian Railway Prospects**.—Would some reader give a few hints as to the best part to go, and what are the prospects in the loco department? RAILWAY FIREMAN.

[46875.]—**Model Electric Engine**.—To "SUNLIGHT."—Kindly give more minute details of the engine described by "R. W.," ENG. MEC., March 17th, 1882 (46217). I am in the dark on some points, especially with the working of connecting-rod, G, and beam, B (Fig. 1). What is meant by "Mercury cups M.M.M. connected by N to E"? Please explain construction of keeper, E, and contact-breaker, &c., Fig. 3. Any general information on the subject, and description of good constant battery will be esteemed by—DARKNESS.

[46876.]—**Circular Saw**.—Will some brother-reader of the "E. M." inform me what speed a circular saw should run?—the saw about 18in. and turned by hand from a wheel 5ft. high, and about 2½ cwt. And what sort of teeth would be best for cutting ash and oak? The wheel is what turns my lathe, and I want to work the saw from the counter-shaft. The strap runs off the 5ft. wheel on to 1ft. pulley on the counter-shaft. And a few hints on making saw-bench, and what size spindle and bearings would be best.—A YOUNG WHEELWRIGHT.

[46877.]—**Wheel Skates**.—Will any reader of the "E. M." kindly explain the construction of a pair of pedomotors?—BEETLE CRUSHERS.

[46878.]—**Respiration and Ventilation**.—Will some of your readers kindly say where I have gone wrong in the following conclusion?—In Prof. McKendrick's "Outlines of Physiology," page 309, it is stated in reference to breathing air in a confined space that "when the proportion of oxygen does not fall below 15 per cent., respiration is normal; from 15 to 7 per cent., respiration becomes deep and prolonged; from 7 to 4 per cent., respiration is carried on with great difficulty, and below that amount, there is risk of immediate asphyxia." Now taking the composition of the air at N 79 and O 21, when the O is reduced to 4½ per cent., its place has been taken by CO_2 to the extent of 16½ per cent. But surely asphyxia will take place when there is much less CO_2 than that. Huxley, in "Elementary Lessons in Physiology," page 100, says that asphyxia takes place whenever the proportion of CO_2 reaches 10 per cent. McKendrick, in his small handbook, published by Chambers, under head "Ventilation," page 99, says, "If CO_2 be present to the extent of 1½ to 3 parts in 1,000, headache and giddiness are felt; and if it be increased to 20 parts in 1,000, death will, in all likelihood, be the result." This does not seem to agree with what is quoted above.—VOLVOX.

[46879.]—**Telephone Transmitter**.—Will Mr. Frank and Mr. Tolman accept my best thanks for kind replies to query, and would the latter please send sketch of transmitter, as offered? I am just completing a pair of circuits and calls (as per 46836), and should be glad if he would kindly answer the following:—1. Amount of primary and secondary with gauge? 2. Would Bell's pattern be a good receiver? 3. Over what length of ordinary line wire should they be serviceable if well-fitted? —ON GUARD.

[46880.]—**Analysis of Water**.—Can any of "ours" inform me which is the most suitable battery to accomplish the analysis of water, and which will also give a spark sufficient to explode a mixture of H and O synthetically? I have been pressed by some of my friends to give a lecture during the forthcoming winter to fill up a series, as this is a subject in which I am much interested. If I comply, I should like to make it as practicable as possible. But what I desire most is to make all necessary apparatus myself, even if not of an elaborate kind.—CLAYTON.

[46881.]—**Boring Working Barrel**.— Would "Sunlight" or "Jack of All Trades" favour me with a sketch of a boring bar suitable for boring a 12in. working barrel out with a 10in. centre lathe? The barrel is 9ft. long, and the bed of lathe 14ft. long.—A COLLIERY MECHANIC.

[46882.]—**Dynamite**.—Will some kind reader inform me what gases are produced and disengaged in the combustion of dynamite? And why the force exerted by the evolution of the gases at the instant of explosion is downward, whilst that of blasting powder is upward?—ZULU.

[46883.]—**Bleaching Straw Hats**.—Can any of "ours" tell me the best and cheapest way to bleach straw hats that have been discoloured by the sun?—STRAW.

[46884.]—**Varnishing**.—Could any reader of the "E. M." instruct me what polish or varnish should be used for Windsor chairs that have been newly painted? I have tried French polish (which I bought ready mixed), which does not give satisfaction, and if French polish should be used, how?—7 4 M.

[46885.]—"**Austral**" **and** "**Sahara**."—I shall be glad if any kind reader will tell me the dimensions of the engines and boilers in the above two named vessels owned by the Orient and Cunard lines, respectively?—ALDIBORON.

[46886.]—**Model Marine Screw Engine**.—I have a pair of double-action oscillating cylinders inverted 1¼in. stroke by ⅝in. bore. The boiler is of copper, 6in. long by 4in. wide, 3½in. deep, copper riveted, with one flue, pressure 20lb. per sq. in. Will any kind reader inform me what size of boat these engines would drive? The propeller I propose is 2½in. diam., three blades. Would it drive a boat 3ft. by 4½in. wide, 5½in. deep, at 10 miles per hour? And will the boiler stand any higher pressure than above? It is made of 20 gauge copper. The boiler ends are flanged and lamp underneath.—ALDIBORON.

[46887.]—**Composition for Tablets**.—How is the cream-coloured material made with which portable writing-cases are often fitted? Pencil marks are easily erased from it, either by water or indiarubber.—GLATTON.

[46888.]—**Astronomical**.—Will some correspondent kindly tell me at what point in the heavens the sun is first seen on the longest and also on the shortest day?—*i.e.*, how many degrees to the north or south of east? I have been examining a reputed British cromlech—a circle of large stones, now buried and planted with trees. About 120 yards distant lies a huge boulder, which evidently at one time has been placed upright as monolith. A line drawn from centre of circle to base of this stone, and continued, would strike, I think, the point of latest sun rising. This circle, I believe, will prove to have been connected with the worship of the sun by our ancestors. But please answer above questions.—NEO.

[46889.]—**Microscopy**.—To DR. SCHRÖDER, of Frankfort.—Vague rumours have been circulated, within the last year or more, of the existence of a microtome devised and constructed by Dr. Schröder, of Frankfort (formerly of Hamburg), which is capable of cutting horizontal sections of P. angulatum, scales of Podura, or sections of the brain of minute insects, &c. Will Dr. Schröder oblige by a statement of facts regarding the practical success of his microtome? One would think such an apparatus would go far towards clearing up the much-vexed question as to the "hemispherical bosses," "depressions," or "hexagonal apertures," in P. angulatum, &c., and possibly introduce precise data for at any rate disproving *some* of the multitudinous guesses regarding the composition of the scales of Podura. It is also rumoured that Dr. Schröder constructed (wholly, or in part) the ruling machine used by the late F. Nobert for the production of his famous test-plates, and that he supplied the diamond points used in the ruling. It is well-known that Nobert was extremely reticent about communicating information on his method of ruling. Now, however, by his death—leaving no working successor—there can surely be no further need of secrecy, and Dr. Schröder might render a service to science by figuring and describing the instrument, and the method of using it, the preparation of the plates, &c.? By making such information public property, possible simplifications might be suggested in the construction, and the test-plates thus rendered accessible to a large body of microscopists to whom the present cost of them is entirely prohibitive.—AKAKIA.

[46890.]—**Microscopy**.— To PROF. E. ABBE, of Jena.—Prof. Abbe would confer a boon upon microscopists if he would explain, by means of diagrams, the best method of determining (1) the focal length (= power, as generally understood in England) of microscope objectives, dry and immersion? (2) The focal length of eyepieces, Huyghenian, Ramsden, "Orthoscopic," and "Holosteric"? (3) The combined magnifying power of objective and eyepiece? The third will, I presume, include the answer to the often-asked query, What is to be regarded as the strict 10in. tube—*i.e.*, between what points should the 10in. distance be reckoned? I need hardly inform Prof. Abbe that English text-books of the microscope, whatever other merits they possess, do not overflow with information on technical questions relating to the testing of the instrument, but very much the reverse. Therefore, a short exposition of the subject from the pen of so eminent an authority as himself will, I am sure, be highly appreciated in England, where his name has come to be synonymous with all that concerns the development of microscopy, both in theory and practice.—AKAKIA.

[46891.]—**To Mr. Lancaster**.—I am sorry to give you so much trouble. I have a Siemens' armature (6½in. by 4½in.) wrapped with No. 18, and wish to construct an electromotor on either Griscom's or Trouvé's principle. The resistance of the armature is ·625ohms. What must be the thickness and resistance of the wire on the field-magnets? Could you also advise me as to which principle I ought to adopt, and oblige?—CLOTURE.

[46892.]—**Japanning**.—Among my other duties at an hotel in France, I have to paint about 100 copper hot-water cans. I have tried various kinds of paint, but it all blisters. The cans were originally made and japanned outside in England, and I cannot get them re-japanned here. I should be very thankful if any of "ours" would tell me how to paint or japan them so that they will stand hot water.—BOOTS.

[46893.]—**Speaking-Tubes**.—Will any reader kindly say the greatest distance that a speaking-tube is available for, the diameter of pipe, and any particulars? I have a stable about 150 yards from the house, and am uncertain whether to erect telephone or speaking-tubes.—DIAMONDS.

[46894.]—**Covering Silk Balloons**.—I have made a small silk balloon which I thought I could make air-tight by soaking in oil, but I find it is not perfectly air-tight now. I believe there is some kind of varnish I could use, but could I varnish it without taking out the oil from the silk first. I do not think it would be worth while to take out the oil, as it is not a very large one. I only made it for an experiment. Please oblige—CREDENTIBUS NIL DIFICILE.

[46895.]—**Manganate of Calcium**.—Will any of our chemical friends tell me how to make this, or the permanganate for experimental purposes? And, if either of them are produced commercially? I know how to get the potash and soda compounds.—ANGLO-SCOT.

[46896.]—**Manganese**.—How can I regenerate manganese compounds decomposed by contact with organic matter?—ANGLO-SCOT.

[46897.]—**Powerful Bichromate Battery**.—Would some kind reader give description of above, composed of several separate cells, each cell having several carbons, with means of raising and lowering zincs? If drawing could be sent showing plan of lowering zincs, and of joining all the cells together, so as to give a very strong current for electric light purposes, it would be most useful.—A CONSTANT READER.

[46898.]—**Musical Box**.—Would any reader kindly inform me how to fasten the small springs (or quilling, as it is generally called) on the teeth in the comb of a musical box when they become loose and cause the instrument to scratch when playing? and also if a small musical box can be repaired when it begins to scratch in the same way.—W. J. E.

[46899.]—**Heating-Room for Turkish Bath**.—Will some one kindly inform me of an economical, and, at same time, healthy method for heating a room by hot-air, for use as Turkish bath on a small scale for private use? I want something that will not give much trouble. —DELTA.

[46900.]—**Mounting Micro. Lens**.—Thanks to Mr. Lancaster for his notice of my query. My difficulty is this: In mounting a plano-convex lens with plane side inwards, I can turn a square shoulder on which to rest the lens, and can depend upon its being truly centred; but when it is required to mount the plane side outwards, and have the convex side for a bearance, I fail to see how I can secure its being truly centred in the cell. Will Mr. L. kindly help me?—MICRO.

[46901.]—**Watt's Parallel Motion**.—Can any reader favour me with a solution of the following problem? If the beam and the radius-bar be of equal length, and the distance between their centres of motion be given, what proportion should the length of the link bear to the length of the beam, in order that the middle point of the link shall most nearly describe a straight line?—A. J. SMITH.

[46902.]—**Construction of Maps**.—Can any reader refer me to a book now in print dealing fully with the different methods of projection employed in the construction of maps?—A. J. SMITH.

[46903.]—**Electric Bell**.—Will Mr. Lancaster, or other correspondent, kindly put me right? I have made an electric bell (a small one), but it does not answer to my satisfaction. On completing circuit, instead of getting a clear ringing sound, the blows of the hammer are heard quite as plainly as the sound of the bell. The hammer, when at rest, is ⅛ of an inch from the bell, and, if I move back the contact-screw, the magnet is not powerful enough to draw up the keeper. It appears to me I have got the magnet and armature too near the hammer, and, consequently, cannot get sufficient stroke. Also please say if four layers of 26 wire on ⅜ core is about right for magnet, and much oblige—OLD SUBSCRIBER.

[46904.]—**Secondary Battery**.—Would J. Hezmalhalch, jun., kindly give the dimensions of his parallel plate Sutton's secondary battery, how he connected the wires, what battery power he used to charge it—in short, a full description how to make it.—SEAWEED.

[46905.]—**Incandescent Lighting**.—I have made one of Mr. Bennett's cells, by way of trial. The tin pot measures 5½in. high by 3in. in diameter. It rings a bell fairly well, and I have calculated that three of them would equal two small Leclanchés. Now, I should like to know how many of these it would take to light one incandescent lamp equal to four or five candles.—SEAWEED.

[46906.]—**Swiss Watch**.—Will "Alfojoe," or any other watchmaking subscriber, inform me what is the cause of a clinking noise in a Swiss watch when it is held dial upwards? Also, how to rectify? Also, how can I form an idea of the strength of a pendulum spring to a new watch—viz., by pulling out spring from balance by aid of the tweezers?—HARRIS.

[46907.]—**Benzoline**.—To MR. FRED FISHER.—Would you please tell me if you can use benzoline with your generator with as much safety as ether?—W. H. PITT.

[46908.]—**To Hy. E. Hawkins**.—Would you be kind enough to tell me if a quart cell of your form of cheap battery would be anywhere near the power of a Bunsen cell of same size? Also, object of wooden plug, and length and size of platinum wire in Swan's lamp—if not troubling you too much?—W. H. PITT.

[46909.]—**To "H. S. B."**—Would you kindly give us a description of the electric lamp you used with your Bunsen's battery, as I intend making a battery like yours? W. H. PITT.

[46910.]—**Watch Mainspring**.—Will some horological friend tell me how to calculate the length for new mainspring? I trust "A Fellow Workman" will continue his articles on "Watch Cleaning and Repairing." —BAZIL BEE.

[46911.]—**Lathe**.—Would some reader kindly inform me the capabilities of a 5in. lathe without back-gear, compared with a 4in. with back-gear?—BRASS.

[46912.]—**Medical Coil**.—I have a bobbin 6in. long, with hole of 1in. in diameter. What length (or weight) and size of primary and secondary coils? Can the current be properly controlled by adjusting-screw over contact-breaker? Or, would it be advisable to make use of the iron wire core for that purpose? What kind of battery and size is the best to make the whole a portable and useful apparatus; also, what would be the probable cost to complete it? I might add I have a small lathe, and plenty of small tools.—G. D. G.

[46913.]—**Stopping for Decayed Teeth.**—To "ALFOJOE."—Some time ago I tried in vain to make a metallic stopping, as described by you, that would set hard. What is the reason I could not succeed? Coarse and fine pure silver filings were used, and an amalgam formed, but it would not set in the least. Excess of mercury was squeezed out. Silver, 60 parts; tin, 20 parts; and zinc, 6—but with same result. I have teeth stopped by dentists, and it is quite solid. What is it they use?—J. S. R.

[46914.]—**Drop - Shutter.**—Would some reader kindly describe how I can make a simple but efficient drop shutter to fit a lens, diam. of which is 3¼in.? Full instructions, with the measures, would oblige—F.

[46915.]—**Die-Sinking.**—Could anyone recommend me a good book on die-sinking? Also, inform me what tools, &c., are necessary?—JACQUES.

[46916.]—**Carpenter's Bench.**—Will someone send me instructions for making a cheap, strong, and useful carpenter's bench?—W.

[46917.]—**Raising Water.**—Would any kind contributor give me instructions how to raise water a height of 40ft. from a distance of 70ft. up hill? I am living in Burgoyne Bay, Salt Spring Island, British Columbia, so the materials for making the above are very limited.—W.

[46918.]—**Deeds.**—To MR. WETHERFIELD.—A. buys household property of B, a mortgage being left on the said property of which B. holds the deeds. A. pays the mortgage off. B. will only give the last deed up, refuseing to give up the old deeds, under the plea that A. has all he requires for his safety in the property. Can A. claim the old deeds, or what course should he pursue?—R. J.

[46919.]—**American Organ.**—Will some reader be so good as to tell me how I can get at the vibrators of an American organ? One note of mine (an ordinary four-stop organ, with knee swell) has gone dumb. I wrote to the person from whom I purchased it, and he cannot tell me how to get at the vibrator. I took out the front and upper part, and then the key-board. Under this there is a row of pegs on which the keys act. Behind and in front of these there are two thin boards screwed in. These I took out; but I cannot see any more screws, or any means of getting further towards the vibrators.—B. M.

[46920.]—**Skin Disease.**—Will Dr. Edmunds kindly say what agent to apply after the hair-drawing and poulticing, which he advised "Sufferer," in the case of sycosis, a few weeks back? I have had sycosis 23 years. It began, apparently, with a pimple from a cut in shaving; spreading over the lower part of my face and now going up behind the ears into my head.—ARC.

[46921.]—**Organ or Harmonium.**—If "Joiner" will advise me as to following, it will prevent another query, and complete the information needed. Decided that half rows only be used, as I have sub-bass in way. Can I use strips across under side of soundboard for sub-bass? so making one pallet do the work, and dispensing with the existing double pallet action, which is hard, and wastes wind. Of course I know such channels would have to be radiated, but would the sub-bass be as effective? 2. Adopting this, what length should bass-end pallets be? 3. Shall I glue parchment on under side of strips, and finish with wood where pallet rests? 4. My instrument at present has two rows reeds—sub-bass, and octave coupler. The bellows is 2ft. 11in. by 2ft. 8½in., and opens out 6in. With the two extra half-rows added, is bellows large enough, or can it be enlarged, and how? The case won't admit wider.—BETA.

[46922.]—**Patent Wrought Sharp-Pointed Nails.**—Will any reader please inform me how the above are made?—W. H.

[46923.]—**Hollow Back Vellum Binding.**—I have just made six foolscap folio account books with hollow spring backs, but although fairly satisfactory in the result, the means employed by me were, I am sure, not the correct ones, they being so awkward. A few plain directions in vellum binding, a hint or two on case-making would be welcomed.—PRINTER-BOOKBINDER.

[46924.]—**Anemometer for Use in Mines.**—Could any of the correspondents of this valuable paper give me any particulars of the above instrument as used in coal mines, &c., to ascertain the velocity of air passing in a given time? Any information on the subject will oblige—A NEW SUBSCRIBER.

[46925.]—**Water in Gravel-Pit.**—I have a gravel pit of about two acres, in which I am troubled with a considerable amount of water. I have had serious thoughts about getting rid of this water; could I overcome this difficulty by sinking a deep well down to the mainspring, and so draining same way? I should very much like the advice of some of our practical men. Also, if the above would answer? Which is my best way to sink a well for this purpose, and about what would be the cost of same? Any advice on the above would be gratefully received.—H. BOOKER.

[46926.]—**Regilding Candlesticks.**—I have a couple of candlesticks which I want to regild, and I wish to know whether they are done in gold-leaf or bronze. Would Mr. Soward, or some other correspondent, please give the desired information and oblige. I can do plain gilding.—E. RILEY.

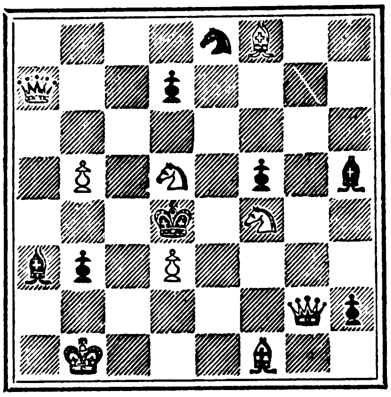
[46927.]—**Gas Bath.**—I have a patent gas-bath by Phillips and Son, Barbican, London, in which the water is heated by circulating through a copper boiler attached to the bath. When first used it gave every satisfaction; but, latterly, the heating has become a very slow process, taking more than two hours instead of the original half-hour. This, I presume, arises from the lime deposited by the water in the tubes having narrowed the passage, and so prevented the rapid circulation necessary. Perhaps some of the many obliging correspondents of "ours" would say what is required that would be within the reach of an amateur, the workmanship being so solid as to be quite beyond his ability to open up. Would it answer to bring up the lower opening into the bath, and pour paraffin into the upper one until the coil be filled, with a view to dissolve the lime? and, if so, how long should it be left in?—H. NOLAN, Clifton Villas, W.

CHESS.

ALL Communications for this department must be addressed to the Chess Editor, at the office of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCXLV.—By SERGT.-MAJOR MCARTHUR.

Black.

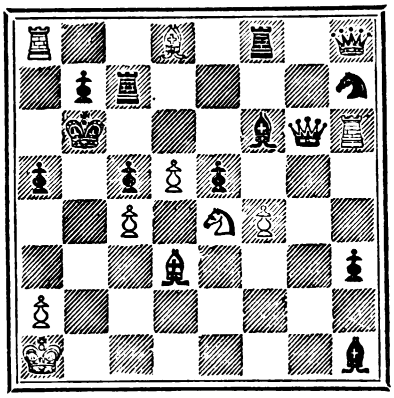


White.

White to play and mate in three moves.

PROBLEM DCCXLVI.—By R. B. WORMALD.
From *Chess Openings.*

Black.



White.

White to play and mate in three moves.

SOLUTION TO 741.

White.	*Black.*
1. Q to K B 4.	1. Anything.
2. P to K B 8 (Kt) mate or Q or R mates accordingly.	

SOLUTION TO 742.

White.	*Black.*
2. Kt to K Kt 6.	1. Anything.
3. Q or Kt mates.	

NOTICES TO CORRESPONDENTS.

CORRECT solution to 741 and 742 by Schmucke.

GAME played recently by correspondence between Messrs. W. T. Pierce and J. Pierce:—

(Steinitz Gambit.)

White. Mr. W. T. Pierce.	*Black.* Mr. J. Pierce.
1. P to K 4	1. P to K 4
2. Kt to Q B 3	2. Kt to Q B 3
3. P to K B 4	3. P takes P
4. P to Q 4	4. Q to R 5 (ch)
5. K to K 2	5. P to Q 4
6. Kt takes P	6. B to Kt 5 (ch)
7. Kt to B 3	7. Castles
8. K to Q 3	8. Kt to K 4 (ch)
9. K to B 3	9. B takes Kt
10. P takes B	10. Kt to K Kt 3
11. Q to Q 2	11. B to Q 3
12. K to Kt 3	12. P to Q B 3
13. Kt to B 3	13. K Kt to K 2.
14. R to K Kt sq	14. B to K 4
15. P to Q 5	15. Q to K R4
16. R to Kt 4	16. R to Q 2
17. Q to B 2	17. K to Kt sq
18. P takes P	18. Kt takes P
19. P to Q R 3	19. Kt to Q 5 (ch)
20. K to R 2	20. P to K B 4
21. R to Kt 2	21. Kt to K 2
22. R to Q Kt sq	22. Q to K B 2 (ch)
23. K to R sq	23. R to Q B 2
24. B takes K B P	24. Kt takes P (ch)
25. Q takes Kt	25. B takes B
26. Q to R 4	26. R to K 6
27. R to Q sq	27. K R to Q B sq
28. B to Q 3	28. Q to K B 3
29. Kt to R 2	29. B to Q 5
30. P takes P	30. Kt takes P.
31. B takes Kt	31. R to Q B 5
32. Q to Kt 3	32. Q takes B
33. R from Kt 2 to Q 2	33. Q to K B 3
34. Kt to Kt 4	34. Q to Q Kt 8
35. R takes B	35. R takes R
36. R takes R	36. R to Q B 8 (ch)
37. K to R 2	37. Q takes R
38. Kt to Q [illegible] (ch)	38. K to B sq
39. Q to K Kt [illegible]	

Black here inadvertently played Q to Q sq., and thus White secured a draw.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or requies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, May 10, and unacknowledged elsewhere:—

GRIMSHAW AND BAXTER.—E. P. Alexander.—Rev. H. L. James.—G. Marecroft.—J. and H. Grace.—S. Lancaster.—C. R. Hibbert.—H. Milnes.—Crossley Bros.—F. A. Cobbold.—A. Broatch.—T. C. Molesworth.—J. Tripplin.—Pragmatical.—Glatton.—H. A. Wassell.—Stereo.—F. Roberts.—Svenska.—J. L. M.—C.—J. C. A.—Odine.—Chemist.—Jas. Parkinson.—H. J. J.—E. R. Trotman.—F. C.—A. Parker.—Aria.—T. W. W.—Moonlight.—E. W.—H. J. Burton.—F. T. Reid.—Leo, Trieste.—C. Detaille.—S. J. Horton.—J. M. Stocks.—R. A. G.—Robinson Crusoe.—Hall.—Beta.—Plymouth.—A. C. Ponton.—H. Middleton.

ANXIOUS INQUIRER. (1st query inserted. 2. Yes, under our present land laws your landlord will take without recompense every improvement you have effected.)—W. J., North Wales. (Such employment *would* tend to deteriorate your sight. Dr. Edmunds intended as such, plainly and rightly.)—J. W. HISCOX. (Your liability *is* limited to the amount of the shares you hold.)—J. F. (Yes, but not to the extent it is used in England.)—H. B. (1. Yes, speaking generally. 2. The exact meaning of the word is "without knowledge," and a modern agnostic is one who holds his belief, as it were, in suspension about matters which others either have or profess to have a clearer idea or belief. 3. We do not know where you are likely to obtain the instrument made by the optician you mention. Possibly an advertisement in the "Wanted" column might procure one, though it is questionable if many were ever made. 4. We know nothing of the maker named. It is, we believe, a common trick on the part of unscrupulous vendors to offer "fire-proof" safes for sale marked with a name closely resembling that of some well-known maker.)—E. HOLMES. (Thanks for the sketches, but we can scarcely find space for drawings which serve only to show that sunspots appear slightly different to different observers.)—W. ROBINSON. (In the first case, apply to the Board of Trade, in the second to the secretary of Lloyd's. For the third, look out for advertisements of the steamship companies wanting a superintendent. If you have any "influence," that would be a great help.)—W. WILD. (If pure rubber, you can join with rubber cement alone, but if vulcanised you will, perhaps, succeed by scarfing the ends and binding them well, using the cement and a piece of thin linen, with fine string or thread. 2. The cement you mean is made by melting together half pound of guttapercha, 2oz. indiarubber, 1oz. pitch, ½oz. shellac, and 1oz. linseed oil. Applied by melting. Not suited for china. For that, shellac alone dissolved in alcohol to a paste is used, or isinglass dissolved in acetic acid. See No. 729 for a variety of cements.)—H. FIELD. (A similar request is made in the last number.)—G. C. FOX. (If the maker advised the glycerine developer, write to him for further instructions. Read the paper on p. 189.)—A. H. METZ. (Besides the number mentioned last week, full directions for making single-needle telegraphs were given in Nos. 549 and 555. Those numbers are out of print, but you might be able to pick them up at some of the second-hand booksellers, or obtain them through the "Sale" column.)—C. THORP. (Prof. Dolbear's description will be found on p. 396, No. 849, and on p. 81 *ante* a correspondent gave an account of the paper Prof. Dolbear read recently at the Society of Telegraph Engineers.)—H. WORTH. (Connect one wire or pole of the condenser to the pillar and the other to the hammer.)—AS I KNOW NOT. (Gold size, marine glue, or asphaltum varnish, but roughen the cell and the slide where it is to be fixed. Gold size is easiest to work. It does for both mediums, provided there is no spirit or turpentine in the preservative. You can add a little whiting to it, or, which will perhaps suit best, use plaster of Paris beaten up with white of egg thin.)—ONE IN A FIX. (You will find a number of recipes for making gold plating solution in Vols. XXVIII. and XXIX. Also in recent volumes many practical directions.)—VOLTAMETRE. (No, we do not. Such matters are of interest only to manufacturers, but there are many machinists who would be glad to make a stamping apparatus of the kind.)—

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, MAY 19, 1882.

THE IRON AND STEEL INSTITUTE.

THE meeting of the Iron and Steel Institute was held last week. The first paper read was that by Mr. E. Richards, on "Certain Physical Tests and Properties of 'Mild' Steel," a material which has recently become of great importance to mechanical engineers and steel-makers. The paper was of purely technical interest, being chiefly devoted to giving an account of a number of experiments made by the author. Mild steel, he said, is a metal possessing the excellent qualities of ductility and strength in so high a degree that it is worked with the greatest satisfaction by practical men. Its use is rapidly increasing, and it is therefore important to ascertain what is its real strength. The author in his paper gives his results for tension after tension, tension after compression, and tension after torsion, and his experiments show that the elastic limit of a steel bar varies according to the treatment undergone by the bar before testing. In one sense, his experiments support the view held by Dr. Siemens that any mechanical treatment to which mild steel is subjected invariably increases its strength, but Mr. Richards points out that this dictum holds good only when "strength" is taken as increased resistance to statical pressure. If by strength is meant the power to resist impact, then mechanical treatment has the effect of diminishing the strength. The paper contained some interesting notes on the permanent magnetic properties acquired by bars tested in a machine placed in a line north and south. Steel under compression he finds also becomes permanently magnetic, the polarity being determined by that of the magnetic field in which the bar is placed during compression. Besides this point the paper is of special interest to makers and users of mild steel, and as the president said, it will bear careful study when published in the *Journal*.

Probably the most interesting paper read at the meeting, from the popular point of view, was that in which Mr. Mosley, of London, described a new method of mining coal, which avoids all the risks that are inherent in the usual system of blasting. The method has been patented by Messrs. Smith and Moore, and has been in use for several months at the Shipley collieries, Derbyshire. The new method consists in the use of a cartridge of lime instead of gunpowder or dynamite,—the expansion of the lime when slaking being utilised for forcing down the coal, thus avoiding the dangerous flame from the explosion of gunpowder. The lime is in a highly caustic state, and after being ground to a fine powder is consolidated under a pressure of 40 tons to the square inch into cartridges of 2½in. diameter, with a groove on one side for the admission of the water-pipe. The shot holes are drilled by means of a light boring machine at Shipley, and an iron tube about ½in. in diameter is inserted first. This tube is perforated, and is inclosed in a calico bag, which covers the perforations and one end, the other being closed by means of a tap. This pipe, it will be understood, fills the groove in the lime-cartridge, which is inserted after the pipe and lightly rammed. The hole is then tamped in the usual way, and a small force-pump is connected by means of a flexible tube. Water equal in bulk to the lime is then forced in, which, escaping at the inner end of the tube and from the perforations, flows along the groove towards the tamping, driving the air before it. The tap is then closed and the flexible pipe disconnected, the steam generated by the action of the lime on the water cracking the coal away from the roof by the high pressure it reaches. After introducing the water, the operator has ample time to get away to a safe distance, though, as a matter of fact, we believe there is no danger of the steam blowing out, and no risk from too early fall of the coal. After the steam has exerted its effect, the expansion of the lime comes into play, and the force can be judged by the bulk occupied by a slaked cartridge as compared with one of the compressed specimens. At any rate, the force exerted is sufficient to bring down the coal in large masses clean from the roof, with the minimum of "small," and in greater quantities than is possible with "wedging." The coal is underholed by the hewer, who places sprags underneath, and it is found as a rule that the coal is cracked away for a distance of several inches beyond the inner end of the bore hole. In places with bad roofs, the collier would remove only a few sprags at a time, so as to let down enough coal to load, and giving him an opportunity of supporting the roof before clearing a large space. The time occupied in drilling is averaged at twelve minutes, charging and tamping consumes four, and "firing," which in this case is pumping, one minute—thus effecting a saving of time as compared with blasting. This saving, however, appears to be lost subsequently, as the lime cartridge acts slowly; but in from ten to fifteen minutes after pumping the coal has been cracked away, and is ready to fall when the sprags are removed. As, however, there is no loss of time in preparing to fire a shot, and no risk of igniting the explosive gases, this method of coal-getting will probably prove to be, as Mr. Cowper said, one of the most important inventions for getting coal we have had. Besides the advantages above noted, it should be remembered that the action of the lime, powerful as it is, is free from shock or concussion, which has much to do with roof-falls, and with disturbing bodies of gas that would otherwise be harmless. No wave is imparted to the air of the workings, and the coal comes down with the minimum of dust, both of which are occasionally elements in an explosion. To give an idea of the power exerted by the lime cartridge, two iron pipes were shown, which had been broken by the expansive force of the lime and steam, though one had been previously tested to a pressure of 953lb. on the square inch. The author of the paper gave a comparative statement of the quantity of coal got in adjoining stalls by means of wedging and lime-cartridges respectively, the comparison being greatly in favour of the latter; but its chief merits are unquestionably the avoidance of risk of explosion and the lessened danger from falls of roof—two evils inherent in the system of shot firing.

The next paper was by Mr. W. Gill, of Luchana, Spain, on the iron ore district of Bilbao. The information given will be of interest to many ironmasters, but possibly the details of the wire-ropeways will be regarded as of most value by miners. There are several miles of them belonging to different companies in the district, and Mr. Gill's paper contains full particulars of their arrangement and working.

Prof. Von Tünner, of Leoben, Austria, sent a paper "On the Use of Lignite in the Blast Furnace," a subject which is not of much interest to English ironmasters, though what the author has to say may be of use to them in other countries.

A paper by Mr. Geo. E. Woodcock, of Sheffield, was read on Friday, in which the author endeavoured to show (1) that the carbon of steel is, primarily, in a state of simple absorption in the iron; (2) that the hardening of steel is due to a metamorphic change in the condition of the carbon, which then assumes a crystalline form, closely analogous to that of the diamond; (3) that the varied tempering of steel results from the dissociation of this crystallised carbon at varying but low temperatures; and (4) that the real strength of steel does not vary to any material degree with a varying content of carbon—that is, *cæteris paribus*, steel is not increased in tensile strength by an increased percentage of carbon. Mr. Woodcock inclines to the theories of Jullien and Prof. Akermann, and he holds that Jullien's hypothesis, slightly modified, is correct. The hardening of steel on this view is due to the crystallisation of the "combined," or, as Mr. Woodcock prefers to put it, "absorbed," carbon in a form resembling the diamond—an hypothesis which was reported on by a committee of the Institution of Mechanical Engineers, who found that, while it accounted for hardening, it left tempering unexplained. Unless some change occurs in the carbon, no hardening takes place: raw cemented steel, as it comes from the furnace, says Mr. Woodcock, is as soft and easy to work with the file as the wrought iron from which it is made; but on being heated and quenched, it becomes as hard as any other description, and if fractured, shows a crystalline structure which can be due to nothing else than carbon. The crystals are not found in wrought iron; they are more numerous in proportion as the original amount of carbon in the steel increases; and in a large bar they may be found more numerous in the outer layers than in the inner, whilst the centre may have none at all. In such a case the hardness of the metal will be found to decrease inwards until when the centre is reached, where no crystals are seen, the steel is found to be as soft as it was in the original unhardened state. The diamond is the only known form of crystalline carbon, and it would seem to follow that the hardening of steel is due to the carbon being metamorphosed into a number of small particles analogous in constitution to diamonds. This "diamond" question naturally formed the chief feature in the discussion, Mr. Stead suggesting that it might be settled by dissolving the steel in acid, for if powdered diamond were mixed with powdered iron, and the mixture digested with acid, the diamond would be found undissolved; but if hardened steel were dissolved in the same, no residuum of "diamond" dust would be left. The general result of the discussion was that more experiments were needed before a conclusion could be arrived at—one at least of the speakers contending that if carbon is combined with the iron it is only by the loosest ties. A paper by Mr. Jeans, the secretary, on the consumption and economy of fuel in iron and steel manufacture, was a statistical account of the development of the manufacture from the point of view of fuel.

LAWSON'S BOILER EXPLOSION EXPERIMENTS.

ON p. 461 of the last volume, we gave an account of the experiments carried out by Mr. Lawson at Pittsburg, with the view of solving some of the mysteries of boiler explosions. His contention is that if steam in a boiler is suddenly allowed to move, and is as suddenly checked, it produces a concussive effect; and, further, that every particle of the water contained in the boiler tends to fly into steam as soon as any portion is released. On the occasion to which we referred at the place mentioned, a boiler, the bursting pressure of which, according to our formula, was 329lb., exploded with a loud report when a pressure of 380lb. was reached, the explosion taking place immediately after, and being consequent on, the sudden opening of a valve which admitted the steam into a closed vessel. As we pointed out at the time, the explosion of a boiler strained beyond its bursting pressure proves nothing; but Mr. Lawson has lately succeeded in bursting a similar boiler at a pressure much below what it is calculated to withstand, and it follows either that there is some substratum of fact in his theory, or that the boiler was not so strong as by the formula it should be. We can only speak from the published statements, and those show that the boiler lately exploded was identical in construction with that referred to on p. 461 of our last volume. It was 6ft. long, 30in. in diameter, the shell being formed of two plates of best iron three-sixteenths thick, the heads being of three-eighths iron, stayed by a one-inch iron rod passing through the centres of the heads. By the well-known formula—$P = T \times c / D$ the bursting-pressure of such a shell is 329lb., single riveting being assumed, for T equal thickness of metal in sixteenths, c equal a constant (1097) for single riveting, and D equal the diameter of the shell in quarter feet. We have thus $3 \times 1097 / 40 = 329$. Two shells of these dimensions constructed from the same batch of plates were prepared for the experiments, but one of them was fitted with Mr. Lawson's patent "diaphragm," an arched perforated plate of three-sixteenths iron, fitted near the water-line inside the boiler and riveted all round—forming, we need scarcely say, a very strong "stay," and enormously increasing the strength of the boiler. The scene of the experiments was the Munhall Valley, about eight miles from Pittsburg, a place which, so to speak, has been fitted up for such trials, and was selected by the Government commission in 1873. Through loopholes left in the bomb-proof, visitors can witness in safety the actual explosion of a boiler. The conditions of the recent experiments were much the same as those detailed in our previous article, the boiler being connected to an old engine cylinder 8in. in diameter and 36in. long, by 15ft. of horizontal, and 3ft. of vertical iron pipe $3\frac{1}{2}$in. in diameter. Near the elbow of this pipe—that is, about 15ft. from the boiler—was placed a quick-opening gate-valve $3\frac{1}{2}$in. in diameter, and the furnace was fed by injecting petroleum on the incandescent coals. Inside the bomb-proof were two gauges connected respectively with the front head of the boiler, one above, the other below the Lawson diaphragm, that is, one to indicate the pressure and disturbance in the steam space—the other to show the disturbance in the water-pressure when the valve was suddenly opened. These pressure-gauges seem to have been very untrustworthy, being some 50lb. or 100lb. "too fast"; but allowance being made for that, no result followed the experiments on the patent boiler with pressures estimated at 225lb. On attempting to experiment with the plain boiler, one of the heads cracked, and it was found impossible to get a higher pressure than 220lb., owing to leakage. Accordingly the patent boiler was reset and trials made at gradually increasing pressures up to 300lb., without creating an explosion. The patent diaphragm was then cut out, with the exception of a margin all round about 3in. wide, so that the boiler was really stronger or weaker than that experimented upon last year by just the difference due to these 3in. strips, less the weakening effect of the rivet-holes by which they were held to the shell and heads. With 20in. of water in this boiler (leaving 10in. at the crown for steam space), experiments were made by opening the valve at every rise of 25lb. up to 225lb., without result. After reaching 235lb. the valve was again opened, and the boiler immediately exploded, the water disappearing in what are termed "practically ultimate atoms," and the shell being "torn into shreds." Seeing that the water in a steam boiler under a pressure of 235lb. has a temperature of 400° Fahr., it is not a matter for surprise that it vanished as a cloud of steam when the boiler was rent into shreds; but the curious part of this experiment is that a boiler, the bursting pressure of which is by calculation 329lb., should have exploded at a pressure of 235lb., when another of similar dimensions and practically identical did not explode until a pressure of 380lb. had been indicated (see p. 461, Vol. XXXIV.). As the facts stand, the result of the experiment would seem to prove that Mr. Lawson's hypothesis is correct, and that boilers may be exploded by the sudden opening of a valve, provided the rush of steam is also suddenly stopped, thus producing a sort of concussive effect; but we suspect that those who remember that steam is an elastic fluid, will scarcely regard these experiments as conclusive, either of the "blow" theory or of the merits of Mr. Lawson's diaphragm, which is supposed to prevent explosions in some occult way by compelling the suddenly created steam to pass through its perforations before it can impinge upon the boiler shell. At the close of our previous article we said that for such experiments to support Mr. Lawson's view it will be necessary for him to show that a boiler which could stand the hydraulic test up to, say, 500lb., can be exploded by merely opening the valve leading to a closed cylinder when the gauge shows a pressure of only 380lb. The figures are not of much moment, and as it is expensive work exploding new boilers, it may be worth while pointing out that old ones will serve just as well. If the "blow" theory is correct, there should be no difficulty in demonstrating it in a satisfactory manner, which can be done only by exploding a boiler at a pressure less than it has previously sustained when tested by the hydraulic method.

SECONDARY BATTERIES.

THE important part that secondary batteries will eventually play in electric lighting, renders any items in connection with their construction of great interest. As will have been expected, several patents have been recently taken out, and many others are awaiting publication. Of some of the devices we are enabled to give a brief description, which may be of interest, though there is reason to believe that later forms have superseded them. As we mentioned some time ago, Mr. Sellon has taken out several patents for secondary batteries, and as the development of that invention will form a feature in the electrical history of the nineteenth century, we give a short account of some of his devices, supplemented by those of other inventors. In his specification of September 10th last, he describes the use of perforated plates, or sheets roughened, serrated, or indented, composed of lead, platinum, or carbon, upon, in, or against which are held films of spongy lead, or salts of lead, or other suitable substances. In the drawings accompanying this specification, Mr. Sellon shows lead plates bent so as to form a series of dovetails over the surface, or serrated like the teeth of a saw, both being perforated with numerous holes, in which and in the folds of the serrations or the dovetails, the active material can be packed, the object being to get as much as possible of that into the smallest compass. Five days after that specification was deposited, Mr. Sellon appears to have left another, the main feature in which is the use of an alloy of lead with antimony as the material of which the plates are to be composed. It is clear that the ingenuity of the inventor has tolerably wide scope in determining what shall be the actual form of the elements or supporting plates of the secondary battery, and it is obvious that if perforated lead plates are an advantage, they can be made up of a number of short pieces of lead tube, arranged with their axes parallel. We have reason to believe that experience has declared in favour of an alloy of lead and antimony in preference to the simple metal, and for convenience in working or for remedying any accidental effects of local action, plain plates, with many perforations, are preferred to the corrugated and other devices suggested for the purpose of gaining surface. It will be understood that one object of these inventions is to dispense with the canvas or felt supports for the coating of oxide, because in practice it is found that nothing yet tried will long withstand the effect of the acid liquors used to excite the action. Corrugating the plates possesses an advantage in presenting greater surface in an equal space; but when felt or canvas is dispensed with, there is some liability of "lead-trees" forming a cross and connecting the two elements of a cell. Hence, it is found advisable to so arrange the plates that any points of contact of that kind can be readily removed. M. de Kabath, of Paris, has also taken out patents for secondary batteries, the feature of his invention being the method adopted to prevent the coating of lead-oxide from falling off. He forms a composite electrode of thin sheets of lead, folded around a thicker sheet, which acts as a support, the whole being enveloped in a sheet of parchment-paper, a substance which, having been already acted upon by sulphuric acid, is only slowly destroyed in the battery. In M. de Kabath's design the sheets are either plain or corrugated; but in all cases a thin coat of sulphate of lead is formed upon them, and the form consists of alternate plain and corrugated lead plates, packed between stout lead covers held together by indiarubber bands, the whole being inclosed in a case pierced with holes. M. de Kabath has also taken out a patent for a method of regulating the discharge of secondary batteries (September 20th, 1881). That is accomplished by increasing or diminishing the depth of solution in the battery-cell by means of a tap moved by magnets actuated by a relay. Thus when the current in the main circuit decreases, the spring of the relay moves the index and puts into action the magnet controlling the inlet of solution, so that a greater surface of the plates is immersed, and the current is increased in proportion. Similarly, if the current is too great, the tap is so turned as to run out some of the solution from the battery, so leaving a smaller surface of plates under action. MM. Deprez and Carpentier have also obtained a patent (September 24th, 1881) for distributing and regulating the transmission of electrical power, in which they use two secondary batteries, so connected by means of a commutator that while one is being charged the other is giving out current; but as they do not specify any form of battery, the claim is only for the details of the arrangement.

Secondary batteries having some really novel features, have been patented by Mr. A. Watt, of Liverpool (October 1st, 1881). He uses the lead-plates, but coats them with a mixture of calcium hydrate, manganese dioxide, and sodium chloride, or preferably with what is known as "Weldon mud," mixed in equal parts with powdered coke. Plates of carbon may be used instead of lead, and in a solution of sulphate of manganese can be employed in one cell, as the sulphate decomposes and covers the carbon with peroxide of manganese. Another form of battery consists of alternate layers of carbon and granulated manganese dioxide mixed with granulated carbon, preferably in equal volumes, or of lead and manganese dioxide or layers arranged as follows: — $MnO_2Pb \| C, MnO^2C \| C, MnO_2 \| C, PbMnO_2C \| C$ and so on, or $Pb, MnO_2C \| C, Pb, Mn\,O_2\,C \| C$, the vertical bars representing porous diaphragms. The exciting liquid is sal-ammoniac, common salt, or dilute sulphuric acid. A convenient form of cell consists of an ordinary battery tank divided down the centre by a porous diaphragm. The charged porous pots, fresh or exhausted, of Leclanché cells, may even be used without further preparation than immersing them in one of the solutions. If one pot be fresh and the other exhausted, the couple is charged and ready to work. Another modification consists of a porous pot containing a plate of carbon charged with a mixture of manganese dioxide and carbon or coke, in a state of coarse powder, and placed in a leaden vessel containing dilute sulphuric acid, the space between the pot and the leaden vessel being filled with a mixture of manganese dioxide and carbon or coke, or simply with granulated lead.

Another secondary battery, which is based on the action of chlorine on copper, has been patented by Mr. A. P. Laurie, of Edinburgh (October 4, 1881). The cell is made up of a thin plate of copper, coated with a paste of cuprous chloride, and wrapped in parchment-paper; that, together with a plate of zinc, is placed in a solution of chloride of zinc, and the two being connected a current is set up, which continues until the cuprous chloride is reduced to a mass of spongy copper. The zinc plate is then withdrawn, and a copper plate put into the cell, which is then ready for charging. The action of the chlorine on the spongy copper can be regulated by means of copper gauze placed over the spongy coat, and connected to the copper plate. These notes, together with those given in p. 413, and elsewhere in the last volume, will serve to convey some idea of the different methods of making up secondary batteries. It is tolerably obvious that, but for its weight, lead would be the only metal experimented upon, its advantages being so considerable, especially in the shape of cost; where, however, portability is desired, it is probable that Sutton's or some modification of the copper-lead cell will be utilised. Possibly, the researches of Dr. Gladstone and Mr. Tribe may lead to the discovery of something more valuable than is yet available.

REID'S PATENT SELF-ACTING CLOCK SYSTEM.

THE above is in action at the Crystal Palace Electrical Exhibition. Fig. 1 shows the principal parts connected with the regulator or motor clock.

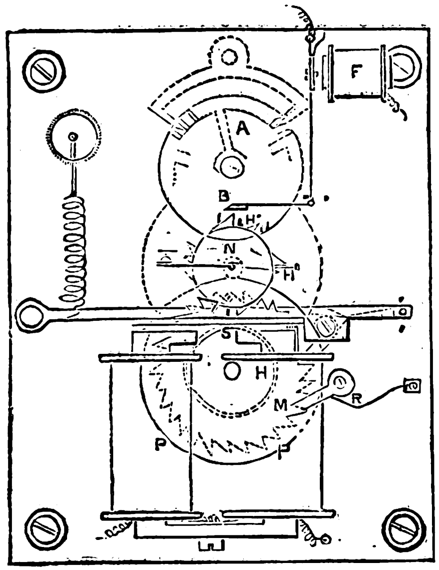


FIG. 1.

By the power of the mainspring contained in the going-barrel H, motion is imparted to the train-wheels and the dead-beat escapement A; the ivory or contact-wheel being outside the clock-plate and attached to the 3rd wheel-pivot of clock-train; the ivory wheel making but one revolution in four minutes; whilst revolving, it lifts in turn the contact platinum-plate B, by the insulating ratchet tooth I on ivory wheel, and allows it to fall on the platinum-point H, by which means it completes an electric circuit, the current passing around the coils of electro-magnet PP, Fig. 1, and A in Fig. 2, the armature S being attracted, and by the click arrangement attached thereto to the mainspring that is contained in the going-barrel H, one tooth of the ratchet-wheels M, and at the same time setting on a relay battery by the electro-magnet A (Fig. 2), its armature being attracted around; and by the contacts D, an electric circuit is completed, which passes through the electro-magnet F (Fig. 1), allowing of its armature's attraction, and throwing the platinum contact-plate into the further insulated ratchet-tooth J, therefore freeing all contacts for expiration of one minute, when a repetition of the same takes place.

The relay (Fig. 2) is provided with a clockwork arrangement, in order to regulate the exact length of time the current should be complete, for which purpose the further end of arm G carries a ratchet-hook, E, which acts in the ratchet-teeth of the wheel C. The current being broken, the arm would instantly rise by the elasticity of the spring K, but is retarded in action by the spring having to force round the wheel C, and with it the train-wheels and fly L, which is capable of any adjustment; the advantage of this arrangement is that, it allows sufficient time for the relays to be properly worked, and time for the attraction of the different armatures, as well as neutralising any error or vibration that might be made by the contacts H and B. If 20 or more contacts be made almost simultaneously, all the dials would only register but one minute or one stroke of current only.

FIG. 2.

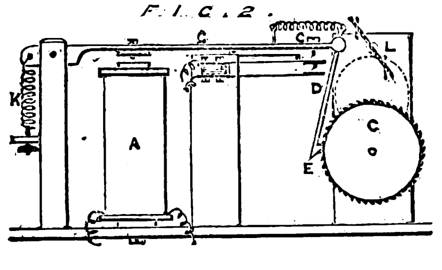
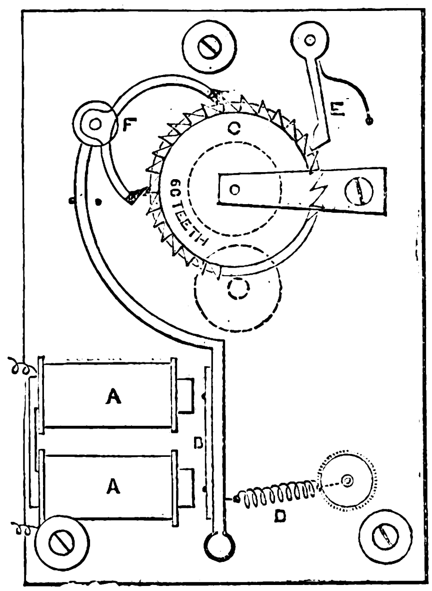


FIG. 3



The dial parts are on an improved principle: the electro-magnets, A A, may be in the same circuit as the coils F (Fig. 1), or may be set on by a relay in the same circuit as latter, the current passing instantaneously one stroke per minute. The magnet attracts its armature B, lifting the pallet-hook into a further tooth of the ratchet-wheel C, allowing (when current is broken), by the elasticity of spring D, to pull back the pallet-hook, and drive the wheel one tooth forward, or 1-60th of a revolution, keeping it in position by the connter-ratchet E, and awaiting a further action for next minute, the pallet-hook F being always firm against the ratchet-wheel C when no current is passing; therefore the hands are always firm, and cannot be easily moved, except by the friction of minute-wheel or arbor, &c., &c., the dial-wheels being under the plate, as shown by dotted lines.

MICROSCOPES AND MICROSCOPY.

By DR. ROYSTON-PIGOTT, M.A., F.R.S.

THE following is the substance of a lecture recently delivered by Dr. Royston-Pigott, F.R.S., to the Eastbourne Young Men's Christian Association. The subject was Microscopes and Microscopy, and some remarks on light formed the introduction. Why, said the lecturer, should its hottest rays be absolutely dark? Why should electric light kill vegetation in some cases unless it first passes through glass? Why should a bar-magnet which lifted 6lb. be able to lift nearly double the weight by two days' exposure to an Italian sun? The solar rays are always pouring magnetism into the earth. The sun attracts the earth with as much force as though the whole of its surface were pulled to the sun with the strength of steel rods, thick as the blades of grass. Again, why should magnetism be poured out from the sun principally by the violet rays? Magnetic storms also exhibited on the earth correspond to changes on the solar disc. Again, why should electricity be always present with magnetism as truly as a shadow follows the light? Let us examine what light is by its known phenomena. It is resolvable and may be recomposed. It is radiant and can be turned from its course.—*Deviation by refraction.*—On this principle the action of the microscope entirely depends. This very principle of deviation, however difficult for man to deal with, is the means of displaying the beauties of the rainbow, the glories of the heavenly hosts, the dazzling flashes of oriental gems, the gorgeous colouring of the dew drops sparkling in the rising sun, the flashing loveliness of the hovering moth, the splendours of the golden west and the awful sublimities of the Arctic Aurora—itself a magnificent phenomenon. The inconceivable powers of sight conferred on a minute insect, every one of whose thousand eyes is a hundredfold more powerful in magnification than the strongest human microscope, result from the same property—*Deviation.* Again, water-sight is wonderful—a fish sees a horizontal bank elevated on high with great precision by the refraction of light passing through through water. And on the same principle the modern microscope, by means of a drop of water covering the object, is immensely improved by what are now called immersion lenses, which crowd a much greater number of rays from the object along the line of sight. The microscope entirely depends on the qualities of a prism for decomposing light and bending the rays towards its thicker side. The pictures on the wall give us all these details. A lens is really a series of minute prisms. It enables the observer to see an object like an insect settled upon it. But by using compound lenses in exact imitation of the formation of the human eye, the colours at first developed by refraction are reunited into white light. An enveloped image is again re-magnified by another set of lenses and thus the total magnification may amount to several thousand times. Armed with this great microscopic eye, the naturalist plunges into a new world of structural wonders. The chemist studies the dissolution and re-combination of the elements; the geologist recognises the minute remains of organisms myriads of ages old, chiefly used by Nature to build up mountains, continents, and islands. The physician detects sure signs of organic disorder and even minute living organisms pervading the very blood of man. The expert reproduces the old blood stains of the murdered or the entombed poison used by the assassin—the adulteration of food and the distinctive marks and signs of different bodies—and distinguishes the paste from the diamond at a glance. Impossible is it to enumerate the innumerable uses of this noble instrument. In magnifying power it far exceeds the telescope—and unlike it, can be applied at all times and seasons. It is essentially a home instrument, and it delights hundreds of thousands of its votaries with an interest ever new and inexhaustible. It was the microscope that first demonstrated the circulation of the blood—a discovery stubbornly scouted by the whole of the doctors of the day. It revealed the nations on a leaf and the swarms of animal life in a speck, whose minuteness is so great as to baffle human conception. Malpighi first saw what Harvey had sagaciously asserted—the streams of blood globules traversing a frog's foot. Sea mosses and sea ferns were found to be forms of animal life. The ancient fable of the Hydra was revived and reinstated. Corallines now were seen to be animals. To the microscope we owe the disproval of spontaneous generation. The various parasites which infest the bodies of animals, causing infinite trouble, and those which attack cultivated plants as blight or fungi, the spread of disease germs, the movements of minute cells in the sap of vegetables, the various and beautiful forms of minute eggs—each true to its own type; these, and a thousand other things, show how vastly our knowledge and power of research has been extended by the microscope, by presenting us with a deeper insight into the mysteries of life. Not only every human tissue has been explored, but I might say those of the whole animal kingdom. "What," says a well-known writer, "can be a more worthy occupation than the attempt to gain an insight, however limited, into the operations of creative wisdom?" These are as wonderful in the smallest as in the largest animal. No insignificant part of the globe's crust is made up of myriads of microscopic skeletons, principally formed of flint, equally indestructible by fire and aquafortis. No instrument more promotes the faculty of philosophic reasonings. Microscopic pursuits at once engage our highest faculties, whether merely as an absorbing recreation, or as a profound research embodying a system of ascertained facts of high value. The microscope brings man face to face with nature in her most minute details. A whole evening may be delightfully spent over the head of a single spider. The eye is not satisfied with seeing, and this instrument, more than any other, at once both gratifies and stimulates the thirst for knowledge and advancement in the works of Nature. "A walk without an object," says Mr. Kingsley, "is a poor exercise, unless in the most lovely and novel scenery, and as a recreation is utterly *nil*. If we wish rural walks to do our children any good we must give them a love for rural sights, an object in every walk. We must teach them—and we can teach them—to find wonder in every insect, sublimity in every hedgerow, the records of past worlds in every pebble, and boundless fertility in the barren shore; and so, by teaching them to make full use of that limited sphere in which they now are, make them faithful in a few things, that they may be fit hereafter to be rulers over much." To teach by rote by book and board, is too often to disgust the tender wonder of budding youth, whilst real Nature presented excites a most lively and abiding interest. A school boy's holiday consists in the liberty of the fields like the flight of a caged bird. Human curiosity and delight is inexhaustible among the microscopic riches of infinite forms and functions. To quench this spirit of inquiry by birch and lesson is one of the saddest outcomes of a bygone pedagogueism. Some strong spirits, it is true, survive long years of literary slavery to the desk and slate; but alas, in too many cases, this system has driven its nauseated victims inte the full enjoyment of coarser pursuits. If the microscope engages youthful curiosity, elevates the taste, raises the mind from a love of sordid to ennobling pursuits, it must be a great boon to rising manhood. Innumerable microscopic societies have thus sprung up all over the world, and their doings fill thousands of "Transactions." But I must have done with these eulogies, though I might add such societies unite in singing the charms of Nature's minutest works. I cannot better illustrate the action of the microscope than pointing to the oxygen lamp illustrating the subject. If you suppose a microscope forty feet long, furnished with an object-glass of a few inches focus, the object is so magnified by distance of the screen as to require no eye-glass for further amplification. These glasses before the lamp are constructed with the highest art. As no single glass can form a distinct image at a distance by its own refraction, on account of the unequal deviation of the various coloured rays, means are taken to unite as many as to produce white light, leaving, however, generally a little outstanding colour at the margin. If only white light could be used, containing no violet or other coloured rays, this margin would disappear: then, however, the difficulty of bringing all the rays to one precise focus for every point of the picture—a difficulty described by the term aberration—is so great as to tax the highest skill of either mathematician or artist. Photographic lenses are simply the same in which the picture is taken in the reverse course from the object, and a very perfect miniature formed on collodion. Some of the most interesting sights the microscope can display is metamorphosis. The larva of the straw-coloured plumed gnat (*Tipula crystallina* of De Geers), emerges from the egg in May and June (it inhabits almost invisibly the water). It rapidly changes into the pupa, about three-quarters of a ninch long and a tenth thick. Keeping it in clear spring water retards the change. Its transformation commences under the eye of the observer—a most interesting spectacle. So complete is the change that its former organisation can no longer be recognised in its new state of existence. The tail had consisted of 22 beautiful plumes. It converts itself into two fine membranes, permeated with numerous vessels. Not the slightest resemblance remains, nor are any vestiges of tail to be seen in the water. Two small horns appear folded up in the head, destined to form the white plumed antennæ. The food canal appears nearly to vanish in the pupa, as it takes no food in that state. During the latter part of the day the rudiments of perfect legs may be traced. It now floats in a vertical position, the head being only just submerged. It had formerly swum in a horizontal position. The circuitous mode of these transformations is truly wonderful. The mere bursting forth of the perfect creature from its envelope is but a small part of the complicated transformations it has gradually undergone. The circulation of the blood in these insects is quite visible, though it is transparent, by the onward movement of little oat-shaped blood corpuscles in vessels furnished with closing valves, as perfectly constructed as those of the human veins. The breathing apparatus of insects, shown by the microscope, evidences beautiful design. As they have no lungs or gills, air is conveyed through trachea or tubes, around which a network of blood vessels are employed to aerate the blood by diffused circulation. The dorsal vessel pulsates, the oat cells are seen to pass rapidly forward. The action of the valves is a most beautiful sight. The air vessels pass down each side of the body, along the legs, the horns or antennæ and the three-forked tail, whilst the blood corpuscles circulate to each (the larva of the day fly). I cannot resist relating an observation on young tadpoles. I observed one of these lively captives did not produce his legs, whilst his fellows were leaping out of the basin. The microscope showed he was suffering from a real poverty of the blood—few particles only could be seen, like solitary sentinels, slowly pacing along their routes. Nutrition had nearly ceased. But the study of formation gives marvellous insights into design—means devised for special ends. An indiarubber tube is guarded and strengthened with spiral wire. The breathing tubes of insects are wound round and round with elastic fibre in two different directions, producing a very beautiful wavy appearance. Again, the human eye lens is exceedingly complex, though in health transparent. It has a curvature different on each face, so as to produce the most distinct image on the retina, which is a receiver of the images formed there. A black ball is visible about two miles off if about ten inches in diameter and elevated on a pole against a dull sky. Now, what do you suppose is about the size of this black ball as pictured on the retina? It is readily shown by optics that its size is about the one hundred and twenty thousandth part of an inch, and yet the optical vision of a really good eye is equal to a result which severely tasks the powers of a very fine microscope. I have frequently seen a black object of this kind. What must be the microscopic arrangement of the tissues of the eye to enable it to convey the impression of such a minute black dot as this to the brain? But much smaller points of this are distinguished if brilliant. The eye is, in fact, a microscope in itself, but used to from miniatures, photographs, as some think. The eyes of insects, however, apparently greatly exceed ours in complexity and contrivance. They have no eye-lids; they must see all round at once to escape their enemies. Accordingly, we find great variety in the quantity of actual eyes studding the head; 4,000 in the house fly, 17,000 in the common cabbage or yellow butterfly, 24,000 in the dragon fly, 25,000 in the mordella beetle. Each eye is made up of two lenses and an intervening cylinder, and tapering pyramids prolong the whole to the nerve fibres. The light is regulated in each by a layer of black matter (pigment) perforated by a minute aperture (just as we are obliged to use in the microscope or telephone to shut off extraneous light). What complicated design and execution, arrangement, order, precision, and baffling minuteness are here in the head of the smallest insect!

THE APPLICATIONS OF ELECTRICITY.[*]

(*Continued from page* 168.)

THE electric arc was first studied by Davy, who investigated the phenomenon with a very powerful battery. Its practical application is, however, but of very recent date, and the different kinds of electrical regulators and lamps which you have seen at the Exposition are mostly of very recent invention. First were invented the costly and complicated regulators of Serrin and Foucault. The electric light, as you know, is the spark of a very powerful battery between two carbon points separated by a small interval. The positive carbon burns twice as fast as the negative carbon, so that we must have a regulator which keeps the carbon points at an invariable distance, and which keeps the light at the same point.

This last condition is essential in the case of lighthouses and for optical experiments, and requires the complicated clockwork regulators above mentioned. For ordinary lighting purposes where the point of light need not be in a permanently fixed position, the regulators are, of course, much less complicated, as only one carbon need be movable; clockwork may then be dispensed with. The simplest kind of electric light is certainly realised in the case of electrical candles. The Jablockhoff candle simply consists of two carbon pencils separated by an insulated layer of plaster of Paris and kaolin.

In M. Jamin's electrical candle this insulating layer is dispensed with, and the arc is kept at the end of the candle by means of an electrical current which circulates in a frame around the candle, and acts by the well-known laws of electrical attraction and repulsions.

The newest kind of electrical light is the incandescence light. The incandescence lamp simply consists of a thread of carbon inclosed in a glass globe, from which the air has been withdrawn. When the electrical current is sent through the lamp, the thread of carbon is raised to a white heat and gives a very pleasant light. It is easily understood that the air has been withdrawn in order to prevent the carbon thread from burning away. Such are Edison's, Swan's, and Maxim's lamps.

For the electric light on such a large scale batteries are not used, but dynamo-electrical machines. These machines (of which there are hundreds of varieties) are all founded on one principle: when we turn rapidly a coil of insulated wire between the poles of a magnet or of an electro-magnet, we generate an electrical current in the coil of wire. When we use an electrical candle we must choose a machine which gives alternating currents in order that both the carbons burn away equally. In electricity all our experiments are reversible; for instance, if we turn a dynamo-machine by a steam engine we get an electrical current; but reciprocally, if we send an electrical current into a dynamo-machine it turns around and gives us an equivalent quantity of movement. In the latter case we have an electromotor. This has been applied to the electrical tramway which formed one of the great attractions of the exposisition. I show you here some of M. Trouvé's electrical motors, such as he employed in his small boat, "The Telephone," with which he used to navigate on the miniature lake of the Palais d' Industrie.

Another very striking instance of the reversibility of electrical actions is shown in the accumulators or secondary batteries. They are merely voltameters with leaden plates of very large surface. The primary current is sent through the accumulator and decomposes the acidulated water. When we connect the two leaden plates we obtain a current which, theoretically, ought to be equal in quantity to the primary current. Those secondary batteries were invented by M. Planté, and have lately been improved by M. Faure.

PURE CARBONS FOR THE ELECTRIC LIGHT.

IN view of applications of carbon to production of the electric light (says M. Jacquelain, in a recent paper to the French Academy), the problem for chemists is to prepare a carbon more conductive than that of calcined wood, and if not wholly without hydrogen, at least exempt from mineral matters. To attain this end, three means seem capable of being employed, viz. (1), the action of dry chlorine directed on carbon raised to a red-white temperature; (2), the action of caustic potash or soda in fusion; and (3), the action of hydrofluoric acid on the cut crayons, operating in the cold state and by way of immersion, more or less prolonged.

The use of chlorine is quite suitable for very divided carbon; we have employed it with complete success in preparing a pure carbon which could be used by M. Dumas in his remarkable work on determination of the equivalent of carbon. Through the double influences of the chlorine and a high temperature, the silica, alumina, magnesia, alkaline oxide, and metallic oxides are reduced and transformed into volatile chlorides, and the hydrogen remaining in the carbon is transformed into hydrochloric acid, which is carried away with the chlorides.

This process, however, would be difficult in the case of purifying the voluminous masses of carbon of gas-retorts. The means we have devised to simplify the work consist in first directing a current of dry chlorine for thirty hours at least on a few kilogrammes of retort-carbon maintained at a red-white temperature, and previously cut in the form of prismatic crayons.

This first operation leaves in the carbon numerous vacant spaces, which it is necessary to fill, so as to restore to the carbons, as much as possible, their original compactness, conductivity, and weak combustibility; accordingly, the purified crayons are subjected to the carbonating action of a carbide of hydrogen, the vapour of which circulates slowly among the crayons heated to a red-white temperature, during five to six hours, in a cylinder of refractory earth. The reduction of the carbide (heavy oil of coal) to vapour, should be effected slowly, in order that the decomposition may be produced at the highest temperature, and a slight deposit of carbon may be formed; otherwise, all the crayons get covered with a layer of hard carbon, thick enough to unite them in a single block, which it is no longer possible to utilise.

Caustic soda with three equivalents of water, melted in iron vessels, offers a more prompt action, converting the silica and alumina into akaline silicate and aluminate. By washing with hot distilled water you remove the akali of imbibition with the silicates and aluminates; then, by washing with weak and warm hydrochloric water, you remove all the iron oxide with the earthy bases: lastly, a little washing with warm distilled water takes away the remaining hydrochloric acid.

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[*] Lectures delivered by C. Detaille, at the Palais du Trocadéro, Paris.

The third process, purification of retort carbon with hydrofluoric acid, is one of the most simple operations. An immersion of the cut crayons in hydrofluoric acid, diluted with twice its weight of water, and set to react 24 or 48 hours, at a temperature of 15° to 25° C, in a rectangular lead vessel with cover, easily realises the object sought. It remains merely to wash with plenty of water, then with distilled water, then to dry and submit the carbon so purified to a carburation of 3 or 4 hours, if the earthy matters removed by the hydrofluoric acid are in small proportion. But the use of this acid, even diluted with twice its weight of water, requires many precautions if one is to avoid burns of the skin, causing purulent blisters, with acute pain and pretty violent fever. It is specially necessary to guard the sight, and to handle the substance with extreme prudence.

Such are the three processes which I have sought to apply either to gas-retort carbon or to Russian graphite.

Lastly, I have been specially occupied with the direct preparation of pure graphitoid carbon. It is shown, in lectures on chemistry, that any volatile organic substance will furnish, on being decomposed by heat, carbon in small, very thin, glittering particles. It is this mode of preparation I have utilised, with the aid of a small apparatus, at the Central School, modified to render the work more regular and more continuous.

All carbides of hydrogen furnished by decomposition, in a closed vessel, of coal, peat, schists, resins, plants themselves, are available for this decomposition, as also oil of turpentine and naphthaline. Those substances with the highest boiling-points are preferable, because of their low price, and their large yield of hard carbon, which rises to about a third of the liquid employed.

Even tar, quite as free from saline matters as the preceding carbides, since it is the first raw product of distillation, has furnished, from the first operation, bright, sonorous carbon, with homogeneous fracture, having the grain of cast steel.

M. Jacquelain indicates, in a table, the results of photometric experiments with the different carbons referred to; and it appears that the luminous power and the fixity of the voltaic arc increase at the same time with the density, hardness, and purity of the carbon.

The natural graphitoid carbon of Siberia (of which the Conservatory of Paris possesses a rich collection, given by M. Alibert) has the singular and unexpected property of acquiring, by purification, a luminous power double that which it presents in the natural state, a power exceeding by a sixth that of even pure artificial carbons.

A NEW FORM OF REVERSIBLE STEREOSCOPE.*

WITH a view to removing for others the difficulty implied in the binocular experiments on which I based the conclusions expressed in my recent papers, published in the November and December numbers of this journal, I have devised the following form of stereoscope, which has been found quite satisfactory. Persons possessing no previous muscular training of the eyes have been able with it to secure reversion of relief in the combined picture as easily as they had obtained natural perspective while using it as an ordinary stereoscope. Some of my experiments involved extreme muscular tension; these required the use of the unaided eyes, but a large proportion of the rest can be performed by the aid of this instrument without special discomfort.

The semi-lenses (Fig. 1, *l*, *l*) rest in a pair of boxes, with windows in front and behind, to transmit the light. These boxes are separated by a thin partition, on each side of which is a spring against which the thin edge of the semi-lens is pressed by the adjusting screw (*s*) at the base. In front is a pair of brass hinges (*c*, *c*); when pressed flat as in Fig. 1, each half of the stereograph is hidden from the eye on the other side; when folded, as in Fig. 2, the whole stereograph is made visible to each eye. Attached to a sliding cross-bar is a wooden screen (*b*, *b*), moving on hinges; when this is pressed down flat, as in Fig. 1, the view of the stereograph is unobstructed; when lifted up, as in Fig. 2, the window at the middle permits the left half of the stereograph to be seen by the right eye, while the right half is obscured; and vice versa for the left eye. From the top of this window is a small projection (*d*). The stereograph rests upon its movable cross-bar (*a*), which slides upon a longitudinal strip about 30 cm. in length.

The semi-lenses are easily removable at will, and a pair of prisms (*pp*), the refracting angle of which is 12°, can be substituted, but with their bases pressing against the springs instead of the screws.

To secure natural perspective through the semi-lenses press the brass and wooden screens flat (Fig. 1), and use the instrument as an ordinary stereoscope. Assuming the stereographic interval to be average, and the distance between the observer's eyes to be not greater than usual, comfortable vision will be secured by turning the adjusting screws until the semi-lenses are pressed as near as possible together. The light which enters the pupils then passes through the thicker part of each semi-lens, and the optic angle is positive and small, or the visual lines may be sensibly parallel. If the observer's interocular distance is much greater than usual, the rays of light which he receives will be transmitted still nearer the base of the semi-lens, and slight optic divergence is necessary. This is avoided by giving a few leftward turns to the screw, permitting the semi-lenses to be pressed a little farther apart by the opposing springs. The same can be done to secure comfortable vision when the stereographic interval is great; pictures 10cm. apart can thus be viewed without discomfort, and without any very objectionable degree of coloration in consequence of want of achromatism in the semi-lenses. By now turning the screws so as to press the glasses closer together, any degree of optic divergence may be attained that the observer is willing to endure, while the picture is still seen in natural perspective, distances being apparently slightly magnified, and diameters also in the same ratio.

FIG. 1

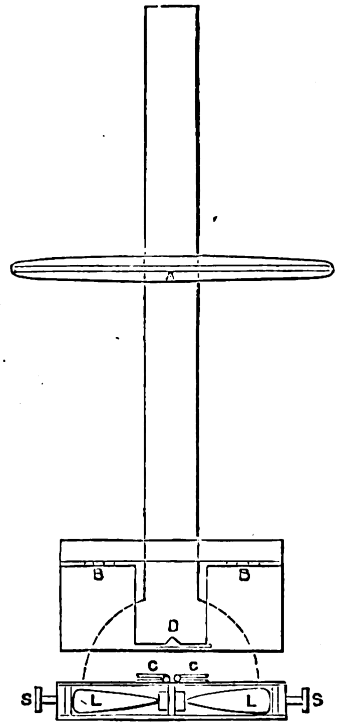
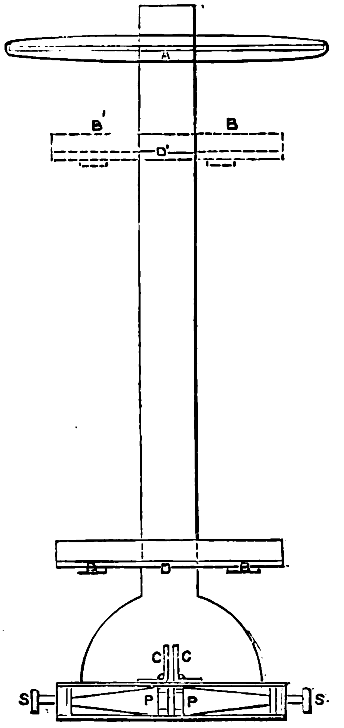


FIG. 2.



To secure reversed perspective, lift up the wooden screen, fold the brass hinges outward in front, and substitute the prisms for the semi-lenses, as in Fig. 2. Slide the stereograph nearly to the end of the stereoscope. Physiological perspective is at once reversed; whether this is enough to overpower the other elements of perspective must depend upon the nature of the picture. If the stereograph be that of the moon, the reversion is complete; if of terrestrial scenery, some objects may be apparently transposed in position while others are not. The same picture may be examined successively with each illusive effect several times in as many minutes. As soon as reversion is attained, the stereograph may be drawn up as close as may be convenient.

If both semi-lenses and prisms are discarded, the instrument becomes a direct-vision stereoscope, in some respects similar to that described by Prof. William B. Rogers in 1855. To secure natural perspective, press the screens flat, pull the stereograph up as close as possible, and gaze as if through it at a remote object, with the muscles of the eyes relaxed. The two pictures, imperfectly focalised, are dimly seen apparently to overlap. The stereograph is then pushed out to the end of the stereoscope, and the pictures are binocularly combined by optic divergence. The stereograph may now be pulled up as near as convenient.

To secure reversion of perspective by direct vision fold the brass hinges and lift the wooden screen, as in Fig. 2. Push this out (*b' b'*) as near as possible to the stereograph at the end of the instrument, then pull it up, keeping the gaze fixed upon the projection (*d'*) at the top. This grows dim as it approaches its previous position. Without changing the direction of the visual lines, except slightly to lower them, transfer the attention to the stereograph beyond. The combined picture is seen in reverse perspective, apparently much smaller and nearer than when the prisms were employed. Those who have tried this instrument thus far have usually succeeded at the first attempt, for either natural or reverse perspective, when the glasses were used. Several trials are often necessary before success is attained by direct vision, but the variation in perspective thus attained is much more striking. But little experiment is needed to prove to any one who is thus successful that in the localisation of objects in the binocular field of view presented by the stereograph, the current theory of successive triangulation by intersection of visual lines is inapplicable. The only substitute that covers the facts which the geometric theory fails to account for is that of associated muscular action, which applies to divergence as well as convergence of visual lines. The use of adjusting screws for the semi-lenses of the stereoscope is, of course, not a novelty. They were thus applied by Duboscq, about 1850, to one of Brewster's stereoscopes, and also, subsequently, by Helmholtz.

ELEMENTARY LESSONS IN DRY-PLATE PHOTOGRAPHY—IX.*

Defects and Remedies.

GENERAL FOG.—This is probably the commonest of all faults with gelatine negatives. It consists of a veil over the whole plate, showing itself by want of transparency in the shadows. It may be so slight as to be imperceptible, except when the negative is laid face downwards on a sheet of white paper, or may be so dense as to make the time necessary to get a print to be measured by days. It is due to one of two causes, which are usually indicated by the names, *chemical fog*, and *light fog*,

The first arises from error in the preparation of the plate. By it is meant that the sensitive film is in such a condition that the silver salt is reduced by the developer without light having acted upon it. In certain cases it may be cured by soaking the plates before exposure in a solution of three grains of bichromate of potash to each ounce of water, afterwards thoroughly washing the plates, and then drying them.

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* By W. LeConte Stevens, in the *American Journal of Science*.

* Condensed from the *Photographic News*.

To distinguish chemical fog from light fog, the best way is to develop an un-exposed plate, performing all the operations in total darkness. This is not difficult. If the plate be found to have darkened, the fog will be chemical fog, or, what is practically the same thing to the photographer, light fog, brought about by the action of light on the emulsion whilst in the hands of the manufacturer.

With the well-restrained developer which we gave in the last chapter, chemical fog is less likely to make its appearance than in the case of the feebly-restrained developers usually recommended. The bromide in the developer may even be increased beyond that which we give, but this will necessitate a somewhat longer exposure. We may state that bromide of ammonia in the developer begins to have an appreciable actual slowing effect on the plate when it is used in the proportion of ⅔ or ¾ the quantity of strong ammonia used. When the bromide equals the ammonia, the slowing effect becomes very great.

Light fog is due to the action of light generally in one of three ways: first, on account of an unsafe light in the dark room; secondly, on account of a defect in the camera or dark-slide admitting light; and thirdly, on account of over-exposure. When the fog is due to light in the camera, this will be recognised by the fact that the portions of the plates covered by the wires or rebates of the dark slides remain free from fog. When this is the case, the camera must be carefully examined by removing the focussing screen, and looking for any the smallest defects which might admit light, the head of the observer being covered with the focussing-cloth. Light finding its way through defects in the slides generally shows itself in the form of streaks or lines. Should no defect be detected, the exposure must be reduced. If fog from unsafe light in the dark-room be suspected, place a plate in the dark-slide, draw out one of the shutters halfway, and then lay the slide for five minutes on the table where the plates are changed and developed; then develop the plate. If one-half darkens, it shows that the light is not safe, and steps must be taken to render it so.

Green fog.—This defect is always due to error in the manufacture of the plates. It makes its appearance only in the shadows of the negative. If the negative be looked at by reflected light, a black object being laid under it, the shadows will be seen to be bright green. On looking through the negative they will appear somewhat pink, or sometimes a sort of "muddy" colour. Green fog makes its appearance only with alkaline pyrogallic development, and then chiefly when the plate has been under-exposed and development "forced."

A slight amount of green fog is not detrimental to the printing qualities of a negative; but if the defect shows itself in an aggravated form, the best means of preventing it is to resort to ferrous oxalate development.

Frilling consists in an expansion of the film to such an amount that it loses its adhesion to the glass, and "frills" off. The phenomenon begins at the edge of the plate, and spreads towards the centre. When it begins at the centre it is termed blistering. It is due to an error in the manufacture of the plate, but is much aggravated by a developer strong in ammonia, by the use of warm solutions, by the use of too strong a fixing bath, or by the use of very soft water for washing. When it makes its appearance only in the fixing bath or during washing, it may be prevented with certainty by placing the plate, immediately after development, in a saturated solution of alum for five minutes. This we advise in all cases; but where there is no fear of frilling, the plate should be thoroughly rinsed before it is placed in the alum solution. If the frilling be of so aggravated a form as to show itself during development, it is more difficult to prevent its occurrence. Captain Abney states that coating the plates with plain collodion before development is a perfect cure. Plates which, when newly prepared, frill frequently, after keeping for some weeks or months in a dry place, show no tendency to the defect. In fact, we have found that the keeping of the gelatine plates for some time improves them in every way.

Want of Density or Flatness of Image is usually due to under-development, or to the use of too weak a developer. A consideration of our remarks in the last chapter on development will show how sufficient density may be gained in almost any case; and we may here say that a very common cause of want of vigor is to be found in the fact that the ammonia is not so strong as is supposed. In the case of liquid ammonia of specific gravity ·880 a very short exposure to the air weakens it, by allowing ammonia gas to escape. It will be generally found that the last of the ammonia in the bottle is considerably below the standard strength, simply from the escape of the gas every time the bottle is opened. It is for this reason that we recommended the dilution of the ammonia with an equal bulk of water immediately after purchasing it. Pouring the strongest ammonia from one bottle to another will perceptibily weaken it.

(*To be continued.*)

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE May meeting of this Society was held on the 12th inst. at Burlington House. Mr. E. J. Stone, President of the Society, and Director of the Radcliffe Observatory, Oxford, occupied the chair.

Mr. Henry George Hollingworth, of 319, Vauxhall-bridge-road; Mr. Samuel Okell, of Bowden, near Manchester; Mr. Wm. Barrett Roué, of 165, White Ladies'-road, Clifton, Bristol; and Mr. H. Goddard Williamson, of Shrigley-road, Bollington, near Macclesfield, were balloted for and duly elected Fellows of the Society.

Mr. Downing read a paper entitled "Discussion of the Observations of γ [Gamma] Draconis made with the Greenwich Reflex Zenith Tube during the years 1857 to 1875 inclusive." The author said: As the discussion of the observations with the zenith tube from 1852 to 1859, which had been made by Mr. Main, and published in the "Memoirs of the Society," appeared in some respects unsatisfactory, I have undertaken this discussion, commencing from the time when the instrument was brought into its present improved position. The period which I have taken is sufficient to include a complete revolution of the moon's node, so that a value of the constant of nutation may be also deduced. The results which I have obtained are as follows:—Constant of aberration, 20·378″; annual parallax of γ Draconis, − 0·131″; constant of nutation for 1866, 9·3353″. It will be seen that the parallax of the star again comes out a minus quantity, which of course throws some doubt upon the results; but it is somewhat smaller than that found by Main, while the constant of aberration is larger. The observations are probably affected by a periodic error, perhaps arising from the effect of temperature on the instrument.

Mr. Glaisher read a paper by Mr. T. W. Backhouse "On the Merope Nebula," in which the author stated that he had observed the nebula without difficulty with a 4¼in. refractor, *Merope* itself being out of the field. The general appearance of the nebula was similar to the drawing which had been made by Signor Tempel.

Mr. Common exhibited photographs which he had obtained, of the central portion of the nebula in Orion, in which a large amount of detail was clearly visible. The exposure had been ten minutes. The photographs had actually been made to test the efficiency of an electric control to a clock, and Mr. Common hoped that in future he might be able to obtain negatives showing still more detail.

Mr. Common then read a paper "On the Illumination of Micrometers," and exhibited a micrometer with the lamp attached, to show the arrangement of the apparatus. The principal feature was the employment of a small incandescent carbon electric light, which the author had found an extremely convenient mode of illumination.

Mr. Marth exhibited an apparatus, and read a paper describing it, entitled "Note on an Apparatus for Determining those Errors of Astronomical Observations which are caused by the flexures of an instrument, and by defects in the shape of its pivots." The author said: At the December meeting I mentioned an old proposal of mine for determining these errors, and M. Loewy has a communication in the new number of the *Monthly Notices* in which he makes some critisisms upon the method which I recommended. My apparatus consists of two object-glasses with a half-silvered mirror between them. It is placed in the cube of the instrument to be examined. One of the object-glasses has the object-glass of the instrument in its focus, and the other the wires of the eyepiece, so that a mark on the object-glass can be seen directly through the unsilvered portion of the mirror, while the wires can be observed at the same time by reflection. The amount of flexure is then determined by the displacement of the images. The same apparatus is also to be used for investigating the defects of the pivots. In reply to a question by the Astronomer Royal, Mr. Marth explained that it was not essential that the object-glasses of the flexure apparatus should be absolutely perpendicular to the axis of the telescope, as the displacement of the images showed simply the *difference* between the flexure of the two ends of the instrument.

The Astronomer-Royal said: I think that this method of determining flexure too much presupposes a rigidity in the instrument which it obviously does not possess. The cube in which Mr. Marth's apparatus is placed is the weak part of the instrument, and in the new transit circle which is being made for Melbourne, it will be replaced by a cylinder, to which the two ends are bolted. It has been suggested that the tube of the telescope should be carried right through; but there is a difficulty in this, as it would have to be perforated for the illumination, and this would weaken the tube too much. I believe Mr. Marth's mode of determining flexure is a valuable one; but I think the best method is that of reflection observations. It may be desirable to interchange the eyepiece and object-glass, or to determine flexure by means of collimators; but other sources of error may then be introduced.

The President: Mr. Marth's method appears to be a very valuable one. There may be, as Mr. Christie has pointed out, a certain amount of strain, but it would not be anything like that of the ordinary flexure of the telescope. I am much more in favour of the use of collimators for these determinations than Mr. Christie appears to be, although there is a certain amount of danger from uncertainty of temperature. Still, we cannot have too many methods, as they act as checks upon each other. In the new telescope, however, that is proposed, and which I hope still to carry out, I think we shall be able to get rid of flexure, which will be better than determining and correcting it.

Mr. Marth: Collimators will merely give the horizontal flexure, whereas this apparatus gives flexure in any direction of the telescope. The objection to reflection observations is that they are confined to 40 degrees; your results are also affected by errors of division.

The Astronomer Royal: I hope soon to have an arrangement by which the collimators may be removed when not required. We shall then be able to extend our reflection observations as far as 70 degrees. We have determined our errors of division as well as we can, and I think there is very little outstanding error in our determination.

The President: I may mention that in two cases which have come under my own observation I have met with something which was not astronomical flexure, but which produced much the same results. The first occurred at the Cape, where the error was found to be due to the lenses of the object-glass, which had become separated, and slightly shifted as the telescope was moved round. The other case was at the Radcliffe Observatory, and where an apparently large flexure was found to be the effect of displacement of the object-glass, owing to a small amount of play in the screws with which it was fixed. We see, therefore, that independently of the flexure of the tube there are errors arising from slight movements of the object-glass.

The Astronomer Royal read a paper on the spectrum of comet *a* 1882 (Wells), which had been examined at the Royal Observatory, Greenwich, on April 22nd and 24th, and May 11. No bright bands were seen, but only a continuous spectrum, which was remarkably bright from the nucleus, considering the faintness of the comet.

The Rev. F. Howlett exhibited a number of drawings which he had made of the great sunspots which had recently been visible, and read a communication in reference to them, in which he called attention to the immense size of these spots—one being nearly 3′ in diameter. His drawings also showed a very large number of faculæ, which had been visible on the solar surface.

The Astronomer Royal showed some enlargements from photographs of the same spots, which had been obtained at the Royal Observatory. He said it was remarkable that the first group appeared on the 13th of April, and three or four days afterwards a great magnetic storm occurred. There was a smaller group of spots also, which, on the 17th of April, burst out suddenly, the group rapidly becoming nearly as large as the other group. Following this, on the 19th of April there was another violent magnetic storm, lasting about twenty-four hours. A double outbreak on the Sun and two magnetic storms are interesting facts, to which attention should specially be directed.

Mr. Mattieu Williams asked if any remarkable prominences were observed in connection with these magnetic storms, and referred to the explanation which he had suggested some time ago, that prominences were the result of vortex action, producing great agitation of the vapour on the solar surface, and causing electrical disturbance, which would show itself in magnetic storms.

Mr. Knobel read a paper by Mr. Pratt on the great sunspots of April, in which the author called attention to the great changes which had taken place in the form and size of the spots. The diagonal of the principal spot, which was somewhat square, in shape, measured 2′ 7″, or about 59,000 miles.

The President gave an account of a paper by Col. Tennant, entitled "An examination of the Roorkee Observations of the Transit of Venus, 1874." The President said: Col. Tennant thinks that his observations of ingress, which have been rejected in the discussion, have not been considered so accurate as they should have been. Col. Tennant, who is an exceedingly good observer, is firmly convinced that he saw nothing like a black drop, but observed pure geometrical contact. This, however, is absolutely incompatible with the series of measures which he gives of the distances between the limbs of Venus and the Sun, so that what he considered geometrical contact was, in all probability, what other observers have seen, and called *shadow*.

The following papers were also announced and partly read:—J. B. Coit, "Determination of the Orbit of η Cassiopeiæ": J. Gledhill, "Observations of the Phenomena of Jupiter's Satellites made at Mr. Edward Crossley's Observatory, Bermerside, Halifax"; and A. Graham, "Elements of the Orbit of Comet Wells."

SCIENTIFIC NEWS.

THE comet Wells (*a*, 1882) is gradually becoming brighter, and should, if the calculations are correct, be shortly visible to the naked eye. Dr. Lamp, of Kiel, gives an ephemeris for Berlin midnight, which may possibly be of some use to our readers:—

	R. A.	N. P. D.
	h. m. s.	° ′
May 20	2 53 0	22 41
„ 21	3 5 21	24 5
„ 22	3 16 26	25 34
„ 23	3 26 24	27 6
„ 24	3 35 20	28 41
„ 25	3 43 27	30 20
„ 26	3 50 46	32 2
„ 27	3 57 24	33 47
„ 28	4 3 27	35 35
„ 29	4 8 57	37 25
„ 30	4 14 1	39 19
„ 31	4 18 39	41 15

The perihelion passage, according to Dr. Lamp, will take place on June 10th. Prof. Lewis Boss gives an account in the *Astro. Nach.* of the discovery of the comet on March 18, and says that when he observed it on the 19th, it appeared like a great comet in miniature.

Dr. J. Palisa has discovered another small planet, the number of which will be 225.

Prof. Henry Draper has succeeded in taking four photographs of the spectrum of the nebula in Orion during the spring, about the same time as Dr. Huggins on this side of the Atlantic also secured photographs. It is too early to speak of the conclusions to be arrived at from a study of these photographs; but one thing may be asserted, that hydrogen maintains its position as an element unimpaired. Prof. Draper believes that he has evidence of the process of aggregation, or of condensation of the nebulous matter into stars.

The Council of the Iron and Steel Institute have awarded the Bessemer medal for 1882 to the late Mr. Alexander Lyman Holley, and have decided to forward it to his family through the American minister.

The deaths are announced of Mr. Charles Hockin and of Mr. Thomas Dunman. The former was well known in scientific circles as an authority on his special subject, for although only forty-two at the time of his death, he had made his talents known in the electrical world, and was a collaborateur with Dr. Matthiessen, Sir W. Thomson, and Prof. Clerk-Maxwell.

The Burt prize for the best means of ventilating ships, awarded in connection with the Shipwrights' Exhibition, has been gained by Messrs. Robert Boyle and Son, whose system is as simple as it is efficient.

An application of the electric railway has recently been made in the linen bleachfields of Le Breuil-en-Ange, Calvados, for gathering in the bleached cloth. A Siemens dynamo and the collecting apparatus are placed in one vehicle, a set of Faure accumulators in another, and the cloth is carried in a series of trucks. The line of railway has 21 branches, each about 500 metres in length, and the pieces of cloth, being connected at their ends, are gathered up in long lengths, 5,000 metres being rolled up by the machine in half an hour, whereas by the old method such a length was a day's work.

Professor Edlund contends that a vacuum is a good conductor of electricity. In a vacuum tube he distinguishes two resistances to passage of the current—one is that of the column of rarefied gas, the other exists at the places of contact of the electrodes with the gas. As the gas is increasingly rarefied the former decreases, but the latter increases, and at length becomes so great that the current cannot surmount the obstacle. Professor Edlund has furnished proof that this obstacle is due to an electromotive force giving a current opposite in direction to the principal current. One evidence that vacuum presents very little resistance to passage of electricity is that if electrodes be dispensed with, electric movements so considerable as to give light may be produced by induction at a distance, or by friction, in a tube in which the air is too rarefied to allow of a strong induction current passing between electrodes. The new view, if accepted, would require us to part with the conception that ordinary matter is necessary for propagation of electricity. Indeed, the various material substances are to be thought of merely as offering more or less resistance to that passage; their *rôle* is not active, but passive. The idea of "conductivity" loses its old significance.

The French Government has resolved to establish a zoological laboratory on the shores of the Mediterranean, at Villefranche, near Nice.

Spain has been badly off hitherto for railway communication with France and the rest of Europe. The Pyrenees, with a total length of some 500 kilometres, is crossed with railways only at two openings, one in the west at Irun, the other in the east at Port Vendres. The triangle formed by joining the ends of the range with Madrid contains in part the rich provinces of Arragon, Catalonia, Navarre, and Castille. Recently, the Spanish Cortes has authorised the construction of a new line which will cross the range between the others. Starting from Huasca, it will go through the Col de Canfranc, and join the French lines at Oleron. It will penetrate the mountain mass near Gomport, and its traffic will be directed towards Toulouse, Bordeaux, and Nimes. The distance between Paris and Madrid will be shortened by 100 kilometres (say 62 miles). The recent law specifies the conditions of execution of the line, which will receive a subvention of 60,000fr. per kilometre. The work is to be completed in six years. The Spanish Government will bear half the cost of the tunnel, which will be 6,600 metres in length (about four miles), and so the shortest of the great international passages. The Mont Cenis is 12,233 metres; the St. Gothard, 14,920 metres; the Arlberg, 10,270 metres; the Simplon, it is estimated, will be about 18,000 metres; and the Channel Tunnel 34,000 metres. The means of execution will be those now familiar, unless, perhaps, an economical application of electrical force takes the place of the remarkable machinery applied so successfully in the Mont Cenis and the St. Gothard.

Liquid ozone must be a highly interesting substance. MM. Hautefeuille and Chappuis have recently obtained it in the form of liquid drops of a deep indigo blue colour. The liquid could be kept nearly thirty minutes under a pressure of 75atm. Its vaporisation is not very rapid, even at atmospheric pressure. The liquefaction was effected by compressing, at about 125atm., a mixture of oxygen and ozone in one of M. Cailletet's tube-shaped vessels, which terminates above in a capillary part bent downwards. This descending part was exposed to a jet of liquid ethylene, a new method whereby M. Cailletet gets temperatures as low as − 105°C. The blue coloration is very distinct in the cooled part. On releasing the pressure the tube becomes instantly colourless, but a dark blue liquid drop remains at the end; this liquid ozone may be examined either through liquid ethylene, or by momentarily removing the cooled tube from this liquid.

It is stated that a new shell has been recently invented at Krupp's works, the effects of which, owing to the explosive matters used, and the mechanism causing explosion, are equal to those of torpedoes. Further, a new gun there devised, is mounted on a pivot furnished with mechanism which quite suppresses recoil. Notwithstanding large calibre (30 to 40ctm.), the smallest gunboats may be armed with it.

We learn from a Swiss source that superior effects have recently been obtained with a rifle invented by M. Hess, a gunsmith, in Zurich. The peculiarity of the weapon is, that it is only rifled about 12in. in front of the chamber, the rest of the bore being smooth and of calibre slightly less than that between the partitions. There is no cone of connection between the smooth part and the rifled part. After firing 200 shots, the rifle can be perfectly cleaned by working the scouring rod in it two or three times.

Underground telegraph cables are at present being laid in the North of France. The line between Paris, St. Quentin, and Cambrai is already completed. In order that lines may be quickly repaired in case of rupture, chambers called *marmites* are formed at intervals of 555 yards in the plains, and at shorter intervals where there are curves; these are so many guiding marks. The arrangement is such that from a telegraph-station connected with the cables it is easy to determine to what chamber a workman should go to repair a broken wire, and the precise spot at which he has to dig down to the cable is indicated. These underground cables are not meant to replace the air lines, and they are not for private telegraphy. The Government at present retains them at its disposal.

A new self-exciting dynamo-electric machine, the invention of MM. Dandeu and Chertemps, is described in *L'Electricité* as giving remarkable effects. A wooden board is pierced with holes in which are solidly fixed six coils, and is fixed on a support. Through a hole in its centre passes a movable axis. In a plane perpendicular to the board are two groups of three horseshoe magnets, with coils similar to those in the board, and making 1,200 revolutions per minute. It is on the fixed board that the currents are collected, by an arrangement which allows of grouping them in as many currents as there are cylinders, less one, the electricity of this latter cylinder not being used for exterior work, but serving to excite the moving electro-magnets. It appears that the machine consumes a motor force of only four h.p. while supplying ten Jablochkoff candles in a normal way. The special merit of the machine is said to consist in the suppression of the induction currents which are produced in the heart of the iron pieces facing each other in other generators.

The city of Paris has granted the Society of Agriculture and Insectology a piece of ground of more than 4,000 metres, in the park of Montsouris, for formation of a school of insectology. This will comprise the study and practical treatment of useful insects (bees, silkworms, &c.), the study of auxiliary insects (useful to plants), and investigation of the best means of combating noxious insects. Already the society has provided lectures, this year, on bee culture (by M. Hamet), in the Luxembourg Garden; these will be repeated at Montsouris, where an experimental apiary is constructed. Ere long, instruction about silkworms will be given, and a silkworm nursery, with mulberry trees, formed. For the study of auxiliary and noxious insects, a building is required to accommodate collections and apparatus, and will probably soon be erected.

The Swiss watchmakers at Geneva and Neuchatel have derived great advantage from the chronometric observatories at those places. With a view to benefiting the same industry in Franche-Comté, the French Government, in concert with the town of Besançon, have lately decided to institute an observatory in this town. The difference of longitude between the site for this new observatory and the observatory at Montsouris has been carefully determined by MM. Barnaud and Leygue. They arrive at the result, 14m. 36·267s.

If two metallic surfaces be placed for a few moments opposite each other, at a short distance (a small fraction of an inch), it is generally found that each metal has undergone a slight superficial alteration. The change increases with time, then tends to a limit. When the influencing metal is withdrawn, the metal affected reverts gradually to its previous state. These observations have been made by M. Pellat, who detected and estimated the alteration by measuring the difference of potential. He shows reason for believing that the action is not electrical, but purely material. It depends essentially on the nature of the influencing metal, being great with lead, less with copper, and *nil* with zinc. It is as though the metals emit at ordinary temperature a volatile substance, which, being deposited on the surface of objects, modifies their nature chemically. When the influence of the metal ceases, the volatile body gradually leaves the surface to which it has attached itself.

With delicate apparatus, Herren Wolffhügel and Hüppe have investigated the penetration of heat into meat in ordinary cooking. In boiling of pieces that weighed 3 kilogr. (7½lb.), the inner temperature in 2½ hours was 92° or 95° C., according as the meat was placed directly in boiling water, or in cold water, which was raised to boiling. A ham of 4·5kg. acquired in 4 hours' boiling an internal temperature of only 88° C. The roasting of 3kg. of veal produced 92° to 98°; and that of a piece 14·25kg., 71°—89°. In a second series, tins of corned beef, the contents of which weighed 730g., 2,500g., and 6,300g., were put in boiling water, boiling salt solution, and in a steam-boiler with a bath temperature under 100°, the inner parts never reached 100°, but the temperature varied between 87° (in the larger) and 98° (in the smaller). Heating over 100°, the temperature in the larger tins only reached 72°—98°. These facts, according to the author, explain why the larger tins of American meat often contain bad parts.

LETTERS TO THE EDITOR.

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[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

> "I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
> —*Montaigne's Essays.*

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"INTAMINATIS FULGET HONORIBUS"—STAR ATLAS FOR AMATEURS—SURVEYING: FINDING GEOGRAPHICAL CO-ORDINATES WITH A THEODOLITE—SPECTRAL PHOTOGRAPHY—THE GALILEAN TELESCOPE—AN UNPREDICTED OCCULTATION—COMET *a* (WELLS)—PROPERTIES OF LENSES, &c.—COCKROACHES—TRIPLE STAR IN MONOCEROS—HORIZONTAL POINTS OF SUNRISE ON THE LONGEST AND SHORTEST DAYS—CONSTRUCTION OF MAPS.

[20035.]—ASTRONOMERS will learn with gratification that the University of Glasgow has conferred at least as much honour upon itself as it has upon Mr. J. R. Hind, F.R.S., by making him one of its honorary LL.D.'s. We may now, perhaps, hope that one or both of our older universities of Oxford and Cambridge will at no distant date confer a similar distinction upon this eminent servant of science. Comparatively few men outside of the circle of professional astronomers know to what an extent we are indebted to the indefatigable and well-directed labours of Mr. Hind. Of the thousands who use the *Nautical Almanac*, but few, indeed, give a thought to the share which its superintendent has had in bringing it to its existing condition of perfection. It is, I imagine, incontestable that no one could employ the materials at his disposal more admirably and efficiently than Mr. Hind has done. I have, on more than one occasion, called attention in these columns to the shortcomings of the Predictions of the Phenomena of Jupiter's Satellites; but no man can make bricks without straw, and as long as he is confined for his materials to the imperfect tables published 46 years ago by Damoiseau, just so long must we exonerate the superintendent of the *Nautical Almanac* from blame for the errors which continue to disfigure this part of his work. If a small part of the money so indefensibly wasted on that trumpery imposture, "The Committee on Solar Physics," had been applied to the production of new and trustworthy tables of the Jovian Satellites, the solitary blemish in the work so admirably supervised and conducted by Mr. Hind would assuredly have been long since removed.

I regret to say that in the absence of my XXXIVth. Volume at the binder's, my memory fails me as to the exact nature of my original answer to Mr. Bridle, to which he refers in letter 19993 (p. 193). Doubtless, though, my reference was to Proctor's "Star Atlas," which is incomparably the best one for the amateur that I am acquainted with. I prefer the large edition myself, for several reasons. Every object in Webb's admirable "Celestial Objects," visible to the naked eye (and numerous others), will be found so clearly laid down in it as to render the identification of a given star or nebula certain on comparison with the sky.

Adding to the imaginary outfit of "Young Aspirant" (query 46768, p. 204), the *Nautical Almanac* and a book of mathematical tables, I will try to show him what he may hope to effect with the means at his disposal. Under any circumstances the results he will obtain can be only regarded as approximate, but with careful instrumental adjustment they will probably be sufficiently so for his purpose. With reference to his theodolite, he should have the ordinary system of wires removed from its eyepiece and the diaphragm of a transit substituted for them. This, as he may have heard or read, consists of five equidistant vertical spider-lines crossed centrally and accurately at right angles by a single horizontal one. I take it for granted that your correspondent is familiar with the adjustments of the theodolite, and knows how to level and collimate it, &c. We will then suppose him to be in some unknown part of Tasmania, with his instrument set up and accurately in adjustment. His first step will be to determine his meridian. This he will, of course, know more or less roughly from a compass or the position of the midday sun. Hence, he will have set up his theodolite with the 360° division pointing somewhere towards the north. Now let him select a bright star at some considerable distance to the east of the meridian, bisect it with the horizontal wire in his eyepiece, and note the reading of the horizontal circle. The diurnal motion will at once carry this star above the wire, and it will continue to mount and mount until it arrives on the meridian. Thence it will descend until, when it is as far to the west of the meridian as it originally was to the east, it will obviously have precisely the same altitude. All that we have to do, then, is to leave the altitude circle clamped, and to follow our star by a movement in azimuth alone until it is again threaded on the horizontal line. Then the theodolite will point, as I have said, exactly as far to the west of the meridian as it originally did to the east of it, and a point on the horizontal circle midway between the two readings will be in the meridian. Suppose, for instance, that "Young Aspirant" notes that when a bright star is 42° 21′ 8″ high to the east of the meridian, the horizontal circle of his theodolite reads 283° 6′ 9″, and that when, some hours afterwards, this star has the same altitude to the west of the meridian, the circle reads 85° 20′ 31″; then, quite evidently the Meridian must be half-way between the two points, so that if he makes the vernier read 4° 13′ 20″, the telescope will cut out a true north and south line in the Celestial vault. Having now got our theodolite into the meridian, we may proceed to determine our latitude. The most simple way to effect this is to measure accurately the meridian altitude of a star whose declination is known. Then 90°—this altitude = the star's zenith distance. If the latitude and the star's declination have the same name, the sum of the zenith distance and the declination will be the latitude. If they have different names, the declination must be subtracted from the zenith distance, and the remainder will be the latitude. I will illustrate this rule by a hypothetical example. Of course we are in south latitude in Tasmania. Very well, let us measure the meridian altitude of Antares, a star whose south declination is 26° 10′ 13″; and suppose that we find it to be 74° 2′ 20″. From this instrumental altitude we must subtract 17″ for refraction (as we shall find by reference to a proper table). Then the true altitude of Antares will be found to be 74° 2′ 3″, and taking this from 90° we get 15° 57′ 57″ for its zenith distance. Finally adding to this, according to the precept, the declination of Antares 26° 10′ 13″ (because both latitude and declination are south), we obtain 42° 8′ 10″ south as the latitude of our station. Had we employed a star with north declination (such, say, as δ Aquilæ), the calculation would have stood thus: Star's apparent, or instrumental, altitude 44° 59′ 43″. From this, following the table, we deduct 58″ for refraction; the remainder 44° 58′ 45″ being the true altitude, and obviously 45° 1′ 15″ the true zenith distance. From this (latitude being south and declination north), we *subtract* the star's declination 2° 53′ 5″. The remainder will be 42° 8′ 10″ as before.

To obtain longitude accurately is a matter of the greatest difficulty, nor can I pretend to furnish "Young Aspirant" with any method of determining it, save approximately, by aid of the means at his disposal. If his chronometer has been brought out from England, and indicates Greenwich time, its error and rate moreover being accurately known, the matter will be much simplified, inasmuch as he has only to determine his local time in the manner to be immediately explained, and the difference between this and that shown by his chronometer (when corrected for error and rate), will give his longitude by inspection. I must suppose, though, that his chronometer only shows his local time. In order to utilise this he must know our longitude roughly. We will imagine that we are, as nearly as we can guess, about 9½ hours east of Greenwich, and that we are observing on July 18th, 1882. Turning to p. II. of the month of July in the *Nautical Almanac*, we find that the "Sidereal Time at *Greenwich* Mean Noon" will be 7h. 44m. 46·41s. It will, though, be found, from p. 494 of the same work, that if the place of observation be not on the meridian of Greenwich, the Sidereal Time must be corrected by the addition of 9·8565 seconds for each hour (and proportional parts for the minutes and seconds) of longitude if the place be to the west of Greenwich, but by its subtraction if East. Tasmania being East of Greenwich, we take the correction of 1m. 34s., which this precept gives us, from 7h. 44m. 46.41s., and get 7h. 43m. 12·41s. as the Sidereal Time at our local Mean Noon. Now, on the night of July 18th, the right ascension of η Ophiuchi, a convenient star for our purpose, is 17h. 3m. 40·68s., *i.e.*, that is the time which a sidereal clock should indicate at the instant of the transit of η Ophiuchi over the meridian. Our hypothetical chronometer, though, shows Mean Time, so we proceed thus: From the star's right ascension, 17h. 3m. 40·68s., we subtract the Sidereal Time at Mean Noon 7h. 43m. 12·41s.: the remainder, 9h. 20m. 28·27s., is the number of *Sidereal* hours, minutes, and seconds after our Local Mean Noon, at which η Ophiuchi will cross our meridian. This we turn into Mean Time by the aid of the table on pp. 480 and 481 of the *Nautical Almanac*, so:—

h.	m.	s.		h.	m.	s.
9			=	8	58	31·5340
	20		=		19	56·7235
		28	=			27·9236
		·27	=			·2693
				9	18	56·45

If, then, we set the chronometer to indicate 9h. 18m. 56·45s. at the instant that η Ophiuchi is on our meridian, it will show absolutely correct local mean time. Having obtained his local mean time, probably the most available way for the surveyor to determine his longitude is by the aid of what are known as Moon Culminating Stars; for which he may consult pp. 367 to 396 of the *Nautical Almanac*, and the explanation given on pp. 504 and 505. He must be particularly careful, however, to multiply these observations, and, notably, to observe both limbs of the Moon. To confine his observations to either limb singly is to insure the observer being wildly out. The disappearance of Jupiter's 1st Satellite in Eclipse, as observed with a small telescope, will give an approximate longitude by comparison with the predicted Greenwich time in the *Nautical Almanac*. To expect to obtain accurate longitude, however, with a theodolite, and nothing else, is akin to hoping to execute delicate ivory-carving with an American axe. I don't quite know what "Young Aspirant" means by a "micrometer attachment to telescope of a theodolite." If he means an eyepiece-micrometer (albeit I have never seen such a thing attached to a theodolite), he might find the distance of an object of known height or width by dividing such height or width by the tangent of the angle it subtended at his eye. In this way; A gum-tree exactly 86ft. high subtends an angle of 1° 2′ 15″, how far is it off?

86 log. 1·934498
Log tan of 1°2′·15″ 8·257913

4748·8ft. log. 3·676585, or 0·8994 mile.

Any high-class optician may be depended upon to furnish excellent surveying instruments.

"Cinquanta" (query 46778, p. 204), should obtain Mr. Rand Capron's excellent and useful work "Photographed Spectra," published by Spons. He will find a full description of the apparatus employed, photographically illustrated, in it. No intelligible reply to such a query as 46778 could be compressed into a paragraph in a letter.

Did "Aqua Fortis" (query 46819, p. 205) ever see an opera- or field-glass in his life? or is he ignorant that telescopes with concave lenses have been used as "spy-glasses" since the year 1609, when Galileo invented this form of instrument? The field of view becomes so constricted with deep concave eye-glasses, as to render the employment of a really high power upon this form of telescope impracticable.

I can, I am sorry to say, only give negative evidence with reference to the subject of query 46822 (p. 205). I know of no 6th magnitude star that lay very near the Moon's path, as viewed from the South or centre of England on the night of April 26th; but I can say quite definitely that it was *not* 9 Sextantis which was occulted, inasmuch as the Moon was at some distance to the North-West of that Star at the hour specified by my querist.

Had Mr. Fleming (letter 20013, p. 216), read the predictions with reference to the increase in brightness of Wells's comet a little more carefully, he would have noted that it will not become a daylight object until it has passed too far to the south to be visible in the British Islands at all. In a 4in. achromatic, last night (the 11th), with a power of 40, it presented a very interesting appearance, the nucleus being apparently stellar, and the tail extending more than $\frac{1}{2}$° from it in a *n.p.* direction as a bright beam of nebulous light, and being traceable at least 15′ farther by averted vision.

As "Orderic Vital" (letter 20022, p. 217) gives no reference to the number or page of the query of "Lens," I am rather at a loss to know what it is with regard to which your very able correspondent has referred such querist to me. Meanwhile, I do not know whether it will be of any use to "Lens" to say here that Sir George Airy shows, in his "Undulatory Theory of Optics," that if e be the radius of the aperture of a telescope in inches, the extreme diameter of a star disc in seconds to the first black ring will be 2·76 divided by e. Some very interesting micrometical measures, made by that eminent double-star observer, Mr. George Knott, in the course of an experimental investigation into the accuracy of this theory, will be found on pp. 87 and 190 of Vol. XXVII. of the R.A.S. *Monthly Notices*. Possibly, too, a paragraph in a letter of my own (18314), on p. 494 of Vol. XXXII. of the ENGLISH MECHANIC, may be of some service to "Lens," if I rightly gather the tenor of his question from what "Orderic Vital" says.

"Brickwall" (query 46861, p. 226) must consult some work on systematic Entomology for minute details; but I may say here that the filthy Blatta orientalis, Cockroach or Black-beetle, belongs to the order of Orthoptera. The most immediately patent difference between this and the order of Neuroptera consists in the fact that in the latter the four wings, generally equal in size, are traversed in all directions by very numerous nervures (a dragon-fly's wing furnishes a good example of this), whereas the nervures of the hinder wings in the Orthoptera always radiate from a central point to the circumference. These radiating folds and nervures are wholly absent in the posterior wings of the Coleoptera, which are really used for flight. A cursory examination of the wings of the Blatta will show how unfit they are for any such purpose.

Writing on the day of the appearance of query 46870 (p. 227), in the middle of May, I can of course not examine a region of the sky which is on the meridian between 2 and 3 o'clock in the afternoon; but as there is no triple Star anywhere near the position indicated by Mr. Tindale, except 11 Monocerotis, I can only conceive that that is really the one which he has got hold of, malgré the seeming discrepancy in his position angles. Unless he either observed the object when actually on the meridian, or his telescope is equatorially mounted, he may easily have made a mistake in his estimation of them. He did not reckon that of C B did he (taking C as the initial point)? because this would bring him rudely into his position angle of 305°.

"Neo" (query 46888, p. 227) would appear to be unaware of the fact that the points at which the Sun appears in the horizon on the longest and shortest days respectively, vary with the latitude of the place of observation. The simple trigonometrical formula for determining them is this: Sin. Sun's declination × sec. latitude = sin. of amplitude (amplitude being the distance of the Sun from the east point measured on the horizon). Let me illustrate this by an example. Whereabouts does the Sun rise at Beaumaris (lat. 53° 17′) on the longest day?

Sun's Declination North 23° 27′ sin. 9.599827
Latitude of Beaumaris ,, 53° 17′ sec. 0·223402

41° 43′ 49″ sin. 9·823229

Therefore, on June 21st the Sun will rise at Beaumaris at a point 41° 43′ 49″ to the north of east. On the shortest day it will pretty evidently rise precisely as far to the south of east.

I am afraid that Hughes, on "The Construction of Maps," published by Longmans, has run out of print. If not, it is the very book for Mr. A. J. Smith (query 46902, p. 227.)

A Fellow of the Royal Astronomical Society.

WELLS' COMET.

[20036.]—IN your journal for August 21, 1874, you kindly permitted me to describe a method for finding a comet's orbit by projection. I have employed that process to find an orbit for Wells' comet from observations of my own with the following result: time, June 13, 1882.

$$\begin{array}{lll} \pi & = 48^\circ\ 20'\ 0'' \\ \Omega & = 211\ \ 10\ \ 0 \\ \iota & = 78\ \ 20\ \ 0 \\ \text{Log. } q & = 9\ 0899. \end{array}$$

These elements differ a little from those that have been published in the MECHANIC, and I give two positions indicated by the above orbit near which I think the comet will be. June 1, R.A., 4h. 12m., Dec. N., 50° 50′; June 8, R.A. 4h. 42m. Dec. N. 36° 35′. The comet will be nearest to the earth on May 17th, about 85 millions of miles from us, its distance will then slowly increase; on May 25th, it will be 86 millions of miles; on June 1st, 90 millions; and on June 8th, 96 millions of miles from us, while its distance from the sun on those dates will be 61; 44; and 22 millions of miles; the motion of the comet in its orbit at the same times will be 113,160 miles, 133,400 miles, and 193,200 miles per hour respectively; while on the 13th June, when nearest to the sun, about 11 millions of miles, its rate of motion will be 276,000 miles an hour. The comet will not be a very conspicuous object. Owing to its great distance from us it will appear small, and from the increasing twilight and moonlight and its approach to the horizon after sunset, its splendour will be much diminished.

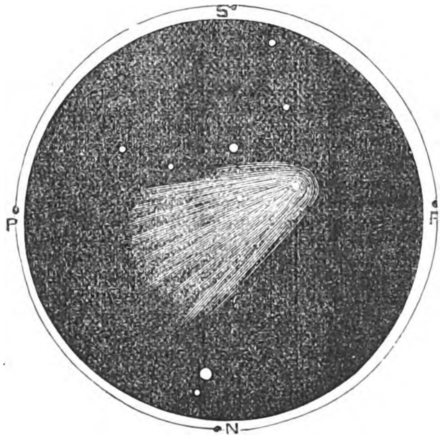
I have noticed that comets when approaching the earth rapidly increase and brighten much more than their nearer distance would warrant; when they are nearest, their brightness usually varies very much, and when they are departing from us they fade away very quickly; of course, this is modified according as the comet is approaching to, or departing from the sun: I should be glad if some one could say what theories (if any) have been formed to account for this phenomenon. Also, I should be glad to know upon what data the predicted brightness of the present comet has been estimated. An answer to the above from some correspondent will greately oblige.

J. Lane.

29, Wyvis-street, Bromley-by-Bow, May 13th.

[20037.]—ON Saturday, the 13th May, I had a fine view of the new comet (Wells'), with 12¼in. mirror, and power about 130. With this aperture it presented a bright and conspicuous object, at once attracting the eye in sweeping for it.

The tail was much better defined than hitherto, not requiring indirect vision to show its spreading outlines. In the immediate vicinity of a corona of small stars, it was quite interesting to observe how rapidly the comet advanced, changing its relative position with the stars manifestly and quickly. As some of the readers of the ENGLISH MECHANIC may desire to see how this object will appear by-and-by to the naked eye, I furnish a drawing, made at the telescope about 10.30 p.m. At that time, a faint star was visible shining through the tail, showing its extreme thinness. A fine orange star, with a companion in the N. preceding field, completed a view of no ordinary beauty, and which my diagram attempts to represent.



Droylsden Rectory. **S. Mills.**

[20038.]—IN your last week's issue, you kindly reported my observations of Wells' comet up to May 6th. Since then I have seen it three different times—viz., May 8th, 10th, and 13th; each time between 10.30 and midnight. On the 10th it was exactly below Gamma Cephei, and on the 13th it had entered Cassiopeia. On that night the nucleus, stars 23 and 21 Cassiopeiæ, were in a straight line, each being equidistant from the other. The tail extended beyond these two stars and embraced them; the stars shining brightly through.

The night was very fine, and the view as good as any I have hitherto had. It is keeping close to the path indicated by Mr. Hind. It does not appear to me to be brightening much, and I doubt whether it will ever become a conspicuous object, as it is travelling fast into a light region. Knowing where to look for it on the night of the 13th, by the aid of the two stars above noted I could just pick it up by the naked eye, and this was fully as much as a friend and I could do. This was after seeing it through my telescope, and thereby ascertaining its exact position. **L. T. Fleming.**

Berwick-on-Tweed, May 15.

WENHAM'S NEW MICROSCOPE.

[20039.]—I SHOULD not have noticed letter 20021 as it is written by an anonymous writer, had he not insinuated that I pirated the idea, or derived my "inspiration"!! from Dr. Edmunds. This I totally deny. I had not even read his remarks, published in the *Journal* of the Royal Microscopical Society.

On the first appearance of the "Wale" microscope, I made some diagrams with the arc struck from the object-point as a centre; the result was unsatisfactory, as no substantial room could be obtained on the limb for clamping the arc up to 90°, or from the required horizontal to the vertical position. There can be but little claim to invention in this idea, as it might readily occur to anyone looking at the illustration of the "Wale" microscope then published.

A description with figures had been sent to me of an equatorial telescope, designed in the year 1868, and published in *Carl's Repertorium für Experimental-Physik*, in which all the motions were derived from the eye as a centre, so that the observer need not move in the least from his position in viewing every portion of the heavens. This gave me the idea of a microscope in which all the motions would be round the object-point as a centre.

As the writer of letter 20021 had no access to the workshop of Messrs. Ross, it is absurd for him to assert that the microscope proved a rickety and unmanageable contrivance, when the fact is, that it has the firmest standing, and is more free from tremor, than any microscope of the class that has preceded it, as the centre of gravity is unusually low, and if it appeared some months later than the instrument of Messrs. Watson, it is because this was a business arrangement; there is no antagonism between the firms.

The design was a mere matter coming within the scope of my duties, and having been patented, is, therefore, not honorary. I have already experienced sufficient ill-will this way, from persons who have claimed as novelties ideas published by myself many years before.

Dr. Edmunds has described nothing new or practicable; the mere suggestion that he made has not even been illustrated by him, and I understand that he failed in the attempt to get together a microscope of the "Wale" form, with the arc struck from the object-point, and the instrument has never seen the light. **F. H. Wenham.**

[20040.]—OUR attention having been called to the letter of "Another F.R.M.S." in your current issue. It is not our intention to enter into a controversy with the writer as to the origin or construction of the above microscope, preferring to leave your readers to form their own estimate of his remarks, which appear to us to savour more of malignity than fair criticism.

Ross and Co., Opticians.

112, New Bond-street, London, W., May 15.

WENHAM'S AND WATSON'S MICROSCOPE STANDS.

[20041.]—IN the current number of your valuable paper I see a letter (20021) by "Another F.R.M.S.," in which he does Mr. Wenham and the inventor of the microscope known as "Watson's," the honour of pointing out that the origin of their instruments is due to certain words spoken by Dr. Edmunds at a meeting of the Royal Microscopical Society on the evening of November 10, 1880.

Permit me, Sir, to give to this statement an unqualified denial. I know it to be untrue in both cases, but will leave Mr. Wenham to meet the statement touching himself (should he think it worth while) in his own way.

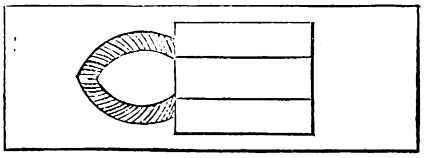
But, as the inventor of the stand known as "Watson's," I beg to state that its origin was not in the remotest degree connected with anything that Dr. Edmunds ever said, wrote, or thought. It was devised—as is well known to many—long before the words quoted by your correspondent were uttered, and primarily for a purpose in the perfecting of microscopic vision, which, to judge from his letter, he has as yet failed to grasp.

John M. Moss.

19, Eldon-place, Patricroft, May 12.

A TADPOLE SLIDE.

[20042.]—"VOLVOX" (see letter 20020) would find it easier to construct a special slide for his tadpole than to use the method he advises. His method prevents the use of a higher power than the ½in., and never insures the tail lying flat from end to end. The use of chloroform, too, retards the circulation. I send the description, with a drawing, of a slide, easily constructed, that enables the microscopist to view with an eighth of an inch glass the circulation in any part of a tadpole's tail; and that without injuring the object. Two pieces of vulcanite ring are fastened to an ordinary 3 by 1 glass slide, so as to form a small oval cell, just large enough to admit the body of the tadpole. The cell must have a free opening, so as to allow the tail to project out of it, and lie along the slide. Close to the opening of the cell an ordinary square thin cover glass is cemented on the slide by means of Canada balsam, for the purpose of raising the tail to its proper level with the body. On each side of this must be cemented two small oblong pieces of thin glass (made by dividing one of the little square covers in half); these will then form a kind of cell for the tail to lie in. Take a tadpole out of the water with a dipping-tube, and place the body in the oval vulcanite cell, when it will be securely held there by capillary attraction; the tail will then project along the slide, and may be held there by a square cover glass being placed over it. Another small square being placed over the body, it will be found that the tadpole is quite comfortable, and can readily be examined with high powers by the hour, without a chance of his moving. It is well to make these with the cells of two or three different sizes, to fit tadpoles of different stages of their growth. It is necessary that the cell should be only a trifle larger than the body of the tadpole, so that it is impossible for him to get his tail curled round the body, there not being room for it: hence it must be outside.



Alf. W. Stokes.

Paddington Vestry, W.

ASTRONOMICAL — ELECTRIC LIGHTING DANGERS — STRING VIBRATIONS.

[20043.]—Not having any of the works mentioned by "Ascalon" in letter 19992, I cannot compare his diagrams with theirs; but very likely they show either the formation of an image or how achromatism is maintained, so he cannot expect them to appear so "simple" as his, which show nothing. If Mr. Johnson had said that the current from Edison's dynamo could not pass through his body, he would have been nearer the truth. I should think I had to state six times in as many days after the statement appeared that it was all humbug, and if "Sigma" had not saved me the trouble I should have criticised it in "ours," so G. A. Moore's letter is only a waste of space.

"Fiddler" also fills nearly a column in order to extract information which a query of two lines would have brought forward, and in going "out of the beaten track" to attempt an explanation of a well understood fact, he gives a rough imitation of an exp. I saw worked last July by Professor Guthrie, who proved experimentally that when a string is fixed at one end to a vibrating fork (the other end being carried over a pulley and weighted) the number of segments is, within certain limits, inversely proportional to the sq. rt. of the stretching weight. Stick a shilling on one prong of a small tuning-fork, and see how long it vibrates, and then don't wonder that your hair-pin will not vibrate and carry a greenhouse shelf, or at any rate its own weight on one leg. The vibration of the thread is produced by the vibration of the hair-pin, and not by its sound, which is merely a sensation produced by its vibrations. The G string responds to the vibrations of the soundboard when produced by the upper G, and as the length of a string is inversely as the number of its vibrations if G vibrates in unison with its upper octave, it can only do so when it is divided into two equal parts by a node at its centre.

The production of overtones is not caused by weight, but by bowing the string near one end (the bridge). If weight did produce overtones you would require a strong "third finger" in order by stopping the D to put four times the tension on the G that the latter obtained in turning by peg.

J. M. Stocks.

TO MR. BRASHEAR, "ORDERIC VITAL," AND "PRISMATIQUE."

[20044.]—I tender my thanks to Mr. Brashear for his full reply about the colours of the first and second order. I shall have occasion to use the information when I come to the working of flats, which I am afraid will be some time yet, for no one knows how much time is taken up in trying all the experiments necessary to the satisfactory elucidation of all the laws that govern the various processes involved.

I am glad "Orderic Vital" (19968, p. 172), thinks the rule I use the correct one; it is perhaps a difficult matter to demonstrate it mathematically. The way I decided which rule to adopt was simply, judging from the discussion that was carried on in our columns some time ago, although not a sufficient mathematician to prove it for myself, I judged from the arguments for this rule and for Dr. Draper's, that Dr. D. was mistaken, and it appears my judgment as to where the truth lay was correct. Can any one prove the rule to be wrong? Some, I know, think it is; but they will have to explain how it is that when a speculum is worked to this rule the outside, intermediate, and centre rays have all their foci at one point for parallel rays; this fact confirmed me in the adoption of the rule. I should like to know whether this rule strictly applies to a speculum one-third its focal length in diameter, as it seems very nearly to do to a speculum one-ninth its focal length in diameter. It may be only an approximation to the truth for the latter speculum, and considerably out for the former; this is important to know if we wish to make short Cassegrain or Gregorian telescopes. "Orderic Vital" suggests that those who have a Calver or a With speculum should test theirs by this rule, and see if they answer to it. Now, many who would like to help to settle this question and have a Calver or a With speculum may not have the necessary apparatus to prove it, much as they may desire to know if their specula are according to it. I, therefore, offer to any such that if they will trust me with their Calver or With speculum, and will send it to me, I will test it for them, and this will, as "O. V." suggests, be a very practical way of helping to settle the matter; but surely it may be settled by mathematical proofs, and I hope that now the question is on the anvil, all who can help, either practically or theoretically, will strike the iron while it is hot, and besides, not allow the correspondence to degenerate into a mere assertion of opinion, and mere lengthy letters; let us all unite to settle the matter once for all; whatever previous opinions we may have to give up, truth is certainly worth confirming to those who have it, and far more worthy of the space that error now occupies in the minds of those who have perhaps long cherished it than that error As to the use of the eyepiece in testing at the centre of curvature, I have discarded it for some time. I did not find it so convenient, nor so delicate in my hands. One great objection to its use is the great care necessary to get the axis of the eyepiece in an exact line with the axis of the cone of rays, but if any wish to try the use of the eyepiece, I shall be happy to describe how I did it. I think it is not the best way, but those who think it is may like to try it for themselves.

I am always glad to see a letter from "Prismatique." It is bound to be brimful of practical information. I fully admit the force of all he says in his letter (19969, p. 172), about grooving, &c.; yea, I admit its truth, and hope to give paper a fair trial; perhaps if I had as much practical knowledge of the polishing with paper as I have of the polishing with pitch, I might be able to recommend it in preference to pitch. I am sure of this: we are all much privileged in having one in the trade (I question whether there is another in all England) who so thoroughly will throw off the trade reserve. No one but he who so loves his art as to be above its mere gain, could thus come forward to our help: his letters are like a good gold-mine, to be carefully preserved and looked over by those who know the worth of real gold.

H. A. Wassell.

Addenbrook Villa, Love-lane, Stourbridge.

GRINDING AND POLISHING GLASS SPECULA.

[20045.]—A very simply constructed apparatus can be made to melt and strain the pitch at the same time, if an oven is used. An earthen pipkin, glazed inside, with a capacity of at least three times that required for the pitch; a wooden rod long enough to project over the sides a few inches, and a square of muslin, are the tools required. The pitch procured at the chemist's shop in the boxe is the best; the lid of the box only need be taken off, the box then, bottom up, placed in the centre of the muslin, the corners of the muslin gathered up and tied round with a string, dumpling fashion, the ends of the string tied to the wooden rod. Now suspend the muslin bag at a short distance from bottom of the pipkin, and place in the oven. Care must be taken not to have the oven hot enough to scorch the muslin, or it will be weakened, and the pitch break through. Straining and melting is thus done at once. When all is run out, have ready a pail of cold water, and lift out the bag and drop bag and contents into the water; a lot of trouble is avoided by this plan. It usually takes four hours of simmering to drive off the oil of pitch sufficiently, very frequently much longer. When the pitch has simmered four hours, it is well to test it roughly. With a clean stick drop a small quantity on a face-plate or other cold smooth surface; let cool; if, when cool, it sticks quickly to the finger pressed upon it, it requires more boiling. It should take the impress of the skin, and leave the finger clean when boiled enough.

There have been many ingenious plans adopted by amateurs for testing by allowing a small weight to rest on a mass for a given time. The late Mr. Lassell used a sovereign standing on its edge; but as the speculum was a metallic one, his test of "three impressions of the milled edge of the coin in one minute" would prove the pitch too soft for glass specula. One impression in one minute, if the specula is upwards, and two if the polisher of light wood is used upwards, would be nearer the mark for this test.

A moment's consideration will satisfy anyone that the test is not a common workshop test even now; as a sovereign is not always ready at the workman's hand: the rule of thumb is usual. The literal rule for the thumb-nail is the workman's testing tool, and I find it difficult to describe the application. The amateur, however, can generally get over these little difficulties in another way. In working, dragging is a sure proof that the pitch is too hard or the temperature too low. If, on the first examination of the surface, after using the pitch polisher, the surface presents a blue stained appearance (like the surface of tarry water), the pitch is too soft, and must be scraped off, and fresh, harder pitch tried. The method described by Mr. Brashear seems a very good plan when that form of polisher is used; but for the wooden-backed polisher it is better to roll the pitch into rods, and lay them along the edges of the laths. If the pitch is of dough-like consistency, and quickly managed, this is not a difficult job. There need be no great thickness of pitch, say, ¼in. at most. By moulding quickly, the faces of the ridges only need warming. Then, by the use of the "marra" tool and tissue paper, as described, the transverse grooves only need cutting in: the longitudinal are already formed, and need trimming along the edges to something like uniformity.

Prismatique.

ELECTRO-MAGNETIC MOTOR.

[20046.]—Mr. Huxley, in letter 19997, has not given any factors for the determination as to whether or not it is possible to use the alteration of state in magnetising and demagnetising soft iron for motive power, and until are known, 1st, the amount of contraction, and 2nd, the electric force necessary to produce it, speculations on results must be very wild indeed. Mr. Huxley assumes the force is enormous, whereas the probability is the force is very minute, in fact, just sufficient to overcome the friction of the particles of iron. It is also probable the elasticity of iron would completely baffle any attempt to employ the alteration of state as a motor in the manner suggested by Mr. Huxley, and if the iron be under any stress, the electric force would probably have to be increased to the extent of that stress, so as to overcome it.

There is, however, one method that might be employed to produce motion, which is as follows:—

It is evident if a system of long electro-magnets be balanced round an axis, and each magnet be contracted when it enters one half phase, and remain so until it emerges into the other half-phase, the centre of gravity would be altered, and rotation would follow. Again, it is not difficult to magnify this result by making each electro-magnet carry a piece of thin lead shaped so as to form the segment of a cylinder at the free end, and thus one might even have a few pounds' weight of thin lead falling through a space equal to the diameter of the cylinder in a continuous stream, and that from a very small electric current. **A. C. Ponton.**

Viewfield, Parkstone, Dorset, May 8.

NOTES ON DYNAMO-MACHINES.—II.

(*Continued from p. 176.*)

[20047.]—15. If R is the resistance of the field-magnets in an ordinary dynamo-machine, and R_1 the resistance of the armature, then that ratio of work to waste may be a maximum. R_1 should be somewhat greater than $R + R_1 / 2$. The exact value depends upon the susceptibility of the iron in the machine; the forms, magnitudes, and relative positions of the wires, &c.,—quantities not derived theoretically.

16. In the shunt dynamo, if E be the resistance connecting the terminals of the machine, it is best to have, approximately, $E = \sqrt{R \times R_1}$.

17. Since the E.M.F. created in a closed coil is proportional to the rapidity with which lines of force cutting the coil are added or subtracted, it follows that no E.M.F. can be induced in a coil moving *parallel to itself* in a uniform field. If, however, the coil be caused *to rotate* about an axis passing diametrically through it, and lying perpendicularly to the direction of the lines of force (as in the Siemens continuous current machine), a current will be generated in the coil. The current will be reversed when the greatest number of lines of force cut the coil, and will reach a maximum when no lines of force cut the coil.

18. In a magneto-electric machine, the E.M.F.

is simply proportional to the number of turns of the armature per minute, and $C \times R$ is a constant for any given speed of the armature; hence, for a given resistance, the current is proportional to the speed.

19. In the dynamo machine, the E.M.F., or $C \times R$, for any fixed speed, is variable, depending on the magnitude of R. If R be too great, the dynamo will not magnetise itself. In the ordinary dynamo, where the field-magnets are in circuit with the lamps, the current, when an extra resistance is introduced, is diminished, for two reasons —(1) Because, with a given field, if R increases, C diminishes; (2) because, by reason of C diminishing, the magnetic field is weakened, which further diminishes C. In the shunt dynamo, where the field magnets are wound as a high resistance shunt to the main circuit, an additional resistance in the main circuit causes a stronger current to flow through the field magnets; hence, the magnetic field is made stronger, and this compensates for the additional resistance in the main circuit, in such a way as to make the current practically constant under considerable variations of R. Experiments have been made to determine the constancy of the current generated by the shunt-dynamo as compared with that generated by the ordinary dynamo, with these results:—The speed was in each case constant, and the current varied from 40 to 30 ampères in the shunt-dynamo, as resistance was increased from 1 to 2 ohms in the external circuit; while in the ordinary dynamo the same variation of resistance caused the current to vary from 50 to 25 ampères.

20. The shunt-dynamo, with 20 per cent. to 25 per cent. variation of resistance, gives a pretty constant current. But the fact that the current cannot be regulated to any great extent by varying R, renders it inconvenient for many purposes. One of the reasons why cast iron has been adopted for the field magnets in later dynamos is to obtain, to some extent, the steadiness of the shunt-dynamo, even at the expense of current. Cast iron, although incapable of being magnetised to the same extent as wrought iron, is less liable to become demagnetised, and the magnetic field is consequently less liable to vary with every slight variation of R.

21. With a uniform field, as in a magneto-machine, the E.M.F. is proportional to the revolutions per min. of the armature; hence, if the current circulating round the field magnets be kept constant in a dynamo, the E.M.F. will increase directly as the number of revolutions. Let r be the internal resistance of a dynamo, R the external resistance, and N the number of revolutions per min. of the armature. Since N is proportional to $(R + r)$, so long as C remains constant it follows that if a new resistance $= (R + r)$ be added to the resistance R, so as to double the total resistance, the speed of the machines can be doubled without any danger of overheating, the current being the same as before, but the external to internal work being now in the proportion of $(2R + r)$ to r, instead of R to r. The mechanical friction is obviously doubled also, it may be a little more than doubled.

22. In a dynamo where the magnetic field is constant, the E.M.F. is proportional to the number of coils connected in series. Suppose we have a machine on the armature of which there are twelve coils. These coils may be connected up in several ways (*e.g.*, the twelve in series, in six pairs, and the pairs in parallel circuit, &c.), but if the resistance of each coil is the same the E.M.F. is proportional to the square root of the total resistance of the armature from brush to brush.

23. The work done by the current is proportional to the square of the current multiplied by the resistance. Let H.P. = the work in horse-power, then, if R = resistance between any two points between which it is desired to measure the energy expended, C = current in ampères, and E = E.M.F. in volts between those points $H.P. = C \times E \times \cdot0013409 = C^2 \times R \times \cdot0013409$. **E.**

Errata.—On p. 176, for *does not increase* in note 6, read *increases*, and for *but* in the following line read *and*.

[20048.]—I have been waiting for several weeks in hopes of seeing an answer to "Fritz" (letter 19758, p. 591, last Vol.), as I am in the same predicament. With regard to dynamo machines, I have made a machine of the same type as his; but instead of being so small as "Fritz's," it has an armature 15in. long by $2\frac{1}{4}$ diameter, wound with four layers of No. 14 cotton-covered copper wire, and the machine gave an excellent current. But the E M F was so low that it would not overcome the resistance of an ordinary Swan lamp of 20 candle power, nor even ring a bell; so I wrote to the Editor of the journal in which the instructions appeared from which I made the machine, to know the cause; but, instead of inserting my letter, the Editors answered themselves, and said it could be remedied to any extent by winding the armature with finer wire and a greater number of convolutions. I have accordingly wound it with eight layers of No. 18 cotton-covered wire, with commutator in same position as formerly, but the machine will not now produce the faintest spark. I have altered commutator, reversed wires of field-magnet, and tried everything I can think of without success. Will "Sigma" or Mr. Lancaster or any experienced electrician come forward and help us? I want the machine to light a Swan lamp and charge Faure batteries. In conclusion, I may say the field magnet is wound with 12lb. of No. 14 cotton-covered wire. **Fainthearted.**

DR. HAY'S SIMPLE BAROMETER.

[20049.]—I hope Dr. George Hay (20024) is not laying the flattering unction to his soul that his simple barometer is an invention. No one doubts its efficiency; but to my knowledge it has been used in Scotland, and, I suppose, in many other countries, for a great many years among farmers and others whose faith in the barometer has been shaken by observing the mercury standing at, perhaps, 30·5 and rain coming down in torrents. Apart from knowing of its existence in this manner, I find it mentioned in a little book (almost worthless otherwise) called the "Weather Indicator." The principle has been well known for many years, although the particular mode in which Dr. Hay makes it may not have been generally adopted. As taking a considerable interest in all kinds of home-made barometers, I have used for more than a year a storm-glass, which must be familiar to many readers of the Mechanic, and which, I know, is well known among seafaring men on the south coast of England, and also among the fishermen in the Orkneys, although in intermediate parts it seems to be very little known or appreciated. It consists of a pickle bottle with a large mouth, almost filled with water, and a Florence flask inverted, and the water rises and falls within the tube of the flask in correspondence to the weather. It acts exactly as the storm-glass of which Dr. Hay speaks, by the different tensions of the atmospheres outside and inside the flask. The difficulty with it, as with all home-made barometers, is that it is very subject to temperature, but when kept in a room such as a bedroom, on the shady side of the house where no fire is used, it acts with great satisfaction, and predicts storms of wind and rain as quickly as any barometer. I have made repeated experiments extending over several months with a thermometer and a barometer alongside the storm-glass, and I find that it is very much more subject to atmospheric pressure than temperature.

I find that a rise in the thermometer of 10° is nearly equal to a fall of the water in the tube, caused by the expansion of the air in the flask, of $\frac{1}{3}$in., the diameter of the tube being about $\frac{1}{2}$in. It is easy, of course, to paint lines on the tube to notice the rise and fall. I could give many instances where such a storm-glass has been of great service to small coasting vessels, which do not carry barometers, and I know masters of large vessels trading to the East who carry the two bottles regularly, and would not be without them for anything.

Glasgow. **R. H.**

MEDICAL REPLIES.

[20050.]—Scrofulous Glands in Neck (46852).—Read my recent reply on scrofula,

Skin Disease (46920).—Sufferer from sycosis for 23 years asks, "what is the application which I should use after the hairdrawing and poulticing already recommended?" This is a practical question not quite answerable without seeing the patient. But the object is to kill the parasite with a poisonous substance that can be made to penetrate the skin and hair follicles, and yet not injure the skin. Generally, my choice would lie between the following:—(1) a 5 per cent. solution of carbolic acid; (2) freshly precipitated yellow oxide of mercury in very fine division, mixed thoroughly into soft vaseline—say, 1 part of oxide to 7 of vaseline; (3) the nitrate of mercury ointment, commonly called citrine ointment. The latter is of a citron colour, the former of a fine golden yellow: if touched with a knife or other metallic substances, they blacken and spoil. Go gently to work, so as not to produce erysipelas of the skin. Should the skin become inflamed, stop the parasiticide, bathe with warm water, return to the poultice, and, on recommencing, use weaker preparations. Give one application an exhaustive trial before commencing another, or use different applications on different parts of the skin, so as to test them accurately. Do not mix the applications. It should be recollected that sycosis is infectious.

James Edmunds, M.D., &c.

Grafton-street, Bond-street.

SMALL MILLING MACHINE.

[20051.]—"J. K. P." describes a milling machine which he has fitted to one of his lathes, on page 185, Vol. XII. It seems a very nice arrangement, and I should like much to see it. I think "J. K. P." would afford useful aid to many if he gave in your pages a drawing of his pulley there described, carrying the following divisions. 300 outside, then 11, 13, 14, 17, 19, all in one row (I do not understand how they can be arranged to be all in one row), 216, 140, 96, 84.

I have two lathes, and would like to take his advice, and add his milling machine to one of them.

I have also, in same vol., page 156, been looking at Mr. Plant's description of his geometric chuck, first part. Would "J. K. P." kindly say if it would do to try and make such a chuck, using Lloyd's 14-pitch wheels for the purpose. My lathe, to which I thought of applying it, is one with a gap, which allows a face-plate 18in. in diameter, to swing. It is very similar to those advertised in your columns by Selig and Sonnenthal, 5in. centre, 6ft. bed, with two driving-wheels.

I purpose using a 96-toothed wheel instead of the 120 one, and a 72 in place of the 96 ratchet-wheel.

There would be some labour in turning down the wheels to about half their present thickness, leaving a boss, but I fancy with them a very inexpensive chuck might be made. Of course its power would be rather less than "Plant's" one, as the 96 wheel would only divide ten times in place of fourteen, as the 120 does. **Gereb Admi.**

ORNAMENTAL SLIDE-REST.

[20052.]—I beg to thank "F. W. G." for his endeavour to explain by diagram the clamping action of his longitudinally-divided nut upon the leading-screw of a slide-rest. No doubt the nut would so act, as shown in the diagram, where there is, as there represented, a new and unworn nut and screw. But the question is, what would be the action when the nut has been worn by use? And if "F. W. G." had drawn on a larger scale the sectional form of this worn thread, he would, I think, have seen that the wedge action is effectually prevented by the two corners or "steps," which are formed in any case, and which stop the nut from closing sufficiently upon the screw to produce a wedge action. The effect of thus clamping the nut on the screw will, in fact, be to part the surfaces of the threads, which should be in contact, and all the work will be thrown instead on the end of the screw-thread, which will work upon the steps until it wears it away by friction, when backlash will again ensue, as I remarked in a former letter.

The external thread of the leading screw, whether the outside is flat or rounded, has by friction enlarged the internal thread of the nut, in the case of backlash, beyond its own sectional size, and nothing smaller than this enlarged cavity can fill it and act as a wedge. "F. W. G." allows this to be the case in the flattened screw, and I think he will find but little difference when the thread is rounded. Continual screwing up of the nut and wearing away the step bit by bit must be resorted to until "backlash" is exterminated, and all this time the screw will have been working in the nut under most disadvantageous circumstances for a slide-rest.

I think "F. W. G." will admit that the steps will be formed in any case, and that he would be glad to part with them. Prevention is better than cure; and the only remedy I see is to make that portion of the internal thread of the nut, which is in the engraving unoccupied by the truncated thread of the leading screw, square instead of angular, or rather a little more than this portion. No corner or step would then be formed by wear, and the nut, when screwed up, would work upon the whole of its thread surface and backlash would be extirpated.

There would not be much difficulty in cutting this small depth with a specially formed internal screw-chaser.

This mode of curing backlash would then be better than that which I advocated, inasmuch as my plan throws all the wear on half the screw-surface of the nut; but I question whether the superior action of a square-threaded screw and nut does not decidedly outweigh this consideration.

M. A.

FOUR-JAWED CHUCK.

[20053.]—One of your correspondents having expressed a wish for a description of a good four independent-jaws chuck, I give illustrations of one I have in use myself. It is an exceedingly useful chuck for anyone who works much in metal, and I also frequently use it for woodturning. In many ways it is superior to the American self-centring chucks, though not so good for holding twist-drills as the latter, and for a few other purposes the American chuck is very handy. I have two of them myself; for not only is it very easy to centre accurately a round article in the independent-jaws chuck, but it will hold almost any irregular shape.

Fig. 1 is a front, and Fig. 2 a back view; the latter shows the mechanism. Mine, which is $10\frac{1}{2}$in. diameter, is cast with hollows in it, as seen in Fig.

2, for the sake of lightness, and the raised ribs give it rigidity; but for a smaller lathe it might be left solid; but in any case, the slots through which the jaws work ought to be cut out of solid metal. Mine is cast iron, as it is much easier to do so than to true them up when cast hollow.

FIG. 1.

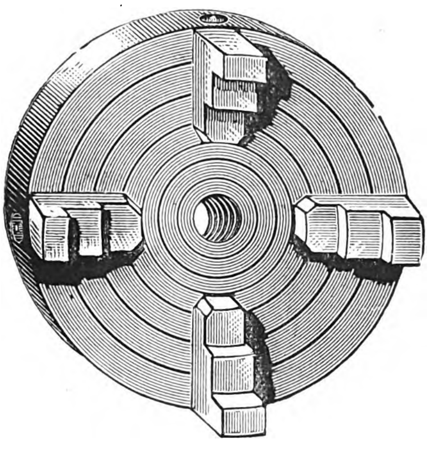


Fig. 3 shows how the jaws are made; they should be of steel, or well-hammered iron casehardened; the part A should be a good deal broader than the slots, so as to take up a good bearing on front of chuck; they are turned out in three steps—for a smaller lathe two might be sufficient—in order that they may take in articles varying considerably in size without much movement of the leading screws, and these steps should be equally proportioned. The part B, Fig. 3, must be nicely fitted to pass through the slots without side-shake, and it is in cutting out slots like these, that the milling attachment of my lathe (which I formerly described), acts so well, as it cuts them out true and parallel very rapidly, though of course they can be made by drilling and filing; but in doing them this way a considerable amount of skill with the file is required, more than most amateurs possess. The four holes, two of which are seen on rim of chuck, are drilled with a pin-drill the same size as the collar C, Fig. 3, of the leading screw, and the screw is secured from moving endways by a semicircular groove being turned in the collar in which two steel pins, one on each side, engage, which are driven through the chuck, as shown in Fig. 2. After the screw is in its place the holes for these pins are so drilled that when in their places half the pin is in metal of chuck and half in groove of collar. The jaws are moved by turning the screws with a box-spanner, Fig. 4, which is inserted into the holes on rim of chuck, the squares on end of leading screws being flush with rim. The plate and nut which secure jaws are shown in Fig. 3; the slight step on plate fits the slot and prevents it turning round. A number of concentric circles are cut on front of chuck, Fig. 1, which assist greatly in centring work, and the steps of the jaws must be turned true in their places. This chuck, to be efficient, requires to be made strongly and carefully, and is a very expensive one to buy, costing as much or more than a slide-rest for the same sized lathe, but to anyone who cares to make it will amply repay their trouble. The leading screws in my chuck are ⅝in. diameter, but for a 4in. centre lathe ½in. would probably be strong enough, and if one has a screw-cutting lathe, are better made square-threaded; the chuck should be as large as the lathe will take in. Now, a few hints with regard to centring work in this chuck: if it be round, see which of the concentric circles on face of chuck is nearest in size to it; move in your jaws to this circle, and fix article between them.

FIG. 2.

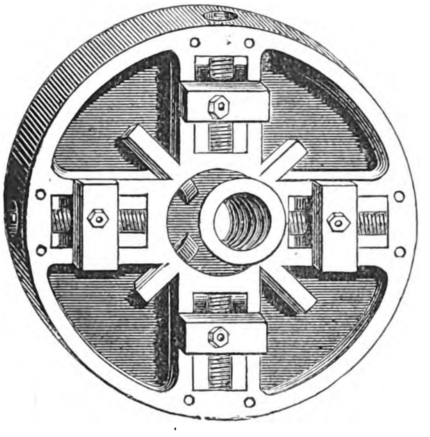


FIG. 3

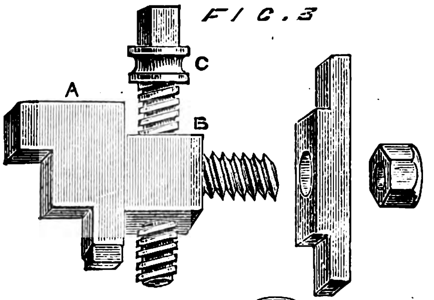
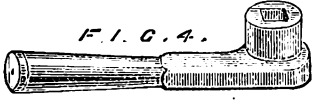


FIG. 4.



It is most convenient to have two spanners, for by fixing them on two opposite screws and turning them simultaneously in the same direction, one jaw moves towards the centre and the other from it, and so the work is carried, still held fast between the jaws across the centre of chuck, and by revolving it and holding a piece of chalk against the edge of work you can see when it is running true. If the work to be chucked is not circular, the best way is to make a dot with a centre punch at the point you wish to be the centre, and having fixed work between the jaws, bring up the back centre of your lathe to it, and move screws of chuck until the point of back centre drops into the centre punch-mark. I need hardly mention that the leading screws must be steel, as there is considerable strain on them. **F. W. G.**

CHANGING-BOX FOR USE WITH DRY PLATES.

[20054.]—The above sketches represent a form of changing-box, which is designed for use with ¼-plates. It consists of a box of ½-deal, of dimensions shown, dovetailed together (Fig. 1). A longitudinal partition is fixed in it at 3⅜in. from the front, and two cross partitions between it and the front, forming the boxes (*a*, *b*, and *c*), the two outer ones being thus of a size to hold ¼-plates. These boxes have sliding covers of ¼-mahogany grooved into the front of the longitudinal partition. A narrow strip of wood screwed on the top of each serves to move it; the long space *d* holds the camera and dark slides for travelling. The box shown was made to suit a small Lancaster's "Merveilleux." The box is covered in by a double cover, as shown by the dotted lines. The outer one consists of black twill, and the inner one of yellow twill. They are fastened together only at the ends of the sleeves. The latter are 6in. in diameter and 12in. long, with elastic bands for the wrists, and are sewn on at *e*. The cover is attached to the box, as shown in section (Fig. 2). A groove along front and ends of box, and lid ⅛ wide and ¼ deep. The cloth is laid in it, and a strip of wood glued and sprigged in above it; *a* is the cloth, *b* the fillet. The inner edge of box is chamfered off, as at *c*, to allow of the lid being closed. Fig. 3 shows the mode of packing the plates. The tape *t* is fastened to bottom of box, and led to and fro between batches of, say, four to six, plates, which can thus be lifted out. The box *a* is for fresh plates, and *c* for exposed ones. The space *b* may be fitted to hold developing measures, &c. A small turn-button keeps the lids from shifting about when filled with plates. The box may have either hooks in front or a lock at each end, and a handle in front to carry it by.

N.B.—The sleeves are omitted in sketch (Fig. 1) to save space. **S. G. Horton.**

FIG. 1.

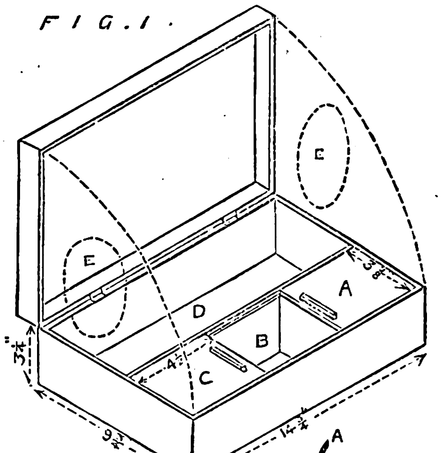


FIG. 3.

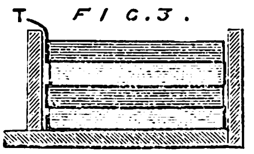
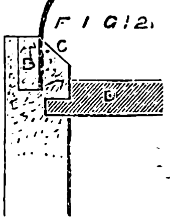


FIG. 2.



REFRIGERATION SIMPLIFIED.

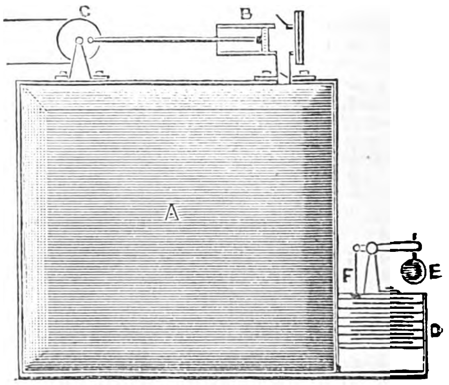
[20055.]—Many of us have, no doubt, read of the man who was dying of thirst close to a river, but unable to partake of it. In such case are the people of this country when they hear of millions of cattle killed abroad for the sake of their skins only, the meat being left for the vultures, while we are here paying famine prices for meat.

There is good reason to hope that with a simple, easy, and cheap process of refrigeration a remedy may be found which would break up the butchers' monopoly, and also avoid the host of common sense which is allowed to be patented.

This invention dispenses with the use of ice, chemical salts, ammonia, ether, compression, &c., which are troublesome, expensive, and in some cases require time for cooling, recrystallisation, &c.

The process here proposed is continuous, and avoids all the inconveniences above enumerated. To explain, when we ascend a mountain at a certain height, we find perpetual snow. This always corresponds with a certain reduction of pressure, or partial vacuum, which fact, taken as our guide, exhibits a principle which enables us to construct a simple refrigerating apparatus.

The figure is shown in section. A is the refrigerating chamber, connected at its top with the exhausting cylinder B, where the two valves may also be observed. The piston-rod is connected with a band wheel C, which is rotated by a band from some part of the steam-engine. At the right hand lower part will be seen the valve F (to which may be adjusted the weight E), so as to give way at an excess of vacuum. This opens inwards to the air-drying chamber D (if such chamber is found necessary), where the air will successively pass over a number of trays filled with chloride of calcium or other suitable deliquescent salt, and enter at the bottom part of the chamber.



A small cylinder only will be required, as after the vacuum equal to the reduced temperature as per thermometer is obtained, the air only requires removal to make up for heat penetrating the outer casing. Thus is the cooling process continually renewed.

Barry-road, S.E. **J. H. Huxley.**

IRON MOULDING—NO. IV.

[20056.]—Having got the thickness on all the blades, the face of each is coated with water-blacking, and some dry parting-sand shook over afterwards. The top part or cope of each blade is now required to be made. There are several ways of making the cope. The way in this case will be by casting two plates for each blade, 7in. in breadth and 1½in. in thickness; the length and shape of them will depend on the breadth and form of blade (see Fig. 1). Along the centre of plate there is a row of 2in. square holes, about 4in. apart. The one end of these plates lies on the top edge of bearing, and the other on the bottom edge; the end of each extends over the building on each side 6in. The round holes in the end are for the purpose of lifting the cope off or on, and also for making it fast to the bottom when casting. When the ends of the plates are resting on the bearing, that part of the plate that is over the blade should at the least be 1in. clear for loam. As these plates will have 7ft. in length of a cope to lift, one of them will be placed 20in. from the boss, and the other the same distance from the outside end of the blade, and the one parallel with the other. Cast-iron bars are made 1½in. square and 7ft. long. The bars are now inserted in the square holes in the outside plate, and passed on through the holes immediately opposite, and to within 2in. of the boss, the holes in the plates being larger than the bars, so as wedges can be driven in, and the one made fast to the other. To the end of the top and the bottom bars an angular piece of ½in. iron is made fast with wire, and kept clear of the joint that has been carried from the bottom (up to 4in. above the boss) of the outside of the blade opposite; from this angular piece of iron to the ends of the other bars more pieces are attached, so as to make it firm and secure. These irons are for supporting the building that covers this part of the outside of boss. A coat of red loam is now put over the face of mould, and over it some building loam, as it is less expensive, and answers quite as well. Building brick is now dipped in clay-water, and inserted in between the cast-iron bars, and pressed through the loam to within ¾in. of the face of mould. Some parts of the cope are more deep than others, and will require the brick to go endways. Where the blade joins the boss, the same care should be taken as in the bottom part—viz., put in loam brick, or keep the hard brick well back so as to allow the sharp edge to be rubbed round. When the cope is all bedded with brick, the joints, if any are open, are filled with loam, and the surface made level. Afterwards, a coat of clay-water is applied with a brush, which, when dried, makes it more firm and compact. The joint is pared and marked all round, so that when dried and finished, and about to be closed, the marks will guide it into the same place. The remaining blades go through the same process. All is covered now, excepting the top of the boss; what has been built stands 4in. higher than the boss, and serves as a guide for the top covering. It is slightly bevelled to allow the covering to be lifted easily off or on. A joint is made with paper in the same manner as the other joints; it is now filled with red loam, and a round plate bedded in with a round hole in the centre, large enough to admit one end of the core, that is afterwards put in the boss; on the one side of this plate there are projections (commonly called dabs), the length they require to be is 1in. less than the depth of loam. There are also four holes a little outside of the centre hole, and placed so as there shall be one over each end of the blades. These are for what is termed flow-gates. (When the mould is full of metal it rises up into the flow-gates, into which a small rod is inserted, and made to work up and down in the manner of a piston, so as to have communication with the boss, that fresh metal may be injected to supply the shrinkage that takes place while the metal in the mould is passing from the fluid to a solid state. The higher the flow-gates stand above the mould and kept full of metal, the more solid will be the casting.) The building of the mould is now completed; stakes are driven down each side of the base-plates to serve as guides. Two handles are on each side for the purpose of lifting them. When made fast to the crane and started from their bed, each one is slid back, so as in the hoisting the boss end of the blade will be free of the boss that is left standing; or if the moulder wishes, the top covering of the boss can be dried, or made stiff enough to lift off, and the building of the boss can be taken down (as it is now no longer required), and the base or building of each blade lifted straight up and put in the stove to dry. In any case the covering of the boss must come off first if the blades are to be dried in the stove or on the floor. When all is in the stove one piece remains on the floor; that is the bottom of the boss. It is dried where it sits.

Foundry.

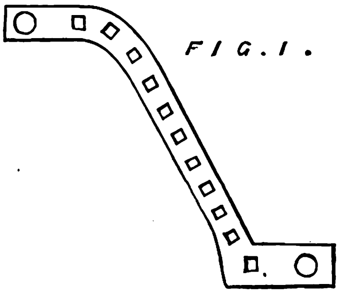


FIG. 1.

[20057.]—I HAVE read "Foundry's" letters. In No. 1 he says the spindle should be turned. Now, this is not necessary, and, as to the making of a cross or socket for the spindle to work in, my plan is to run up a core on the spindle, so that when it is cast in the cross it forms a recess: the spindle then has two bearings at top and bottom, it then works much steadier than bearing all the way (see Fig. 1).

I fail to see the use of the step shown on outside bearing in (Fig. 1, letter 2); all that is necessary is simply a flat bearing. I am proud to say, in my experience, Fig, 3 is a thing of the past. Wheel weight and right angle arm are all laid on one side for a more improved plan—that is to build the blades first, then build the boss, then fill in with loam brick. In some shops two blades are built at one time, and in some all four (see Fig. 2).

Cast Iron.

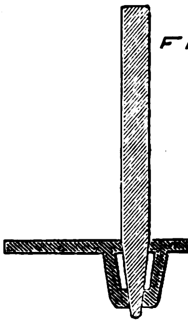


FIG. 1.

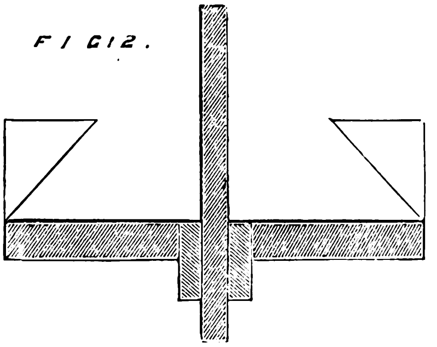


FIG. 2.

CHARLES DARWIN, AN EXAMPLE OF THE SCIENTIFIC METHOD — EYEPIECES — CASSEGRAIN TELESCOPE.

[20058.]—WITH every word of the first paragraph of letter 19991, p. 192, all students of science must agree, and I should like to add my word to the wail now being sent up by the whole world for the loss of the intellectual giant. It is yet too soon to calmly estimate the effect of Darwin's writings on science. My intention just now is to point out a characteristic peculiarity in those writings, and that is, his consistent search for *truth*. Nowhere do you find a fairer statement of each side, nowhere more logical conclusions, than in his writings. Those accustomed to debate, feel, after reading an ordinary book, scientific or otherwise, that there is another side to be read. Darwin's books never leave such an impression. One feels that it is useless to look elsewhere for adverse facts; the most that can be done is to disagree with the conclusions drawn from them. Recollecting this, we begin to understand how he has succeeded in changing the entire course of scientific thought in such a short time.

Echoing "F.R.A.S.'s" quotation, let me sorrowfully commend Darwin's works to all lovers of truth.

It is indeed remarkable that so much carelessness and inaccuracy should be exhibited by writers on astronomy when they speak of the principles of the construction of telescopes. Those "Ascalon" (letter 19992, p. 193) quotes seem fair samples; I don't know Guillemin's "Heavens," though, and it may be right. "Ascalon's" diagrams are quite right, but in the second one the focus is rather far from the field-lens, and in the first the rays should cross as near the field-lens as the diagram puts them to the eyelens.

The greater complexity of some diagrams mentioned by "Ascalon" arises from their representing a relatively large image. "Ascalon" will notice that his image is only a point, as if of a star; if, therefore, he was considering the result of looking at an object having a sensible diameter he would see that such object would be made up of innumerable points, from each of which a series of rays would pass through the telescope as "Ascalon" has drawn them, each series, however, holding a slightly different position. Suppose "Ascalon" to be looking at the moon. An image of the moon would be formed where the lines cross in his diagram, and every point on the moon's surface would send a series of lines through the telescope, and converging to corresponding points in the image. If only a few of the infinite number of series of rays are shown in a diagram it must necessarily be very complex. The apparent difference at first sight between a diagram representing one series, and another representing several series of rays, is a rock over which most self-taught students of optics stumble.

When powers are mentioned in a letter they always mean the actual magnification, the focal length of the o.g., as well as the equivalent focal length of the eyepiece, being, of course, taken into consideration.

The rule given in letter 19971, p. 172, for finding the distance between mirrors in Cassegrain telescope is the simplest and best I have seen, and was given by "A. N. H." (letter 18685, p. 209, Vol. XXXIII.)

Paugul.

A PORTABLE BEDSTEAD TABLE.

[20059.]—ENJOYING the luxury of quietness, and having but few rooms in my house, I contrived to turn one of my bedrooms into a study. I got a carpenter to make a table to perform the double duty of study table by day, and bedstead by night. The following is the arrangement:—Length, 6ft.; width, 3ft. The top of the table is made in the usual style of library tables, with American leather centre, and polished-wood border, with "thumb" moulding. The legs are turned in the usual way—in fact, externally it differs not from an ordinary table. To get your bedstead the top is made to lift off. The sides are made deep enough to screw on their inner lower edge bearers 1½in. wide, which support laths, on which rest the mattress and bedding. While at your breakfast, the servant throws open the windows, makes your bed, puts on the table-top, which shuts all in as in a box. The whole thing is portable, as the legs unscrew with the usual bedscrews; the holes for these are covered with shifting ornamented panels made to fit over, or turned knobs fitting in the holes.

Beta.

METEOROLOGICAL.

[20060.]—THE simple barometer of Dr. Hay (letter 20024) is not a new device, but, as a mere "weather-glass," it is far better than the mercurial barometer itself. The appearance of the drop, depending as it does upon the atmospheric pressure and its humidity together, must be as certain an indication of rain as we can have. A combination of the barometer and hygrometer to indicate the approach of rain was devised by Herr Klinkerfues, of Gottingen, some time ago, and briefly described in these columns (Vol. XXXIV., p. 278).

By some mistake a magnetic storm (Vol. XXXV., p. 215) has happened prematurely. The sun-spots have not mustered in sufficient numbers yet to account for such a phenomenon.

The Australian drought, too, is altogether out of season, for this ought to have been a wet year by rights. The *Scientific American* says that Australia is a land of contradiction, this drought having occurred to confute "the 19 years' cycle theory." Can this be yet another cycle? Let us hope it is a misprint.

An enterprising investigator has compared the statistics of rainfall and the fire insurance returns, and has been rewarded by the discovery of a remarkable connection. He has demonstrated the well-nigh incredible fact that fires are more numerous in dry than in wet weather! But, strangely enough, he has omitted to take the next step, and prove that fires are most prevalent when sunspots are few.

J. A. Westwood Oliver.

167, Gloucester-road, Regent's-park, N.W.

LEGAL REPLIES.

[20061.]—WILLS AND TRUSTEES (46860.)—I know of no way by which any officer of the Court of Chancery can be appointed trustee of a will. If the querist chooses to invest a sum of money over £20 in the name of each of his children, he can make them wards of Chancery by taking the proper proceedings, and then the Court of Chancery would look after their property upon his death. He might also appoint one of his children, or some other person, executor of his will, with a direction that the assets should be administered by means of a suit in Chancery. But undoubtedly either of these modes would be very costly and wasteful of his little property, and he should find some suitable trustee and leave a careful will.

AUCTIONEERS' RESPONSIBILITIES (46868).—In this case, if the broken part of the article injured can be mended, and so the whole restored, it is clear that the price of this part only is the legal measure of damage. In refusing to fetch the article away, and in claiming the full value of the whole, two mistakes were made. The proper course to adopt in this case is to have the article repaired and sue the auctioneer for the amount paid for so doing; while as to warehouse room, seeing that the auctioneer was presumably to blame at the beginning, I do not think any judge would allow him to charge for warehouse room under the circumstances.

Deeds (46918).—The deeds go with the law is the rule at law. I presume that when A. paid off the mortgage he took a re-conveyance or assignment from B., so that he obtained the legal title. With this he should have had the deeds, for he then had a clear right to their possession. It is nonsense to say that the last deed is the only one A. needs, as he would soon find if he tried to sell the property. A.'s proper course is to write formally demanding these deeds of B., and if they are not handed over, he should bring an action against B. for their unlawful detention.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall.

THE "ENGLISH MECHANIC" AMATEUR PHOTOGRAPHERS' SOCIETY.

[20062.]—It is proposed to found a Society, to be called "The English Mechanic Amateur Photographic Society," on the same plan as the Microscopical Society, a project for the starting of which appeared a short time ago in these columns. The following paragraphs state the objects and contain some of the proposed rules of the Society, subject, however, to the consideration of the members, and any alteration or modification if necessary:—

1. That the purpose of the Society be for the circulation of prints, negatives, &c., &c., and for the advancement of the science and art of photography amongst its members, each of whom will be requested to send in one print of each ¼ or ½-plate he may take for insertion in a scrap-book, together with a few brief notes respecting its reproduction, kind of plate used, lens, exposure, light, locality, &c., &c.
2. That a note-book be published with each scrap-book, in which members may jot down any useful hints or information, interesting experiences, &c., &c., which may, if suitable, be compiled and published, each member receiving a copy.
3. That, for the benefit of beginners, bad prints, as well as good ones, be circulated, together with notes on them.
4. The country to be divided into districts, through each of which one scrap-book shall be circulated at a time, when, having gone the round of members in that circuit, it shall proceed to the next.
5. That a certain period be determined upon for each member to detain scrap and note-books (say two or three days, as decided upon), when they are to be forwarded to the next name on the list circulated with the said books.
6. That a committee be annually appointed, who shall have the management of affairs.
7. That every member pay an entrance fee of 2s. 6d., and an annual subscription of 5s., payable in advance.
8. That if the Society flourish numerically and financially, and it be found advisable, a magazine be published at convenient intervals.

The undersigned will be glad to receive the names and addresses of persons desirous of helping to form such a society, and giving any practical suggestion, &c., &c.

F. C. Cowley,
106, Western-road, Brighton;
W. B. Allison,
North Staffs. Infirmary, Hartshill,
Stoke-on-Trent.

PROPELLERS.

[20063.]—I read letter 20008 by "Milford," on propellers, with interest, as it coincides so closely with one I made that to all appearance worked well, but I could not afford to try it on a larger scale. It was two vertical shafts at each end of the boat through the bottom, a crank at both ends of each; the inside ones were driven by a small engine. Attached to the outside cranks was a framework working to touch the bottom of the boat, hinged to which were twelve floats, concave shape, about 16in. wide by 9in. deep, set at a slight angle towards the stem, hinged so that at the forward stroke they all laid to the bottom of the boat; at the back stroke they stood out. The shock they gave to the boat every time they took the water was fearful, and again the forward stroke went like a shot out of a gun.

The floats in the position I describe gave very little slip in my case—too little; they fairly lifted the boat forward the full stroke; but they were out of all proportion to the boat. It went at an immense speed—I should think almost the speed of the travel of the engine; but it shook the whole affair to wreck in a very short time. **Mc.**

COAL-TAR PRODUCTS.

(*Continued from page* 61.)

[20064.]—These fractionnaters will be found useful to those who wish to value commercially samples of crude naphtha and light oils. In the case of once-run naphthas, the percentage of commercial benzols and toluols can generally be obtained by taking, say, 400cc. of the once-run naphtha and distilling in large ordinary retort; the portion of distillate which distils over up to a temp. of 140° C. will contain most of the benzol and toluol present: thus, 400cc. of 45 per cent. once run distilled in ordinary retort yielded 280cc. distillate at the temp. of 140° C. This 280cc. distillate was transferred to flask connected with fractionnater and distilled to a temp. of 100° C., it was found that 148cc. had distilled over. On testing, this proved to be 90 per cent. commercial benzol. The portion of distillate following this up to the temp. of 120° C measured 72cc., and on testing showed boiling point 107° C., and yielded 90 per cent. at 120° C., that is, it was commercial toluol. The estimation of the solvent naphtha can be made by fractionnating the heavy portion left in retort after first distillation. It should, however, have been mentioned that the once-run naphtha requires to be rectified or washed with sulphuric acid, as stated in a former article, before estimation is proceeded with. The sample of once-run naphtha thus tested yielded, calculated on 100 gallons—

37	gallons of	90 per cent. benzol
18	,,	90 ,, toluol
31	,,	Solvent naphtha
2	,,	Heavy burning naphtha
12	,,	Loss
100		

In order to arrive at the commercial value of the once-run tested, it will be necessary to calculate the value of the finished products at the current prices, and from the total result to deduct discount, cost of freight, working, materials used, &c. These vary in different works.

To estimate the value of a sample of light oil, it is necessary to first estimate the crude carbolic acid present by washing with about one-third the volume of a solution of caustic soda, sp. gr. 1·070, or 14 Tw., neutralising the resulting carbolate of soda, collecting the carbolic acid, and testing by methods to be afterwards described. The light oil, after extraction of carbolic acid, is distilled in large retort up to a temp. of say 200° C.

The portion of distillate up to this temp. is then redistilled and fractionnated in a similar method to that adopted in the case of once-run.

A sample of light oil testing:—

Sp. Gr.	B.-P.	160° C.	170° C.	180° C.	190° C.
980	138 C.	8	16	31	42
					200 C.
					62 per cent.

yielded, on fractionnating, per 100 gals.:—

3	gallons	50 per cent. benzol.
4	,,	90 ,, toluol.
16	,,	solvent naphtha.
30	,,	burning naphtha (sp. gr. ·970).
8	,,	crude carbolic acid.
26	,,	creasote or dead oils.
13	,,	loss.
100		

Benzol, benzene, or phenylic hydride C_6H_6, when pure, has a boiling-point of 80·5° C. Dr. Hoffman first pointed out the existence of this compound in coal-tar in 1845. But to Mansfield we owe its commercial production. Since 1847, the yearly production of benzol kept increasing; but it was not till the introduction of the aniline colours into commerce that the benzol trade assumed any magnitude. The present annual production of benzols in Great Britain is probably over 2 million gallons, worth about half a million pounds sterling.

For the methods of producing nitro-compounds, aniline oils, and the aniline colours I must refer the reader to works on organic chemistry—the last edition of Miller's, Roscoe and Schorlemmer's, Richardson's and Watts's "Dictionary of Chemistry," and numerous other works. A large amount of information on fractionnal distillation is also given in the *Journals* of the Chemical Society for 1879.

Carbolic acid, or phenol C_6H_5Ho, discovered by Runge; sp. gr., 1·065; B.P., 370° F., or 187·7° C. Absolutely pure phenol, first prepared by Mr. Chas. Lowe, crystallises at 104° F., or 40° C. It is a powerful caustic, heated in closed vessels, under pressure, with ammonia. Phenol is transformed into aniline. It is extensively used for medicinal purposes, and in a cruder form as a disinfectant. But the greater portion of the carbolic acid produced is used in the manufacture of aurine and picric or carbazotic acid. Salicylic acid is obtained from phenol, by dissolving phenol in caustic soda, evaporating down, and heating the residue in a current of carbon-dioxide.

Crude carbolic acid is obtained from that portion of the distillate from coal-tar, which has a sp. gr. of from ·920 to 1·000, and also from the lighter or first portions of the creosote oils. The oils are agitated for one or two hours with about one-third their bulk of a solution of sodic hydrate (caustic soda), the sp. gr. of which in different works varies from 14 to 20° Twaddell or 1·070 to 1·100. After agitation, the soda solution containing sodic carbolate, which on account of its density forms the lowest stratum of liquid, is run off into lead-lined tanks, where it is neutralised with sulphuric acid, when the crude carbolic acid rises to the surface of the resulting sulphate of soda solution, as a brown oily liquid with a sp. gr. of about 1·060, and containing from 14 to 16 per cent. water. It is, after separation from the sulphate of soda solution run into store tanks in order that any sulphate of soda solution which may be mechanically retained by the crude acid may separate. The carbolic acid is sold in this crude state to the manufacturers of crystallised carbolic acid. There are at present two methods of commercially testing this crude acid—viz., the bottle test and Lowe's test, the latter being the most general. The bottle test consists in taking 10 fluid oz. (ounces) of the crude carbolic acid and distilling in glass retort; after the whole of the water present has distilled off, and the oil, which has passed over along with water, and formed a layer beneath the water in receiver, shows 7½ per cent. on the 10oz. taken, the carbolic acid which is now distilling over is collected in bottles measuring exactly half an ounce. The portions of distillates in these bottles are then tested for crystallising point, a crystal of carbolic acid being introduced to facilitate crystallisation. According to the number of bottles which have a crystallising point of 60° F., or over, the acid is valued; thus a sample of crude carbolic acid yielding seven bottles crystalling over 60° F., and the eighth bottle crystalling at 60° F., would be called eight-bottle acid. Ordinary crude carbolic acid of commerce tests from six to twelve bottles, and should not contain more than 14 or 15 per cent. water.

Lowe's test was introduced by Messrs. Charles Lowe and Co., and is as follows:—Take 1,000 grams of the crude carbolic acid and distil in 6oz. retort; a 1,000 gram burette is placed as receiver; after the water present has distilled off and 10 per cent. oil along with it, the receiver is changed, and the distillate collected in a clean dry burette till it measures 625 grams: this 625 grams is thoroughly agitated, and a small portion placed in a test tube and tested for crystallising point, by inserting a thermometer in the liquid, and noting the point at which it crystallises. In order to facilitate the crystallisation, a crystal of carbolic acid is introduced into the acid to be tested. Whilst the acid in the test-tube is cooling, it must be kept continually in motion by moving the bulb of the thermometer briskly round the interior of the tube. Enough acid should be taken to cover the bulb of thermometer to depth of ½in. Should the test-tube require to be inserted in a cooling mixture, as is usually the case in hot weather, care must be taken that the cooling does not proceed too rapidly, and the acid must be, as before mentioned, continually agitated by the thermometer, otherwise the crystallising point may appear to be a little higher than it really is. The thermometer used should be graduated to half or quarter of a degree Fahrenheit. The usual crystallising points of commercial crude carbolic acid, tested by this method, range from 55° Fahr. to 70° Fahr. The temperature at commencement is 212° Fahr. When the water has distilled off, the temperature varies from 360° Fahr. to 370° Fahr.; the temperature at end of distillation being from 375° Fahr. to 390° Fahr.

The purified crystalline acid of commerce is obtained from the crude carbolic acid by several distillations and crystallisations of the various fractions of distillate from the crude acid—the crystalline acid being distilled with one or two per cent. of sulphuric acid, for the purpose of rectifying or decolourising.

Patents have recently been granted for improvements in the method of obtaining the crude carbolic acid; the improvement consisting in using carbonic or sulphurous acid gas for neutralising the carbolate of soda solution, instead of sulphuric acid, as now used. Should these improvements become adopted, the cost of production of crude carbolic acid should be materially decreased, since the by-products obtained would be carbonate or sulphite of soda, instead of, as at present, the almost valueless sulphate of soda.

Naphthalene ($C_{10}H_8$) is present in large quantities in the distillate from coal-tar, having a density of from 1·000 to 1·040. If the oils having this density be exposed to cold in shallow pans for a few days, naphthalene will crystallise out. The fluid oil is drained off, and the naphthalene submitted to pressure in hydraulic press, in order to to remove all adhering oil. The pressed naphthalene is now placed in a vessel and melted by means of a steam coil. When the whole mass has been rendered fluid, it is agitated with 5 to 10 per cent. by weight of sulphuric acid, sp. gr. 1·850 or 170 Twaddel. After agitation, the waste sulphuric acid is run off, and the naphthalene washed twice with hot water, and finally with water slightly alkaline. The washed naphthalene is transferred to a still and distilled, and the portion of distillate collected, which distils over between 212° and 214° C. Care must be taken that the still-pipe leading to condenser be kept hot, and the water in condenser kept boiling, in order that the pipes may not be blocked with solid naphthalene.

Good commercial naphthalene should not become discoloured on exposure to the rays of the sun for two or three weeks, and on distillation the boiling-point should not vary by more than one degree Centigrade from commencement to finish of distillation.

The demand for naphthalene is so limited in comparison with the enormous quantities of naphthalene present in coal-tar oils, that it is a matter of importance to many tar-distillers how to get rid of their crude naphthalene. In consequence of this limited demand, pure naphthalene may be obtained in any quantity at the low price of £10 per ton. It is so easily obtained in a state of purity that it is rarely, if ever, adulterated.

Anthracene was first obtained from the last fractions of the distillation of coal-tar by Dumas and Laurent in 1832. They, on analysis, gave it the formula of $C_{15}H_{12}$, and as this is half as much again as naphthalene $C_{10}H_8$, they named the new substance para-naphthalene; but this chemical composition and the low melting-point, 180° C., prove that they did not obtain anthracene in a state of purity. Fritsche described in 1857 a compound obtained from coal-tar which had a melting-point of 210° to 212° C., and formula $C_{14}H_{10}$.

Anderson, in 1862, confirmed these results. In 1866 Limprecht obtained it by heating chloride of benzol with water in sealed tubes at 180° C.

He also showed that toluol alone, a mixture of styrol and benzol, or of benzol and ethylene, passed through a red-hot tube, furnished anthracene.

In 1868 two German chemists, Graebe and Liebermann, engaged in investigating the class of bodies known as quinones, succeeded in obtaining anthracene from alizarine. Having obtained anthracene from alizarine, which is the principal colouring-matter contained in madder root, they attempted to convert anthracene into alizarine. This they succeeded in doing, and thus for the first time a vegetable colouring-matter was artificially produced. The tar-distillers at once set to work to produce anthracene on a large scale. The Germans, as usual in all matters relating to organic chemistry, were the first in the field. Several works were erected in Germany and one in England for the manufacture of alizarine from anthracene.

Thus anthracene, which previously had been sold in a crude state as a rough lubricant, suddenly became an article of great commercial value. In the year 1867, a few months before the discovery of Graebe and Liebermann, Dr. Letheby, in a lecture he delivered on Coal-Tar Compounds, said, speaking of that portion of coal-tar distillate which contained anthracene, "The greasy matter or green oil, which follows the dead oil in the distillation of coal-tar, is used for making railway grease, with resin, oil, &c."

Anthracene is obtained from that portion of the distillate from coal tar which has a density of from 1·060 to 1·110, or 12 to 22° Twaddell. This portion of the distillate is allowed to stand in cooling pans for several days, when the anthracene crystallises out. The oil containing the crystals is filtered through long cylindrical bags, suspended from a frame, or through filter press; the crystals being retained in the bags or filter press in the form of a yellowish-green paste. The paste is now placed in strong canvas bags and submitted to pressure in hydraulic press. The clear oil which filters from the crystals is reserved for further distillations. The anthracene paste, after pressing for several hours, is obtained in the form of a hard cake containing about 30 per cent. anthracene. After being disintegrated or reduced to powder, it is sold to the alizarine manufacturers. Some tar-distillers increase the percentage of their crude anthracene to 50 per cent. by washing with light oil or naphtha, and refiltering and pressing.

The quantity of anthracene obtained from coal-tar is very small; in fact, a yield of 7lb. of pure anthracene from 2240lb., or one ton of tar, is considered a fair yield. This equals about 0·31 per cent. on the tar. Thus, to obtain one ton of pure anthracene you must distil about 400 tons of tar, which equals about 4,000 tons of coal. Yet, although the quantity of anthracene obtained from coal-tar is so small, it is now made in such quantities that the madder-root has been practically driven from the market this last few years. Prof. Roscoe estimated that in the year 1880 there were produced 1,400 tons of pure alizarine.

Anthracene Testing and Valuing.—When anthracene became an article of commerce, it was necessary that some method of testing should be devised by which its value could be approximately ascertained. The first method introduced by Dr. Gessert, and known as the alcohol test, was based on the insolubility of anthracene in alcohol, the melting-point of the anthracene insoluble in alcohol being also taken. Following this method came the bisulphide of carbon test and Perkin's test, in which both petroleum spirit and bisulphide of carbon were used to dissolve the impurities found in crude anthracene. The percentage of anthracene by each of the above methods being determined by the quantity of hydrocarbons insoluble in a certain measured quantity of the solvents, the results obtained by these methods were very unsatisfactory. In 1873, Mr. Luck, a chemist at Meister, Lucius, and Brüning's, published a method which, in a modified form, is now universally adopted. It is known as the "Anthraquinone test."

"Take one gram of the crude anthracene, place it in a flask of 300cc. capacity, fitted with upright condenser; add to the one gram anthracene 45cc. of glacial acetic acid, and heat to ebullition. To this solution, which is kept boiling, add, drop by drop, a solution of 15 grams of cromic acid in 5cc. of water and 5cc. of glacial acetic acid. The addition of the chromic acid solution should occupy about two hours, the solution being allowed to drop down the condenser tube by means of tubulated and stoppered funnel. After the whole of the chromic acid solution has been added, the contents of the flask to be kept boiling for two hours to complete oxidation. The flask is then allowed to cool for several hours, and the contents afterwards made up to 200cc. with water.

The precipitated anthraquinone is now collected on a filter and washed—first with pure water, then with a boiling solution of sodic hydrate containing 1 per cent. of alkali; and again with hot water: the anthraquinone is now washed from filter into small dish, a little sodic hydrate solution (1 per cent.) added, the contents raised to boiling-point, and one or two drops of permanganate of potash solution added, and the boiling continued for five minutes; if the permanganate becomes decolorised, a few drops more must be added till there is no further decolorisation on boiling. To the solution, after cooling, is added a slight excess of dilute sulphuric acid, and a few crystals of oxalic acid; the whole is now filtered, washed with warm water, then with 1 per cent. alkaline solution, then with warm water, and the filter paper and anthraquinone transferred to water bath for drying. When dry, the filter and contents are weighed, the anthraquine brushed off filter paper by means of a fine brush, and filter paper reweighed, thus the weight of the anthraquinone is arrived at. In order to correct for the slight loss due to the solubility of anthraquinone in dilute acetic acid, ·010 is added to the anthraquinone found. In order to estimate the percentage of anthracene, the weight of the anthraquinone is multiplied by 0·856, and then by 100; thus anthraquinone weight is 0·351

correction 0 010

0 361

·361 × ·856 × 100 = 30·9 per cent. of anthracene present in the sample.

Chemistiana.

(*To be continued.*)

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[46378.]—**Bevil-Wheels.**—I should prefer the larger pair of wheels.—Glatton.

[46396.]—**Terrestrial Eyepieces.** — "Aldebaran" now says (p. 198)—"the emergent rays cross immediately in front of B." Without stopping to inquire what meaning the word "emergent" can possibly have in this sentence, we are surely entitled to ask why "Aldebaran" did not show them crossed in his diagram? It is clear enough to me that "Aldebaran" is troubled by diagrams that show an image of a large object. On this matter he may perhaps find my letter in present issue. It is only necessary to know the very rudiments of optics to be able to calculate exactly where images are formed, and the amount of convergence or divergence. Surely "Aldebaran" can do this. If the rays (of each series) are not divergent between B and C, how is it that the power is increased by further separating the eyepiece from the erector? With regard to the diaphragm, I thought the merest indication would have sufficed to point out the absurdity. The diaphragm must be in the focus where it can best be seen; the image has to be viewed by the help of the same lens, and therefore must be in its focus. Hence the diaphragm and the image must occupy the same part of the tube. Is that clear enough.—Paugul.

[46467.]—**Rheocord.**—A line drawn by a lead-pencil has been used as a resistance in a voltaic circuit. I do not know what the resistance would be, but it must be immense.—Glatton.

[46503.]—**Jamming of Tapered Journals.**—Many thanks, "J. J. A.," for your reply; but it is still short of my requirements. As I stated on p. 178, I merely instanced a lathe-mandrel for convenience of reference. I want a general rule, which would be equally applicable to the pivot at bottom of a turbine-shaft or to a friction-clutch, for example. I did not give the weight tending to force the cone into its matrix, as I conceive that, if it means to jam, it will do so with almost any force; whereas, on the contrary, if the angle (whether A B C or A B D in diagram, p. 91, is the angle is the question I want solving) exceeds by ever so little the angle of repose, no amount of pressure can make it jam. It would doubtless be more correct to speak of the angle of repose as the "angle of friction," in the case of a swiftly revolving mandrel. Of course "J. J. A." understands what the angle of repose means, and is only poking fun at me when he says, "I don't know, &c."—Glatton.

[46525.]—**Botanical.**—If "Robur" wants the flowers for the herbarium, he should dry them before a hot stove, pressing them between newspapers loaded by a weight. The fire must be sufficiently strong to rid the flowers and leaves completely of their moisture. He should not be in the least hurry, but let the plants dry entirely; and should keep the pressed flowers in a dry place. I have seen flowers which were treated in this way, and had not lost their colour after nine years; but the dampness prevailing in England is very disadvantageous for any such collection. For microscopical purposes, I should advise "Robur" to use Farrant's solution for small specimens. In this case he should press the flower together with the covering glass in a spring press. This solution is best made by dissolving four parts (by weight) of picked gum-arabic in four parts of cold, distilled water, and then adding two parts of glycerine. The solution must be made without any heat, the mixture being occasionally stirred, but not shaken. It must be used cold, and soon viscifies without cracking. As other preservative media, I should advise the use of aqueous solution of carbolic acid, or a mixture of one part of glycerine and two parts of camphor water; or, finally, a mixture of three parts of pure alcohol, two parts of distilled water, and one part of glycerine. The last mixture can only be used as a preservative medium for minute preparations; and a cement cell should be used, taking care that the alcohol and water evaporate before the cell is closed (which is done in the ordinary manner).—A Medical Student.

[46528.]—**M.R. Engines.** — The M.R. Co. possess 30 bogie engines; ten are 6ft. 6in. coupled, and the remainder 7ft. coupled. Full dimensions will be found in back vols. The latter class were built by Dübs in 1877. Later on in the year ten passenger engines were built at Derby with a single pair of leading-wheels. These engines, numbered 1347-1356, were in other respects similar to the bogie engines, with cylinders 18 by 26. These engines ran trials with the bogie engines, and the result showed that both classes did their work excellently, and that the single leading-wheels worked as well as the bogie. The result is that no more bogie engines have been built. 1400-1409, 1472-1491 (M.R. Co. 1879-81) have driving-wheels 6ft. 8in., and cylinders 18 by 28. 1492-1501 have 7ft. wheels, and were built by the company in 1881. They belong to exactly the same class as 1347-1356 (which I forgot to state were renumbered 101-110). The last class of passenger engines are 1502-1531 ("Neilson," 1881), driving-wheels, 6ft. 9in.; cylinders, 18 by 28. 111-115, built by the Co. (1880) have driving-wheels 6ft. 6in. There are 30 passenger engines ordered now, I believe, from Kitson and Co.—Meteor.

[46531.]—**Yacht's Deck.**—Not until too late for last week's insertion did I notice "W. R.'s (Liverpool)" reply to this query. I do not think "W. R." is sufficiently explicit in his advice, and if "J. J. A." follows it, ten to one his deck will be nothing better than a riddle to let the water through, for he gives no instructions as to how the seams are to be made watertight. And let us note, the more seams there are the more room for leaks. When I penned my reply to this query, I thought that "J. J. A.," having this yacht, and, like most of us, not overstocked with spare cash, proposed to do all he could towards putting on his deck himself. If that is the case, I say the less seams he has the better for keeping deck watertight; and if he, as I suggested, gets a journeyman shipwright, or an elder apprentice, to give him a hint or two on the spot, it will be the best for him. Another thing makes me think my suggestion is the best for "J. J. A." is, if he had the capital to have a deck put in at a yacht builder's on the finest lines, he would not be asking queries in "ours."—Working Tom.

[46549.]—**Science Questions.**—I should propose the following method:—Since CO_2 and HCl are soluble in KHO, let the whole mixture pass through a tube containing KHO, which, as well as the mixture, has been weighed before the test. Then the weight gained by KHO tells us the quantity of CO_2 and HCl as a whole. Now estimate the quantity of Cl contained in the solution of the KHO, and hence calculate the quantity of HCl. Having found this, we can easily find the quantity of CO_2. This is, of course, equal to the difference between the weight gained by the KHO and the weight of HCl. The other constituents, being insoluble in KHO, can be treated separately, in the following manner. Introduce a certain quantity of O, and explode. Then H_2O and CO_2 is formed. From the quantity of water we can readily calculate H. Without difficulty CO_2 can be got now, and hence CO. Thus only O and N is left. Subtracting the quantity of O introduced from the quantities left by the water and the dioxide, and the quantity present in the free state (which can be found by means of copper or potassic pyrogallate), the original quantity of O is obtained. In this way we have found all constituents but N. In order to get this last quantity, subtract the obtained quantities from the original quantity of our mixture. The difference gives us the quantity of N. (2) 100 parts of $CaCO_3$ yield 44 parts of CO_2.

$$\therefore\ 1 \text{ part of } CaCO_3 \text{ yields } \frac{44}{100} \text{ part of } CO_2.$$

100 parts of $SrCO_3$ yield 29·847 parts of CO_2.

$$\therefore\ 1 \text{ part of } SrCO_3 \text{ yields } \frac{29\cdot847}{100} \text{ part of } CO_2.$$

But $(1\cdot3332 - x)\ CaCO_3 + x Sr$ yield 0·5104 CO_2.

$$\therefore \left(\frac{1\cdot3332 - x}{100}\right) 44 + \frac{29\cdot847}{100} x = 0\cdot5104.$$

$$\text{Or}\quad (1\cdot3332 - x)\ 44 + 29\cdot847\, x = 51\cdot04.$$

$$\therefore\ 14\cdot153\, x = 7\cdot6208.$$

$$\text{And hence, } x = 0\cdot538.$$

Therefore, under the above conditions, 1·3332 grain of the mixture contain 0·538 $SrCO_3$. But since 147·05 parts of $SrCO_3$ contain 87·2 parts of Sr, 0·538 part of $SrCO_3$ contain 0·319 part of Sr. Thus we get—

$$1\cdot3332 : 0\cdot319 :: 100 : x.$$

$$\text{Or, } 31\cdot9 = 1\cdot3332\, x.$$

$$\therefore\quad x = 23\cdot9.$$

Therefore, the percentage of Sr is about 23·9.—A Medical Student.

[46568.]—**Revolving Gas-Burners.**—These act on the principle of Barker's mill—the jets issuing in one direction to the side. The portion carrying the jets is either a simple sheath to the gas-tube or revolves on a needle point.—T. P.

[46577.]—**Telegraphy.**—The querist should refer to your XXXth volume, wherein he will find Mr. Preece's lectures "On Telegraphy"; and on pp. 397, 425, I think the duplex and quadruplex are explained. The lectures are published in a collected form by the Society of Arts at 2s.—E. G. M.

[46639.]—**Power of Water-wheel.**—To E. Morgan.—In calculating motive power there are three quantities to take into consideration—namely, time, distance, and weight. See answer to query 46410 to find velocity of discharge from pipe. A 4in. pipe, 100ft. long, with 15ft. of fall, will give 29 cubic feet per minute, taking water at its greatest density: there are 62·5lb. per cubic foot. Multiply 62·5 by 29 = 1812·5lb. flowing per minute. We have now got two of the quantities, time and weight. Then the fall or distance, 12ft. × 1812·5 = 21,750 foot-pounds. As 33,000lb. raised one foot high per minute is one horse-power, then 21,750 ÷ 33,000 = ·66, nearly. This is the theoretical horse-power. The effective power is one-third less. ·66 × 2 = 132 ÷ 3 = ·44, nearly half horse-power.—W. H. S.

[46660.]—**Sutton's Secondary Battery.**—In reply to Mr. J. Hezmalhalch, jun., when I said that I had indiarubber between top and bottom of the plates to prevent contact, I meant what I said. I have simply two pieces of indiarubber pipe fixed on to the copper plate, one at the top and one at the bottom. Everything is done according to the description given in "ours" some weeks back, and the cell was charged until all the copper was deposited, and the solution left clear and almost colourless. This could not have been the case if I had entirely covered the plates with indiarubber, as suggested by our friend.—W. Stutchbury.

[46704.]—**Blake Transmitter.**—I am extremely obliged to those gentlemen who have answered my query. I have not got the "E. M." referred to by "J. P. M."; would he, therefore, as he offers, kindly lend me the one he has? I will take great care of it. The sketch sent by "Yoshi" has enlightened me a great deal. Will he please state (1) What is the use of the hole in the centre of bar F (in the Fig.), by which the microphone is adjusted? (2) Does the spring, tipped with platinum, touch the diaphragm and the carbon, or only the carbon.—John H. Rider, 48, Southville, Bedminster, Bristol.

[46712.]—**Yacht.**—"Minim" would probably find a boat made of canvas, stretched tightly over a light frame work, the best to answer his requirements. Such boats, called "Curraghs," are used by fishermen on the west coast of Ireland, and are extremely light, one that will carry three men, and as many hundredweight of fish, being easily carried by one man, bottom upward upon his head. A boat 12ft. long, 3ft. or 3½ft. beam, and 18in. deep, would carry "Minim" and a friend upon a draught of about 5in., and would weigh about 60lb. Ballast would be as difficult to carry about as a heavy boat; but two light cylinders of tin-plate fitted to the bilge on each side, and filled with water before sailing, would do equally well. A canvas boat, with a deep false keel, which must be added after the boat is finished, oiled, painted and varnished, will sail very well, even on a wind, and a single paddle dextrously used by a person sitting as far aft as possible, will propel her in a straight course if becalmed away from land. A bamboo mast, about 10ft. high, and a standing lug-sail, with a lighter bamboo for a yard, and a lighter still for a boom, would be the handiest rigs. If "Minim" will send me his address, I will forward him full directions, with sketches to scale, of boat and fittings.—Robinson Crusoe.

[46713.]—**Bleaching Clothes.**—Make a weak solution of chloride of lime, and steep the clothes in it over night; then wash well in clean water, and dip the articles into water made only sour with vitriol; then a final wash, using soap. Your things ought then to be white as new.—John Brown.

[46734.]—**M. R. Engines.**—"Meteor" asks for the number of the Midland engine sent by Fairbairn and Co. to the 1862 Exhibition. It was No. 479. The 270 to 279 class were built by Thompson, Kitson, and Hewittson, of Leeds, 1852; the 280 to 289 class were built by Stephenson and Co., 1853. Both these classes have all been rebuilt or replaced. The present 480 class were built by Stephenson, 1856 and 1857. These numbers were then 381 to 385, and 400 to 404. These old engines have been rebuilt and placed in the 480 class; the old 480 engines have been rebuilt, and now are 480A. These numbers will be changed shortly, as they will be put in the place of 10 worn-out engines.—A Driver.

[46735.]—**Eames' Locomotive.**—Errata.—Line 26, 2nd column, p. 202, should read: The boiler is fed by two injectors, pumps *not* being used; and in line 26, "smokebox" ought to be firebox.—E. W.

[46739.]—**Nitro-Glucose.**—I have experimented according to Mr. Robinson's instructions, on p. 205, and have totally failed. I placed the vessel with the acids in a stream of water to keep cool; but when I added the ground sugar, after a short time, it boiled up and threw off dense brown fumes. Will W. Robinson, or any of the chemical readers of the Mechanic, give me further particulars?—G. Thomas.

[46745.]—**Stopping Teeth.**—To "W. B. A."—Does carbolic acid simply drug the nerve or destroy it? What would destroy it? I have some decayed teeth that make themselves particularly "offending" during this part of the year. A "tiny crystal"—can it be obtained other than in a liquid state?—John Alex. Ollard, F.R.M.S., Enfield.

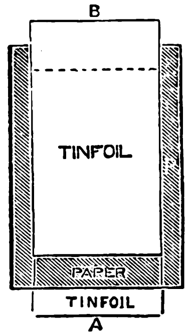
[46765.]—**Periosteal Rheumatism.**—To "R. A. V."—Observe temperance in eating and drinking, and take only plainly-cooked and nutritious foods. If you take intoxicating drinks, limit yourself to one pint of good sound ale per diem. If you smoke, continue the habit. Pay attention to state of your bowels, keeping them regularly moved. Obtain a small quantity of colchicum wine (½oz.) from some first-class chemist in your town, and take fifteen drops in water three times per day. I should like to know if you get relieved. For a purge, when wanted, take ½oz. of sulphate of magnesia, or, as it is called commonly, Epsom salts, combined with half a teaspoonful of ground ginger.—Junior Practitioner.

[46769.]—**Silvering Mirrors.**—Having had considerable experience in silvering mirrors by deposition, I may be able to give a little assistance to "Signed Chemist, No. 50." I first published the process in the *British Journal Photographic Almanac* for 1873, and further remarks thereon in the *Almanac* for 1876; see also hints contained in an article on "Silvering the Front of Glass," by Professor Piazzi Smyth (Astronomer Royal for Scotland) in the *Almanac* for 1881. Make a 20-grain solution of nitrate of silver, and a 10-grain solution of pure caustic potash; also a solution made as follows:—Loaf-sugar, 2,700 grains; distilled water, 20 oz.; nitric acid, 2 drachms; alcohol (strong), 10oz.; distilled water, to make, 80oz. The solutions are mixed for use in the following manner:—Take one part of silver, and one part of potash solutions; add ammonia to just dissolve the precipitate, and two parts of distilled water. Now add a further quantity of silver solution till the silvering fluid is decidedly turbid. The amount to be added will depend upon the quantity of free ammonia remaining. Clean the glass to be silvered with a little of the potash solution and tripoli on a piece of cotton wool, and well rinse in clean water, finishing with distilled water, and keeping it wet till brought into contact with the silvering solution. When all is ready, add to every ounce of silvering solution one drachm of the sugar solution or reducing agent. Take care to make the reducing agent a week before you want to use it: it improves by age. Keep all the solutions and distilled water in a warm room. Rub a little paraffin or beeswax on the stopper of bottle of potash solution, or it will become fast. The metallic scum is caused by the hot water; pinholes are caused by solid particles in the solution or on the glass. The coating of silver should be perfectly opaque by transmitted light. Small mirrors are best dried on a pad of blotting-paper, and after warming, may be polished with rouge and chamois leather, taking care to first rub it with a piece of leather without rouge, till the rubber passes smoothly over it.—H. J. Burton, Tyne Villa, Hanwell.

[46775.]—**New Form of Cheap Battery.**—If I might step in between this questioner and the gentleman appealed to, I would advise your readers not to waste time in making the battery described. It may be all that it is painted, but I should only believe the statements made on ocular demonstration, or when certified to by some such authority as "Sigma." Nothing very marvellous in the way of batteries, whether in constancy, power, or cheapness, is to be expected nowadays, and anything very good would be almost sure to be patented.—Nun. Dor.

[46782.]—**Explosion in Firebox of Loco. Engine.**—To explain satisfactorily this explosion it would be necessary to know something of the nature of the previous bursting of the tube and of the rent caused thereby. However, I will attempt an explanation that may probably be the true and only possible one. When the boiler was emptied after the return to the shed, there remained some steam in the tube as well as some water. The cold water afterwards introduced, would, of course, condense the remaining vapour, and through that a vacuum would be created. The simple loosening of the plugs has caused the air to enter violently, and fill up the vacuous space. This phenomenon is of course accompanied by noise, and projection of all that there might be in the tube, such as soot. This will explain why the man got his face marked with black spots. The re-entrance of air through the rent would help to this considerably.—Ed. Gobert.

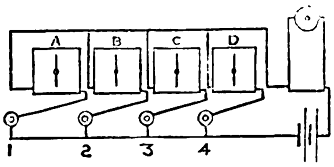
[46787.]—**Condenser.**—I made my condenser of 50 sheets of tinfoil 6in. by 5in., separated by sheets of paraffined white foolscap-paper, 7in. by 6in. Build up sheet by sheet, and notice the increase of spark at the secondary end, and diminution of spark at the contact-breaker. Carefully examine all the sheets of paraffined-paper to have them free from pinholes. Lay down, say, four sheets of paraffined-paper; then, a sheet of tinfoil, projecting as shown at A; then one sheet of paraffin-paper, and then a sheet of tinfoil projecting as at B, and so on alternately projecting over the paper. One series of tinfoils, A, to be connected to the spring, and the other series, B, to the upright carrying the platinum-point of the contact-breaker. When the condenser is finished, keep it hot and put it under pressure; this improves it very much.—Thos. N. Andrews, Silver Medallist Advanced "Telegraphy" City and Guilds of London, Plymouth.



[46790.]—**Stirling Castle.**—436ft. long, 50ft. broad, 33ft. deep, 4,300 tons registered; engines are of the three-cylinder type, cylinders in line fore and aft. 2 l.p. cylinders, each 90in. diameter; 1 h p. cylinder, 63in. diameter; stroke 5ft. 6in. Engines indicated on trial, 8,058 H.P., with 100lb. boiler-pressure, 28in. vacuum, 66½ revolutions per minute; mean speed, 18½ knots.—S. W. J.

[46793.]—**Glueing Belt Splicings.**—Several things are recommended, but I believe there is nothing better than good glue to which tannin has been added until it becomes "ropy."—Nun. Dor.

[46801.]—**Sub-Circuit to Indicator.**—If "Bor" will connect his rooms with indicators as per sketch, he will find no difficulty as to the circuits interfering with each other. 1, 2, 3, 4, pushes, A, B, C, D indicators.—H. J. J.



[46802.]—**Early Rising.**—I take a common American 6s. 6d alarm-clock, and, removing the spring which holds the wire that makes the alarm act, I substitute a wire spring attached to the right-hand side of the plate. To this I fix one end of the wire connected with the battery, so that when the alarm is set, the end attached to the spring does not quite touch within a small glass tube the other wire connected with the battery, which has been fixed within it. Upon the alarm going off, the spring which has held it flies forward and bears with it the end of the wire attached, which touches the other wire completing the circuit.—W. F. R.

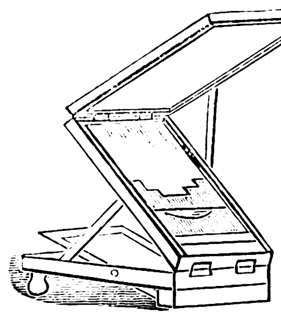
[46811.]—**Re-varnishing Dog-Cart.**—Well wash in water quite free from grease, dirt of any kind, then rub down with a wet cloth and pumice-powder until it is quite dead or without gloss, wash and dry with a washleather. If it is not well rubbed down with pumice-powder the varnish will not adhere as it should. Give two coats, the second as soon as the first will stand working upon. Varnish with best copal varnish, ironwork with japan; get it from the coachmakers.—James Parkinson.

[46813.]—**Dry-rot.**—"R. N. H." will find the only cure for the above is plenty of ventilation. We have tried all ways to get rid of it out of our works but cannot persuade it anyway, but find ventilation the best way of keeping it down.—James Parkinson.

[46813.]—**Dry-rot.**—Dr. Zerener recommends a preparation which he calls "autimerulion." In the liquid form it consists of boracic acid, common salt, and silica. I think you would find a strong (a saturated) solution of borax effective, letting it soak into the wood until the pores were filled with borax.—Nun. Dor.

[46814.]—**Caledonian Engines.**—The class "R.N.H." refers to were Nos. 136, 137, 138, 139, 140, 141, 142, and 143. They were built in 1853. They had saddle tanks. With the exception of 136 and 142 they were all altered to six-wheeled engines, leading and driving wheels being coupled. Nos. 136 and 142 ended their days as tender engines, with intermediate shaft as before, and running on four wheels only. None of this class are now running. The other part of the query is somewhat ambiguous. Does "R.N.H." mean the old six-wheel coupled engines or the modern ones? If he means the old ones, I may say that 96-100 class, by Jones and Potts, of Newton, and 122-131 class, built at Greenock, both came out in 1850. The latter class had originally cylinders 17in. by 24in., but were altered to 16in. by 22in. The six-coupled wheels were 4ft. 6in. The coupling-rods were removed from the trailing wheels, which were removed and a smaller pair substituted. In this form there are two still running now numbered 182 and 183; I am not sure if all were altered to four-coupled engines. In their first form 122 class were very powerful engines, though, of course, the pressure was very low. The modern six-coupled engines are Nos. 631 to 669. I think that class made its appearance some seven or eight years ago; they were built by Dübs and Co. The six-coupled wheels are all in front of the firebox, reducing the wheel-base to about 10ft. 6in. They have 18in. cylinders, 24in. stroke, and the wheels are 5ft. diameter. I am afraid I do not remember either dates or numbers asked for in 35398. A great many of the "Jenny Lind" engines came out in '48 and '49, though some appeared on the scene earlier.—Carstairs.

[46831.]—**Photographic.**—The annexed rough sketch will give you ample instructions to work from. At the bottom there is a reflector, or a piece of white paper will do instead; the bottom piece and bed are made in one piece, and sawn afterwards; then you will have both exactly the same size; the top piece is simply a flat board clamped; dovetail the bottom and bed. There are a number of notches for the carrier to fit upon, in order to raise the negative or lower as desired; there is a piece of very fine-ground glass in the bed for the negative to rest upon; the easel is easily adjusted by the brass clips, as shown at the side. If you cannot dovetail, get some spare pieces of wood and work away till you can; if you simply sprig them together you will have a botch of a job. Every amateur photographer should be his own cabinet-maker. In the last four years I have made apparatus which would probably have cost £25. If the amateur can manage this, then his "hobbie" is in reality a pleasure.—James Parkinson.



[46833.]—**Bumping Noise in Engine.**—Thanks to "J. K. P." and "J J. A.," I may say that the keyway is already sunk in the main shaft and properly fitted, also that the steam enters the cylinder just at the end of the stroke and cuts off a little over the centre. Will they or any other reader kindly advise further?—One in a Fix.

[46833.]—**Bumping Noise in Engine.**—Although addressed to "Sunlight," it will, perhaps, do no harm for another to state causes of the above he has met with in a course of 15 years' experience. As you refer to main shaft and crank-pin, just see both are square with cylinder at all portions of stroke. If shaft is square, try for crank-pin. I have known pin to be not put in true—i e., hole in crank not bored true; same for boss. Examine slide for lift and length of stroke; piston on rod; also look at cylinder covers if piston touches. And last, though not least, look for the *least leetle* drop of water in cylinder at the end of each stroke. Remedy will suggest itself.—R. A. G.

[46833.]—**Bumping Noise in Engine.**—I think the bumping noise in the engine is neither in the crankpin nor the neck bearing, as, after many years of experience with all kinds of engines, I have found that engine-makers do not allow in their valve-setting sufficient cushioning to bring the piston softly to the end of its stroke before it receives the steam admitted by the lead to cause its return stroke. Now, "One in a Fix," should take off his steam-chest cover, and move his engine round, and take notice of the lead of the slide-valve, which, in an engine of the size he mentions, should be about 1-32nd of an inch. He will probably find that the port is open to the exhaust until the piston is just going to commence the return. Should this be the case, he should knock the key out of the eccentric disc (usually a hollow one with no keyway on the shaft), making a mark on both disc and shaft to show original setting, then describe a circle on paper or board the exact diameter of the crank-shaft at the fit of the disc: divide the circumference of the circle into twelve parts equal to one another, and setting his dividers to one division, advance his eccentric disc to that distance from the original mark, in the direction of the engine's motion. Then key up and move round by hand again, and it will be found that the cushioning is rectified, but that there is too much lead. Now cut and drill two strips of iron or brass, and rivet them upon the two *steam* edges of the valve, and file them off until there is 1-32nd inch lead when the crank is just past the dead-centre on both sides; equally, if an horizontal engine; on the weight side more lead if a vertical engine. I am certain that though the noise *seems* to proceed from the bearings, such is not the case, if they are moderately close; and if "One in a Fix" likes to try my simple plan, he will find, like I have done, a silent servant in his engine instead of a noisy one. —Fred. Walker.

[46845.]—**To Mr. Davies.**—I am much obliged to "Ted Arthur" for his good opinion, but I am afraid he would prove himself but a bad exponent of the feelings of the musical portion of our readers were I again to trouble them with the dry details of piano-tuning. I will, therefore, refer him to No. 830 of the E. M., where the matter was exhaustively treated, though should he get into any difficulty I shall consider it a privilege to assist him. I am glad to tell him that by making himself familiar with the stringing he has removed one-half of the difficulty, it being usually just that part amateurs are most afraid of. The best position of the bearings is from the F on the fourth line in the bass to the next E above it. The first note tuned is the C between them, which should be set to the tuning-fork, these 12 notes forming the base from which the rest of the notes are tuned.—W. H. Davies.

[46846.]—**Engineering.**—To "Seaweed."—I should like, as a foreigner, to say a few words on this subject. The *Engineer* of last year inserted two or three letters of mine on the "Education of Engineers." This subject is naturally akin to the present one. There is no examination required in England to become an engineer. The usual thing, as you know, is to serve an apprenticeship in the works of some well-established mechanical engineers, or in the office of a competent civil engineer. There are, nowadays, many examinations conferring a diploma, either of M.E. or C.E. in connection with universities, such as Glasgow, Edinburgh, &c. But no competent man will accept a young man provided with these diplomas, if he has not served the regular apprenticeship. Of course, there is good in both university training and workshop practice. But it is likely that the latter will hold long yet. I advise you, feelingly, to go into some good engineering works or offices, and at the same time devote your leisure to the acquirement of theoretical knowledge. Abroad, especially in France, the diploma is everything, so that we get people that are apt at everything, but good for nought. They get laughed at by the workmen. The German system (Berlin Academy) is the best, as it combines in the course of five years, a thorough, practical knowledge of the shop and tools with a good, theoretical training. Let us hope that we shall see such useful institutions developed here, and we shall have then, no more useless members of the profession. There should be examinations, but no one should be permitted to pass them who has not been trained in some workshop of good repute. If you refer to my letters in the *Engineer* of last year, you will find this matter more detailed than I can do it here, for fear to trespass on valuable space.—Ed. Godbert, B.Sc.

[46850.]—**Electro-Magnet.**—Your magnet did not work either because the insulation was imperfect, or else one coil was wound to reverse the action of the other. A bichromate cell should work such a magnet easily. An electro-magnet will work with one large coil only, very near as well as with two small ones.—J. Sutcliffe.

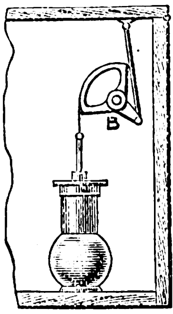
[46850.]—**Electro-Magnet.**—If you wind both legs equal, and put as much wire round them as your core is in diameter (which is being constantly repeated), you will have no difficulty in making your magnet work with only one cell. No one can inform you what power it will take to work the magnet unless they know what it has to do.—Wallington.

[46850.]—**Electro-Magnet.**—You do not give gauge of wire; but even under the circumstances you name, a trace of magnetism should have been apparent. Rewind the limbs evenly, and place a piece of paper between each layer. Try the battery fitted up for tension if wire is thin; but if the wire is No. 20, or larger, connect up for quantity. Probably the iron of your core is too hard—you might soften it a little. If the wires are not evenly wound, of course good results are not to be obtained. Are you sure the wires on your magnet were wound in one continuous direction? If not, the failure is easily traced.—H. Stooke.

[46850.]—**Electro-Magnet.**—The result of wrapping unequal quantities of wire round the limbs of an electro-magnet is that one pole becomes stronger than the other, the strength of a magnet being proportional to the number of turns. I therefore do not think that the unequal number of coils alone were the cause of your magnet not "working." See whether your wire is perfectly insulated, especially whether there are no uncovered places touching the core. I should advise you to equally divide your wire, and wrap it properly upon two wooden bobbins, into which the limbs are fitted. If this is properly done, one single cell will give you a strong magnet.—Kauthack.

[46855.]—**Cayenne-Feeding of Canaries.**—Some friends, whose birds are of a particularly fine colour, attribute its excellence to their practice of mixing cayenne pepper with hard-boiled egg, chopped fine, and supplied to the old birds to feed their young ones with. When grown up, they occasionally revert to this diet.—Glatton.

[46854.]—**Mechanical Action.**—In a sketch *a* is hinge of case; *b* is an axle running the length of case, and connected by a short lever and a rod to lid, as shown. This shaft will then make a portion of a revolution every time box is opened, or closed. Any number of cells may be connected to pulleys or (as in sketch), to quadrants on this shaft by strings, so that when the lid is closed the zincs are raised, and *vice versâ*. If you want dimensions you must give me depth of chest, largest diameter of cell, distance through which zinc is raised, and height from bottom of chest to top of zinc-rod when zinc is pulled up out of action.—Glatton.



[46856.] — **Electrotype.** — Power too strong. Violent action. Soft porous pot.—H. Stooke.

[46858.]—**Organ-Playing.**—It is impossible for you to execute pieces on the organ till you have gained a thorough mastery of exercises and scales. It is, no doubt, the fingering where you find your difficulty. You will find the piano a great help. Purchase an organ primer; though you have no pedals, you will find great assistance. —James Parkinson.

[46858.]—**Organ-Playing.**—You may improve your fingering by learning Bach's "Twelve Petite Fuges," price 6d., and more advanced studies by his "Fifteen Inventions," 1s. 6d., Enoch and Sons, Holles-street. Here are some astonishing ideas produced in a simple manner by the greatest master. Take your time, and play to time. Try Rink's "One Hundred Preludes" for a change, 1s., at any bookseller's.—Fiddler.

[46858.] — **Organ - Playing.**—"Poor Quill Driver" wants to acquire speed in playing the organ. Let him get hold of any good book of exercises, and placing a board or something over his hands, so that he cannot see the keys, work away until he gets the exercises off to his satisfaction without watching his fingers. The rest will come easy enough then, if he has intelligence and taste. When he gets an instrument with pedals, adopt the same plan; never look at the pedals, but let the feet find them. A little resolution is required, but that is the way to master the keyboard.—Organon.

[46861.] — **Cockroaches.** — The cockroach (Blatta [Periplaneta] orientalis) belongs to the order of the Orthoptera. These are ametabolous insects, the majority of which have two pairs of similar, or more or less dissimilar, wings in the adult state; and when the wings are absent, it is probable that they are aborted, not typically absent. The locusts and crickets (Grillidæ and Locustidæ) belong to this order, and are quite distinct from the Neuroptera and Coleoptera. The former have two pairs of wings of a delicate reticulated structure, generally nearly equal in size. The latter, on the other hand, have four wings, the anterior pair of which are not adapted for flight, but are converted into stiff horny elytra, serving as protective covers to the metathoracic wings. The Coleoptera are readily distinguished from the Orthoptera, including all those insects commonly known as "beetles." The order, Orthoptera, may be divided into three sub-orders: —(*a*) Cursoria, from *curro*, to run; (*b*) Raptoria, from *rapio*, to plunder; (*c*) Saltatoria, from *salio*, to jump. The Blattidæ are the only family belonging to the Cursoria, while the locusts form a member of the Saltatoria. The specimen you had must have been a male, for only the male Blattæ have two pairs of wings, of which the anterior are brown, and of a stiff texture. The posterior wings, on the contrary, are membranous, and, in a state of rest, are folded longitudinally upon themselves, the folded edge being internal. The female has very small movable anterior wings, which are, in fact, mere rudiments of the anterior wings of the male. The posterior wings are indicated by little triangular areas on the tergal portion of the metathorax, in which the integument is very thin, exhibiting markings which simulate the nervures of the wings. The cockroaches do not use their wings often; but they are, nevertheless, adapted for flight, and are made use of in the hour of danger. I think that every insect provided with wings is able to use them for flying, or at least for locomotion, for nature has no useless ornament.—A Medical Student.

[46862.]—**Telegraph.**—An insulated wire does not offer more resistance when straight than when coiled, and the strength of current does not affect resistance, but resistance affects it. If R = resistance of wire, S = its section, K = its conductivity, and l = its length, then $R = l / KS$. Try the effect of joining another cell or two in series, or put more turns of wire on instruments or a thicker line wire well insulated.—J. M. Stocks.

[46862.]—**Telegraph.**—No. 26 cotton-covered wire is a little too large for the coils—it should be about No. 30 and silk-covered. For the conducting wires it is much too small; these should be from No. 16 to No. 20; you don't say how many cells you use or of what battery. A wire of the same sectional area always offers the same resistance, but in the secondary of an induction coil there is a small quantity of current but at a high tension.—Kappa.

[46862.]—**Telegraph.**—Your instruments are too weak. Use No. 28 silk-covered wire for interior if needles are worked by electro-magnet, and finer still if worked by a coil. There is not too much resistance in No. 26 cotton for the distance. Are you sure there is no leak and all connections clean? A fine wire (insulated) offers the same amount of resistance when coiled as when straight, but an induced current overcomes a greater resistance.—Wallington.

[46862.]—**Telegraph.**—A couple of Fuller's cells should work your apparatus well, even under existing circumstances. I do not know how your line is fixed, but should say you have great leakage —i.e., if wire is out of doors. I rarely use less than No. 18 conductor for line purposes. No. 20 would do, but No. 26 is rather too fine. Wire in line presents same resistance as in coil. If well insulated in both cases, and under same temperature, I might say that S. N. Telegraph coils generally have 36 s. c. wire on them.—H. Stooke.

[46862.]—**Telegraph.**—The sized wire used for the telegraph ought to answer perfectly well. Will "A. H. B." please state what battery power he uses? I think that is where the fault lies. If they work well over 6 yards, they ought to do so over 60. Most likely the battery used is not powerful enough to work them over the increased distance. If querist were to use No. 22 or 20 for conducting-wires, he would obtain better effects. He should try to balance his battery power with the resistance of the line and instruments, making the resistance of the external (line and instruments) equal to the resistance of the internal (battery). Three cells of the Leclanché pattern ought to work the instruments spoken of. The current obtained from an induction-coil is of a different kind to that produced from a battery. It has a much higher intensity, and can therefore overcome much greater resistance than a battery. It will not, however, perform the work required in a telegraph. If not plain, write again.—John H. Rider.

[46864.]—**Canvas Canoe.**—From the dimensions he gives, "Rob Roy" has probably made the bottom of his canoe semi-cylindrical—the form of least stability for floating bodies. A round log lying in water will revolve upon the slightest touch. If "Rob Roy" will reconstruct his canoe, with a little more beam and less depth (say 27in. or 28in., by 9in. or 8in.) and make her bottom as nearly as possible flat for four-fifths of the middle part—not quite so, as canvas does not stretch well upon flat surfaces—making the ends as sharp as he pleases, he will require no ballast, and he will be able to sit her at ease, and, perhaps, even stand up in her. "Rob Roy" might reduce the length of his canoe to 5ft., or even 4ft., and still have buoyancy to spare; but she would neither look so nice nor go so fast. Every cubic foot of capacity will support 62lb. dead weight—that is the weight of a cubic foot of water displaced; hence the term "displacement" to express the dead weight of a ship. "Rob Roy" would much improve the appearance of his canoe by covering that part of framework above the water-line with pasteboard under the canvas. He can make a strip 6in. or 7in. wide in one length of 8ft. or 9ft., by pasting three or four strips of continuous cartridge-paper together, and letting them dry between two flat boards.—Robinson Crusoe.

[46865.]—**Cod-Liver Oil.**—If the stomach rejects, it is no benefit. Have you heard of glycerine as a substitute, in cases exactly like yours as to rejection? It is worth your inquiry.—Fiddler.

[46865.]—**Cod-Liver Oil.**—If "Leeds" will get some respectable chemist to put into an 8oz. medicine-bottle 5oz. of pale cod-liver oil and 3oz. of lime-water, in which has been dissolved 1oz. of powdered lump-sugar, and 30 drops of essence of bitter almonds, I think he will have a mixture which any child will take. Of course the chemist must take care to add the water very gradually, and it should be well shaken when administered.—A.P.S.

[46866.] — **Photographic.** — 1. Thin plates, over-exposure; it is impossible to get dense negatives from thin plates. 2. If you want good negatives do not try and spin your emulsion out to the greatest possible extent; allow about 1dr. A clay pipe is a very useful ladle for coating with. 3. I find one thickness of ruby with a lamp perfectly safe with Swan's 20 times. 6. I use nothing but rapid plates, and never fail to get density, but apt to get too much.—James Parkinson.

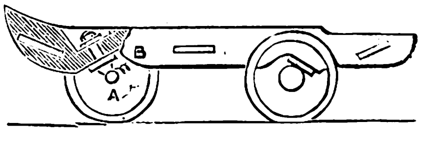
[46867.]—**Bichromate Battery and Intensity Coil.**—There is no intensity coil that can increase the power of your battery. The trough Bunsen described recently by "H. T. B." is as good as any, if the trough is well made. It has a high E.M.F., and can be constructed to work for a long time—two good points when the current is required for amateur electric lighting.—J. M. Stocks.

[46867.—**Bichromate Battery and Intensity Coil.**—There was a machine described in Silliman's *Journal*, some 30 or 40 years ago, which may be what "Jack" wants. It was made by laying a coil of secondary wire over the electro-magnet of an electromotor-engine, when the engine was connected to a weak battery, and the magnet-armature rotated by a hand-wheel, a current of electricity was caused in the secondary wire which would decompose water and give a spark between charcoal points, although the battery-current would do neither. A bichromate battery does not lose force by exposure to the air, but is not suitable for the electric light. Use Bunsen's or Grove's instead.—J. Sutcliffe.

[46872.]—**Staining (?) Walnut.**—Before you repolish, stain the light places with brown umber, or, if that is not dark enough, use Vandyke brown. Grind smoothly in oil, and thin with half polish and methylated finish. You can put any amount of figure in light walnut with the above, following the present grain in the wood.—48 W.

[46876.] — **Circular Saw.**—Holtzapffel gives 900 revolutions per minute as the speed of saw, and estimates power required at 2 horse-power. To do satisfactory work, I have no doubt that quite that power would be absorbed. According to the American practice, the saw would make 2,000 revolutions per minute; 18in. is far too large for manual power; you will find 7in. or 8in. quite as much as you can manage comfortably.—Glatton.

[46877.]—**Wheel Skates.** — The wheels are mounted on "bogies" or T-pieces. The stalk of the T must slant as shown, so that, on leaning over to one side, the wheels on that side approach one another, while those on the other side recede from each other. A spring *a b*, which may be either of wire or indiarubber, is placed at each end of each T (making four springs to each skate), so as to keep wheels straight when not being forced out of that position. The wheels are of boxwood, I believe, and about 2in. or $1\frac{3}{4}$in. diameter, by $\frac{3}{4}$in. broad.—Glatton.



[46878.]—**Respiration and Ventilation.**—In all probability in the proportions given, the oxygen was supposed to be replaced by nitrogen.—Kappa.

[46880.]—**Analysis of Water.**—Five cells of trough battery described by "H. T. B." recently are sufficient to decompose water, and it is not difficult to make; a couple of pt.-tipped copper wires, a plain glass tumbler, and two test tubes will work the exp. as well as the most expensive piece of apparatus.—J. M. Stocks.

[46880.]—**Analysis of Water.**—The most suitable, and, in fact, only suitable, forms of batteries for electrolysis in a lecture-hall are the Grove or Bunsen batteries. You should use 4 to 6-quart cells if you want to obtain anything worthy of a lecture-table. To ignite the detonating gas by a "spark," you cannot use this battery alone. Generally the Leyden-jar is employed, which, in the absence of an electrical machine or electrophorus, could be charged with a glass rod. You could obtain the explosion, using the battery only, by following a plan similar to that described in answer to query 46727, but I hardly think it would answer your purpose.—Kauthack.

[46882.]—**Dynamite.**—The explosive force of this is no more downward than that of gunpowder. The force in each case is exerted in every direction; but gunpowder placed on a stone burns slow, and the pressure gently lifts the air, leaving the stone intact; but dynamite burns fast, and before the air is lifted the stone has received a blow which breaks it.—J. M. Stocks.

[46884.]—**Varnishing.**—Good oak varnish is suitable for newly-painted Windsor chairs; but Windsor chairs are seldom painted, they are generally stained, the backs and seats polished, the legs and rails varnished.—Anxious to Help.

[46888.]—**Astronomical.**—I have asked myself the same question when at Stonehenge, in Wiltshire, and should like to repeat "Neo's" query.—H. STOOKE.

[46888.]—**Astronomical.**—If "Neo" possesses a celestial globe he can easily find the "points in the heavens" at which the sun will be first seen on the days mentioned. On June 21st, when the sun's northern declination is 23° 28′, the point of the horizon at which he rises is 41° north of east, and on the same day the point at which he sets is 41° north of west. The length of time it takes him to describe this diurnal arc is about 16½ hours. On Dec. 21st, when the sun's southern declination is 23° 28′, the point of the horizon at which he rises is 39° south of east, and the one at which he sets is 39° south of west. This diurnal arc is described in about 8 hours. The rule for finding the above points by the globe is: elevate the pole to the latitude of the place, find the sun's place in the ecliptic, bring this to the eastern part of the horizon, and the degrees intercepted between the sun's place and the eastern point will be the rising amplitude, and the number of degrees intercepted between the point at which the sun sets and the western part of the horizon will be the setting amplitude.—A. MANOCK.

[46892.]—**Japanning.**—You require white-lead, thinned with turpentine only (no oil only what is in the white-lead as you buy it). Add any dry colour to required tint; give two coats, letting each dry, and then varnish.—48 W.

[46894.]—**Covering Silk Balloons.**—You should varnish the silk with a thin coat of varnish before sewing it together; wash the oil out with methylated spirit and turpentine, and then varnish with 4oz. benzoline, 1oz. boiled oil, ¼oz. indiarubber; this varnish will dry slowly in a week. Put on two or three coats of varnish as thin as possible.—J. SUTCLIFFE.

[46897.]—**Powerful Bichromate Battery.**—This form of battery can never be used for electric light purposes, as it is so far from constant. Grove's, Bunsen's, or Fuller's should be used.—KAPPA.

[46901.]—**Watts' Parallel Motion.**—The links, according to Molesworth, are usually ½-stroke of engine in length. I do not think that altering the length (unless made very short) would alter the path of middle point of link.—GLATTON.

[46903.]—**Electric Bell.**—Bend stem of hammer back until, when armature touches face of magnet (which should have a little varnish or a thin piece of paper over it to prevent actual contact with the metal), the hammer is about 1-32in. from the bell. The wire should be wound on core till the diameter of bobbin is 1⅛in.—GLATTON.

[46903.]—**Electric Bell.**—I expect your hammer does not strike near enough to the edge of the dome.—H. STOOKE.

[46903.]—**Electric Bell.**—I have had a good deal of trouble with a 10s. electric bell. The armature had been broken, and I thought it must be on that account. I read, in your journal, of the polarisation of batteries, and I thought my battery (a 3s. 6d. Leclanché) must be at fault, and I sometimes found it would work when I put on fresh wires, and then thought it was the fault of the connections. I doctored the battery, without avail; improved the connections by running the two line wires round the wainscot instead of under a carpet sometimes trodden on, and still the bell would only ring sometimes and variably. I finally unscrewed the electro-magnet and adjusted it to the armature in such a way that the bell rang perfectly directly the adjusting-screw touched the armature on the other side, and before any considerable pressure was brought to bear upon it—and now, notwithstanding that the broken armature is very stiff, and an old Leclanché battery is used, the bell rings constantly, perfectly, and invariably, and has done so for months, after some 18 months' bother over it.—L. B. B.

[46904.]—**Secondary Battery.**—My battery was made simply as an experiment, consequently, I used what came in handy. It consisted of three copper plates, each about 5in. by 4in., and two amalgamated lead plates the same size. The copper and lead plates were placed together alternately, being separated from each other by strips of ⅜in. wood, dipped in paraffin top and bottom; the whole were held in place by two strong indiarubber rings. The containing vessel consisted of a rectangular cod-liver-oil bottle with the neck cut off. The solution was saturated sulphate of copper, diluted with one-twelfth part of sulphuric acid. Having inserted the plates in the containing vessel, fill up with solution to within a short distance of the top; connect all the copper plates together by wires, also the two lead ones together. Procure two quart Bunsen batteries, connect them together in series, and lead a wire from the carbon terminal to the lead plates, and another one from the zinc to the copper plates, charge until the copper solution goes colourless. It is, in order to observe this, that you require the containing vessel to be of glass. Of course, you know what I mean by connecting the Bunsen cells in series—namely, the carbon of one is connected to the zinc of the other. It will be also as well to mention that there is no particular virtue in having two lead and three copper plates; one of each would answer quite as well if they had the same area. The vessel containing the sulphate of copper need not be any larger than necessary to contain plates. Further information with pleasure.—J. HEZMALHALCH, jun., Felliscliffe, via Leeds.

[46905.]—**Incandescent Lighting.**—These kind of cells will never be suitable for the electric light. See reply to query 46897.—KAPPA.

[46906.]—**Swiss Watch.**—You have got too much shake or play in your balance. Put a piece of paper under the balance-cock or bar behind the screw; keep slipping the piece of paper nearer the screw until the balance has no shake, then slip the paper gradually back again until the balance is free. If you are not successful, write again.—A FELLOW-WORKMAN.

[46906.]—**Swiss Watch.**—The "clinking" noise complained of by "Harris" may proceed from several causes, so that no definite one may be described. The bars of the "balance" may catch on the tips of the regulator pins, or may be against the hair-spring stud, or maybe the 'scape-wheel trips in the cylinder-notch or passage. Other faults may produce the noise. If the noise is intermittent, one or more teeth of the 'scape-wheel may be bent; if constant, then I should imagine the balance touches somewhere. To discover the fault, remove the movement from the cases, and hold it in all imaginable ways, examining the escapement at the same time, and so notice where the fault is located. The cylinder should have the barest amount of end-shake at the pivots: too much, one way or the other, will frequently bring about the fault complained of. A minute piece of tissue-paper placed under the end of the "cock" before screwing down will generally put the "shake" right if too great. If this is so, and the "shakes" are corrected, and yet the noise is heard, then examine at the pins and stud before mentioned. If at the pins, shorten them a trifle with a slip of Arkansas; very little may suffice. If at the stud, file a little off the face if it will not endanger the pinhole by doing so. Otherwise, the bars of the balance must be "bumped." Great care is required in "bumping," so, unless you have a light hand and hammer, don't attempt it. If you can ascertain the actual fault, I can the better advise you. The concluding query has been answered so recently as two or three weeks ago.—ALFOJOE.

[46909.]—**To "H. T. B."**—If you will advertise your address, I will send you a description of my gravity lamp, which is an improvement on the mercury regulator which I alluded to in my letter. I cannot publish an account of my lamp, as I find it would invalidate any subsequent patent, and I may wish to patent it. I guess by your query to Mr. Hawkins that you wish to make a cheap battery. If you will wait till next week, I will send directions for making quart Bunsens at about 1s. a cell. Of course these don't look much, but for power and constancy, they are equal to the most expensive.—H. T. (not S.) B.

[46910.]—**Calculating Watch Mainspring.**—Take an empty barrel, put in arbor: now, two-thirds of the space left in barrel should be filled up with spring, the other one-third is left for working space; also there should not be less than nine coils, and not more than 13. In cases of small lever-barrels, where the spring is very short, you must follow first rule.—A FELLOW-WORKMAN.

[46912.]—**Medical Coil.**—I have recently made a good one, though small, on a circular stand, reel 2¾in. in diameter at flanges, 3in. high, and core ½in. I do not care for the induced current for medical purposes, so I have no primary and secondary wires. I simply used ½lb. of No. 26 cotton-covered, wound evenly upon my reel, and had a piece of soft iron, ½in. diameter and 3in. long, with the usual contact breaker fixed over it upon the top of the reel. I regulate my current by means of a series of wires I have soldered to every third helix upon my coil, and terminating in a series of brass points, arranged in a semicircle on the stand, with a lever centred so as to reach them all in turn, so as to regulate the strength of the shock. If you like to make one on this principle, I shall be happy to furnish you with a full description of connections and sketches of general details. Mine gives a good result with one Daniell's cell.—FRED. WALKER.

[46913.]—**Stopping for Decayed Teeth.**—To "ALFOJOE."—In reply to "J. S. R." I must say I cannot imagine in what way his difficulty has arisen if he has used pure, or comparatively pure, silver and pure quicksilver. Possibly an excess of the latter has been used, or the two have not been sufficiently blended before packing into the teeth. The amalgam should be made so stiff as to be only just short of being hard. If an excess of quicksilver is present, I imagine it will not set. I mixed mine in the palm of my left hand with a penknife, and pressed out the superfluous quicksilver with my forefinger. The teeth cavities should be prepared before the amalgam is made, a piece of wool being used at the last minute to thoroughly dry the hollow spaces. The amalgam must be pressed with all possible or bearable force into the hollow. As I already have said, the nerves must be absolutely destroyed previously to using the amalgam. Dentists use a variety of stoppings, but I am acquainted with only a few of them. I think I am right in stating that one kind is made from a species of shell-fish. Where one's pockets are well lined with gold, the teeth may be "lined" with the same choice metal. This is packed in carefully in the form of "leaf." It is necessarily an expensive process, but is far the best, as, owing to the absence of chemical action from the acids of the mouth, no unpleasantness of taste is experienced. Reverting to the silver amalgam, let me add the silver should be an almost impalpable powder. Coarse filings will not do.—ALFOJOE.

[46915.]—**Die-Sinking.**—I never heard of any work on the subject, besides, it would be of very little use; the die-sinking has to be learnt by patient hard work. But for my reply in detail to a similar query, see last vol, No. 861, p. 72.—M.M.I.Sc.S.

[46917.]—**Raising Water.**—What natural source of power have you? Is there a stream, and what is its width, depth and velocity? It will be near enough to measure the latter by floating bodies, such as a stick or thin plank. See how long it takes to float, say, 50 yards. If a slow stream, could it be dammed up, and to what depth? Failing this, is there any small stream—a spring, for instance, the water from which could be collected in a reservoir and used to work a hydraulic ram? Is there sufficient wind to depend upon a windmill in your neighbourhood? What is your own notion as to the power most convenient to be obtained—wind, water, or steam? I conclude, from the wording of your query, that water is to be pumped along a horizontal pipe 70ft. long, and then up-hill through 40ft. of pipe, making 110ft. of pipe altogether? Is that correct? How much water should you want per diem? 20 gallons a man is a very usual allowance.—GLATTON.

[46919.]—**American Organ.**—Take the front board off and raise the swell by the knee-lever, and you will see the vibrators. Take a hook something like a crochet-needle, but much stronger, and place the hook in a slot in the vibrators made for the purpose, and draw gently.—W. H.

[46919.]—**American Organ.**—Either "B. M.'s" American organ must be an extraordinary one, or he has gone out of his way to make a mystery of what is very simple. If he will refer to No. 655, p. 117, he will see a section of the usual arrangement, and if he will then compare that with his instrument, he may succeed. The fact that the "person" from whom he purchased it (assuming he means a dealer) cannot tell him how to get at the reeds, would indicate that it is some extraordinary design; but, supposing it is not, let "B. M." take out the front slip in which the lock is placed; then, putting the knee-lever over, he should see the swell lift. If the stops are drawn, one row of reeds will present their heels to his delighted vision, and with a hook he can draw them out. For the back row it will perhaps be easiest to take out the back of the case—the upper part—and lifting the swell he will again see the reeds. Did it never strike "B. M." that a reed instrument must be made so that the reeds can be got at, and that—at least in so simple an instrument as his—it is scarcely likely makers give themselves unnecessary trouble? "Joiner's" sketch on page 219, has probably helped to open his eyes.—ORGANON.

[46919.]—**American Organ.**—Presuming that the instrument in question is a properly constructed American organ, there will be no necessity to remove the keyboard in order to get at the reeds. If the instrument contains two rows of vibrators, the front row can be got at by removing the board in front of the keys; then by raising the swell and drawing the stop which raises the mute, the ends of the reeds will be visible. They are then easily taken out with the reed-hook. The back set is got at by unscrewing the backboard, then raising the swell, which is controlled by the forte stop as well as by the knee-lever. Afterwards draw the respective stop and the ends of the reeds will be visible. American organ reeds, if made of good spring brass and firmly riveted, seldom require tuning. The reeds should be firmly secured to the blocks by two (not one, as in inferior organs) iron or steel rivets. An American organ is often condemned and thought to require tuning when it goes a little out of tune, which is caused (in ninety-nine cases out of every hundred) by the dust adhering to the reeds. In such a case as this, if the reeds are taken out and carefully cleaned with a piece of chamois leather, the proper tuning will be restored. I have in preparation a paper containing instructions how to rectify defects in American organs and harmoniums, which I shall send to the editor shortly. The reeds of an American organ should be taken out and cleaned at least once in six months. This will, to a great extent, prevent any muting of any particular reed.—G. FRYER.

[46921.] — **Organ or Harmonium.** — To "BETA."—If you had stated precisely what you required, it would have been easier to answer you; that is, the pitch, quality, and compass of tone. Do you want the half-rows for variety's sake? If so, put them on the top of the other rows, and save five-sixths of the labour involved in the channeling. But if you want the 16ft. tone throughout from the sub-bass, with another 8ft., you must place them at the back. Any reeds placed at the back, nearest the bellows, will sound loudest; that is why this position is favourable for sub-bass reeds. Some makers even place them so that they protrude into the mouth of the reservoir. Now, if you place channels under them leading to the other pallets, of course your present rows will have first chance of the wind, and that is where you would place a loud-voiced set if you wanted them; while the tone at the back would be much quieter. Get a few strips of wood, and make a specimen cell and channel for a sub-bass reed and satisfy yourself, for I do not think the loudest tone, even for sub-bass, to be always the best. When you have decided on channels, you had better cut grooves ⅛in. deep across the underside of your soundboard, to suit your new boards, and glue strips 1in. by ⅛in. in these grooves; then prepare another thin board, and having grooved it and cut the pallet holes, glue it on the channels. Failing this grooving, you had better prepare your strips ¾in. by 3-16in., and put them on with glue and a liberal supply of fine screws. I do not like the idea of parchment covering for the channels (rubber drill would be better), as the slightest leakage just here will cause the notes to run together and spoil all. Where the sub-bass reeds come you might make new pallets, and cut the pallet-holes 7in. long. If your bellows are the size mentioned (?) they should do; but why not put down a chord on the instrument which shall be equivalent to your intended alteration, and decide for yourself. As to altering or enlarging them. I should think it out of the question, as I am not aware that anything will compensate for lack of space, to say nothing about the patching which must be done.—JOINER.

[46925.]—**Water in Gravel-Pit.**—The well would be of little or no use in your case I am afraid. If you could hire a steam-engine and centrifugal pump, you would soon be able to pump up the water, but a channel of some sort would be needed to lead water away to river or some neighbouring pond. I am afraid, however, that if gravel-pit does not drain itself, the evil will still remain, and every shower of rain will help to fill it again. If you decide to pump it out, your best way would be to advertise for tenders for the job, and let some contractor do it for you.—GLATTON.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

46302. L. and S.W.R. Engines, p. 19.
46307. Barrow, 19.
46324. Shuttle Tongue for Paper Tubes, 20.
46326. Helical Epicycloids, 20.
46346. M.S. and L.R. Engines, 20.
46347. Indigo, 20.
46348. Strophometer, 20.
46353. Chemical and Other Action in Aquarium Fittings, 20.
46362. Cast Steel, 21.
46363. Turning up Cart-Wheel Axles, 21.
46367. Furnace, 21.

46558. Oil for Canvas Belting, p. 114.
46567. Micrograph, 114.
46571. Air-Pumps, 114.
46576. Embossing, 114.
46578. Roof Ventilator, 114.
46680. Governors of American Colonies, 114.
46581. Oxalate Development, 114.
46596. Sugar Boiling, 115.

Test for Mineral Acids in Vinegar.—Chiaffe gives the following as a test for mineral acids in vinegar:—The colour of a solution of Paris violet (methylaniline violet) is converted into ultramarine blue by even very dilute mineral acids, whereas organic acids do not alter the colour.

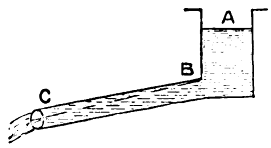
IN concluding a report on the collision that occurred on the 29th March at Stoke Station, on the North Staffordshire Railway, Colonel Rich says, "If this train had been fitted with continuous brakes, the collision would probably not have occurred."

QUERIES.

[46928]—**Diphtheria.**—To DR. EDMUNDS.—The following extract from a South African paper has reference to the cure of the above: "We can vouch for the efficacy of the following remedy for diphtheria. A few years ago, when this dreadful disease was raging in England, a very simple and rapid remedy for it was discovered by the celebrated Dr. Field. He put a teaspoonful of flowers of sulphur into a wine-glass of water, and, when well mixed, gave it as a gargle. Brimstone destroys every species of fungus in man, beast, and plant. Instead of spitting out the gargle, Dr. Field recommended its being swallowed. In extreme cases, when the fungus was too near closing to allow of gargling, he blew the dry sulphur through a quill into the throat; and, after the fungus had shrunk sufficiently, ordered the gargling, and he never lost a patient from diphtheria." As the subject is of great interest to many, would Dr. Edmunds kindly say if there are any pathological grounds for believing diphtheria to be fungoid in character, and if he is aware of the cases alleged to have been so successfully treated by Dr. Field?—H. NOLAN, Clifton Villas, W.

[46929.]—**Iron.**—Will some of your well-informed correspondents kindly tell me how I can get rid of iron, present in water in the form of carbonate? The plan I adopt at present is that of exposure to the air; but this process occupies about 10 days, with the water standing to the depth of 3ft. Without making costly alterations in my works, precipitation by boiling cannot be adopted. But it occurs to me that some scientific reader may be able to tell me how the iron may be otherwise rapidly precipitated without injuring the water for drinking-purposes? For such information I should feel much obliged.—TEN YEARS' READER.

[46930.]—**Hydraulics.**—Given a tank (see sketch),



a constant head of water being maintained therein at A, a pipe (truly cylindrical) issuing from, or nearly from, the bottom of the tank at B, and inclined at any angle from the horizontal line to outlet at C, the pipe to be of any length. Will the pipe be quite full, or only partially so, at the outlet C.? Some of my friends attempt to demonstrate mathematically that, by the velocity acquired by the flowing water it is "thinned down" somewhat as shown by dotted line in sketch, so that at the outlet C it only partially fills the pipe.—A. H. MOUNTAIN.

[46931.]—**Cuts and Bruises.**—Would some reader kindly tell me what would be the best thing to keep in a workshop to apply to cuts from chisels, saws, splinters of iron and wood, &c.? Also, a few simple directions on the treatment of cuts, &c. Perhaps Dr. Edmunds could give a short paper on the subject?—AN AMATEUR M.

[46932.]—**Telegraphic Engineering.**—Could anyone give me any information about the Government Inland and Submarine Telegraphic Service, or tell me where I could obtain it? I have consulted the *Civil Service Gazette* and other works, but find no mention of it. I have also written to the secretary of the School of Submarine and Military Telegraphy, No. 12, Prince's-street, Hanover-square, and have received a prospectus of the school. But there are one or two points on which I have been unable to obtain information. These are principally the examinations, the mode of entering the service, and the limits of age.—JAMES SHONE.

[46933.]—**Photographing Monuments in Cemeteries.**—To MR. F. WETHERFIELD.—Can the burial board of a public cemetery or their servants legally prevent a person photographing tombs and monuments in the cemetery, and can the relatives of the deceased person to whom the grave belongs object to its being photographed?—AMATEUR PHOTOGRAPHER.

[46934.]—**Jewelling Watches.**—Will "A Fellow-Workman" kindly say how watches are jewelled?—HALL.

[46935.]—**Electric Bells and Lightning.**—I have an electric bell in communication with a friend's house, the wires for which stretch from window to window across two gardens. For greater convenience in fixing on a short distance, I have used two line-wires—doing away with the return by earth. Is any risk from lightning to be apprehended? The wires run from the top window of the house at an elevation of about 45ft. If resistance coils are necessary, how should they be placed in the circuit, and also, what would be the cost of construction?—PRAGMATICAL.

[46936.]—**Steam-Launch.**—I should be very grateful if some kind reader of this paper would help me out of my difficulty. I am building a steam-launch 18ft. long, 5ft. beam. What size engine, double cylinders, also, size of boiler will be required to run eight or nine miles per hour? Are dome boilers best? What advantage has a steel boiler over iron? Also, any other information on the subject, which may be interesting at the present season.—MOONLIGHT.

[46937.] — **Oaths in Courts of Justice.**—My views on this subject are almost identical with those held by the Society of Friends. Can I claim (as a right) to make an affirmation, either as a juryman or witness? Or is it in the power of the magistrate or judge to refuse to permit me to do so? I am a Congregationalist—not a member of the Church of England.—T. W. W.

[46938.]—**Photography.**—Many thanks to all who have so kindly answering my many queries. Will Mr. Parkinson give formula he used to develop the rapid plate he exposed for 33 secs. on a waterfall? With a 20 times plate and much shorter exposure, using a very restrained developer, I have never obtained a neg. without fog if the exposure has been much over the usual length for such places. I should have thought a waterfall a bad subject for a prolonged exposure, as it is not stationary.—F. C.

[46939.]—**Eames Locomotive.**—To "E. W."—Can "E. W." or "R. N. H." give sketch and dimensions of tender of the above locomotives? Are not engines with single driving-wheels an uncommon type in America? Also, particulars of the brake used upon this engine?—E. E. R. TRATMAN.

[46940.]—**Sidebotham's Axlebox.**—Could any of "ours" give a sketch and detailed description of the above as used on the Highland, West Lancashire, and also on the Egyptian State and other railways? I have a prospectus of the above, but the description is far from intelligible.—C.

[46941.]—**Soap-making.**—I have been trying to make pale household soap, and would like to know if there are any instruments for testing the strength of the leys (made from caustic soda), say, such as rectifiers of spirit used to tell the strength of spirit? And also the meaning of so many degrees "B.," as in Spon's "Workshop Receipts"?—SVENSKA.

[46942.]—**Resistance of Ring to Collapse.**—Let an iron ring 8in. diam. be suspended from a chain. From the same ring, and at a point diametrically opposite the first chain, a weight of 13 tons is suspended. What is (1) the position of greatest stress? (2) The amount of bending moment at such position? (3) How the above are determined? (4) Diam. of iron of which ring is made, supposing modulus of rupture is 54,000in.-pounds per sq. in.? It seems pretty evident that there are four points (the top, bottom, and points on the sides of ring midway between these) at which the bending moment is edual and at its maximum. It cannot be taken as a simple beam. Nos. 2 and 3 are the questions I wish more particularly to have answered.—GLATTON.

[46943.]—**Sprain.**—Will Dr. Edmunds kindly advise me as to the following?—When using the muscles of my left leg (for instance, when climbing a rope) I feel an acute pain in the inside (meaning right-hand side) of the centre of my foot, which continues as long as the muscles remain stretched; and when they are relaxed, it gradually dies away. There is no swelling or redness, but it feels as if a small bone, or something of that was out of place. I believe it is a common thing with athletes, so I have no doubt your answer will benefit a good many of "ours."—H. J. L.

[46944.]—**To Mr. Lancaster.**—I am in a difficulty with my Leclanché batteries; I cannot make a good connection with the carbons and wire. I have tried melting on a cap of lead, but a very poor current is the result. I have also tried a brass clip with the wire soldered on; but the clip soon oxidises. Will you kindly help me out of my difficulty? How are the connections made on the batteries sold in the shop? They seem to be a cap of lead.—G. I. C. E.

[46945.]—**Leclanche Battery.**—May I trouble Mr. Lancaster, or some other kind electrical correspondent, for a little information respecting the above? I have had a few cells which have been giving a good current about three years, but they are now getting much weaker (all connections are quite perfect). Some of the porous pots are much worn. Will it be well to have new pots and recharge them? And also, is it necessary to go to the expense of fresh carbon blocks? Will they not do again, and how long? Should pure sal-ammoniac be used?—W. J.

[46946.]—**Gold Fish.**—I have a tank which holds about five hogsheads in my garden, made for keeping gold fish in. It is supplied with water that runs off the house during rain; but I find that the soot from the chimneys blackens it so much, that I am afraid the fish will be killed. Could some reader suggest a plan to prevent the above? How would it be to use a kind of filter? And how could I make one to take a stream of water about 2in. diam.? Also, would a filter take any of the properties of the water away essential to the fish?—ROSS.

[46947.]—**Lesson in Assaying.**—I shall be greatly obliged if one of your readers can recommend me a good practical book on assaying, both by the scorification method, and the crucible method. Or perhaps some of your numerous contributors would kindly give a few short lessons on the subject similar to those on the use of the blowpipe, by Mr. C. J. Müller in Vols. XXX. and XXXI., which were extremely useful to myself and, I doubt not, to many others.—J. L. WHITAKER.

[46948.]—**Resistance of Electro-magnets.**—I understand that the resistance of the wire on an electro-magnet should be half that of the whole circuit, including line wire and battery. This, of course, is for a single magnet. When there are two or more in the same circuit, what is the best resistance to give the coils?—GLATTON.

[46949.]—**Sodium Salts.**—Is there such a compound as sodium and hydrogen tartrate ($NaHC_4H_4O_6$)? If so, is there another name for it? Will caustic soda do as reagent as well as caustic potash, and are the reactions the same—*e.g.*, for producing a ppt. with a zinc salt which ppt. is soluble in excess?—W. G. WOOLLCOMBE.

[46950.] — **Composition Gas-pipe.** — Of what metals, and in what proportion is compo. gas-tube made?—A. PARKER.

[46951.]—**Papyrograph.**—Some time ago I saw a rapid process described for copying a number of copies of manuscript by writing on ordinary paper, then placing the paper written on in a strong solution of resin (colophony) in turpentine, then place the resinous paper in a strong solution of caustic soda, withdraw, and wash well with cold water, when you will have a perfect stencil of the writing. If any of "ours" have succeeded by this process, and would give strength of solutions, &c. to be employed, I am certain it would interest many readers of the "E. M." besides—DABBLER.

[46952.]—**Reaction.**—The other day I had occasion to mix a saturated solution of brine (NaCl), and a saturated solution of carbonate of potassium (both commercial), and I was surprised to find that the mixture became cloudy with slight fluorescence, and after some time yielded a white flocculent precipitate. Will some kind reader oblige me with the reaction which takes place, and, if possible, set the equation out ?—Glass.

[46953.]—**Pearl Ashes.**—Will Mr. Allen or other of your kind chemical readers inform me of the most reliable method of analysing pearl ashes for carb. of potash (K_2CO_3), and give full directions ? As I want the results not to differ more than 0·5% in the same sample.—Glass.

[46954.]—**Dividing Apparatus.**—I want to use as a worm-wheel to make a dividing apparatus like that described by "J. K. P." on p. 277, Vol XII., an ordinary cog-wheel of 14 gauge, 120 or 180 teeth, as it would be much lighter than the 10 gauge-wheel used by Mr. Joyce. If I used such a wheel, would "J. K. P." kindly say what pitch and dia. should my tangent-screw have ? My leading screw has four threads to inch.—F. W. Mackenzie.

[46955.]—**Elementary Optics.**—In a telescope objective, can the spherical ab rration be corrected, as is the chromatic, or can it only be reduced ? If corrected, upon what principle ?—E. P.

[46956.]—**Chronometer and Watch Rating.**—Is there anyone among your readers who can tell us how the rate of a chronometer or watch can be ascertained to the ·1 of a second ?—Chronos.

[46957.]—**Battery.**—I have a Bunsen battery, which I want to make use of for plating and gilding purposes. Will any reader kindly tell me how to proceed—i.e., how to make solutions, &c. ? Any information will be gladly received by an—Amateur.

[46958.]—**Half-chronometer.**—Will any practical reader tell me if there is any difference between the escapement of the above and that of an ordinary lever with an overcoil spring ? A description will oblige—Chronos.

[46959.]—**Marine Steam-Boiler.**—I shall be glad if any kind reader can give me a description of the best boiler most suitable for a small yacht to burn charcoal, and to be made of copper, in order to generate steam quickly ?—Dynamatic.

[46960.]—**Model Electric Lamp.**—I have one of the above-named lamps, made by Mr. J. Bathurst, of the Strand, which burns Reynier's carbons, and shall be glad if any kind reader can inform me whether I can produce the light from other means than the acid battery ; and as I have a small steam-engine, I should like to make use of it to drive some dynamo or other electrical apparatus to produce the light, which I am of an opinion that there is some other kind of generator. The engine is as follows: 1½in. stroke by ¾in. bore, slide-valve inverted with an extra large diameter heavy flywheel of iron. The boiler is of a vertical type, 8in. by 4in. dia. ; the shell is made of 1-16in. gauge iron, with copper firebox and copper crown of 1-12in. thick, and one flue, water space all round firebox ¼in., and well riveted, with which a great speed could be obtained. Also, please say what pressure the boiler is likely to stand with safety ? and oblige—Dynamatic.

[46961.]—**Battery.**—To Mr. Tolman or Others.—I have made a battery of three cells, carbon and zinc in sal-ammoniac, plates 5in. by 2½in. I soaked the ends in paraffin all night, and the paraffin has crept up the plates. All connections are properly covered with paraffin wax. The battery will hardly ring when joined close up to the bell, and not at all through the bell circuit. I think it is the paraffin in the plates. How am I to remedy this, please ?—Bell.

[46962.]—**Stereoscopic Camera.**—Will Mr. Lancaster or some other reader kindly give me instructions how to make a steoroscopic camera ? Also, how to take views with same ?—Stereo.

[46963.]—**Astronomical.** — I have been reading "Astronomy Without Mathematics," and am puzzled with one or two statements. 1. It says (p. 45, sixth edition), speaking of the motion of the earth : "the addition of the rotation velocity at night, and the loss of it by day, about 1,000 miles an hour at the equator, is much too little to be perceived, and the change is also very gradual." Now seeing that it is always day somewhere on the earth, and always night, how is the above passage to be understood ? 2. On p. 125, "though the moon goes round the earth, it is no less true that the earth goes round the moon, only in an orbit as much smaller, as the earth is heavier—that is, 81·5 times." And on p. 522, "The earth revolves every month round the c.g. of the earth and moon, which is 2,895 miles from the earth's centre." I cannot understand the earth revolving round the moon, except in appearance to anyone stationed at the moon. Will someone kindly explain ?—Gimel.

[46964.]—**Soluble Oil.**—There is an article used by finishers called soluble oil, one variety of which seems to consist largely of glycerine ; the other is a kind of liquid soap, and smells of castor-oil. Can any of your readers give me any information as to how these are made ?—A Finisher.

[46965.]—**Pianoforte.**—Will any kind reader inform me the best way to prevent the rusting of wires, and to stop it ?—W. H.

[46966.]—**Balance-springs.**—To "A Fellow-Workman."—Sometimes when cleaning workmen's watches, I find spots of rust on the outside coil of balance-spring. What should be done with these to prevent the rust from spreading. I sincerely hope you will continue your articles on "Watch Cleaning and Repairing."—Revel.

[46967.]—**Coin Brooches.**—To "Alfojoe."—I want to make some coin brooches in various patterns. How are the coins to be held in position while soldering ? Binding-wire is out of the question, as the coins are so thin.—Revel.

[46968.]—**To Dr. Edmunds.**—I have a sister, aged 27, suffering from the following symptoms :—About 15 years ago she had a disease supposed to be nettle-rash, that came out out over her body, more particularly at the change of the weather, until the last five years, and was under doctors' hands ; but they did her no permanent good. Now and again a single blotch will come out, causing considerable heat in that spot, and giving a little relief for the time. At other times heat arises in the face, causing it to look a purple red, relieving dulness, &c. Costive at times ; nerve and brain affected, and blood seemingly stagnated.—J. Denvers.

[46969.]—**Railway Curves.**—Will any engineering correspondent, or preferably the able "M.I.C.E.," who dealt with letter 45268, Vol. XXXIV., week ending Nov. 25th, 1881, work an example out for me by the formulæ $a = c / \pi r . 908$, take radius of curve 40 chains, also 100ft. —J. Denvers.

[46970.]—**Grain Dresser.**—Would any reader give me a few hints on the construction of a grain dressing-fan ? A sketch would greatly oblige—G. G.

[46971.]—**Soluble Essence of Lemon and Cinnamon.**—Would any of "ours" give me the process whereby the oils of the above are rendered soluble in water ?—Chemist.

[46972.]—**Cheap Form of Voltaic Cell.**—I have constructed one of the above after the following manner —viz., a tin can capable of containing 3lb. of preserved fruit, porous pot 5in. high by 2½in. dia. (taken from an old form Leclanché cell), piece of new zinc 4½in by 5in. made into a cylinder ○, but the edges not touching each other, copper wire soldered thereto, and passed through a cork to allow of pot being made airtight, pot placed central in tin can, and space between filled with clean cast-iron borings, just made damp with purified caustic potash solution, supplied me by a chemist as suitable to supply the place of commercial potassium hydroxide. All joints are soldered ; but it fails to ring a bell formerly worked by four quart Leclanché cells. Will someone kindly say cause of failure and remedy ? Also, please say what steps to take with reference to the Leclanché, which have also failed to work ? Also, how can I tell if a battery is passing a current in the absence of any electrical appliances ?—R. A. G.

[46973.]—**Musical Shorthand.**—Will any reader of the "E. M." inform me if there be a book on writing music in shorthand ?—Phonographer.

[46974.]—**Horizontal Escapement.**—To "Thirds Practical Watchmaker."—Will you kindly tell me what the three dots are for near the balance in Swiss watches, and what you mean by the "draw" or lift in horizontal escap. ? I know it means two different things in lever escaps. I never knew that horizontal escap. had "draw." I always thought they had a "driving" action. Also, if he recommends anyone to press on watch wheels with pointed tweezer ? I use a cut peg. Will he give me a few hints ?—Working Blacksmith.

[46975.]—**To Dr. Edmunds.** — Having been troubled for the last six months with the gravel, I shall be thankful for information which, even if it does not cure, may relieve me. I am 61 years old. Corpulent ; in other respects enjoy good health, and an abstainer for three years.—A Welshman.

[46976.]—**Canary.**—Can any of your readers tell me the best remedy to employ for a canary suffering from asthma ? Every night the respiration of the little wee thing is visibly painful, and the bird gasps and opens and shuts its mouth, and apparently tries to cough. The sufferings are increased by being in a room where gas is burning. In the morning and during the day the bird is cheerful, and sings freely. Food at present : the usual rape and canary with a little maw seed occasionally, a little lettuce or watercress ; have found a little condensed milk a benefit, but not a cure. Will those having experience with birds give a little information ? as the one on whose part I venture to ask for a few crumbs of ease and comfort, is a general favourite.—R.

[46977.]—**Folding Canoe.**—Can any contributor kindly let me know the particulars for making a folding canoe ?—G. J. H.

[46978.]—**Canaries.**—I have had five nests of young canaries this year, about 15 birds. They live from six to ten days, and then die. Will any reader tell me what they think is the cause ? I think the old birds neglect feeding them. I also, like "Old Subscriber," would like a few hints about cayenne feeding.—Merton.

[46979.]—**Etching.**—Will someone oblige by giving some hints on etching on copper and steel plates ?—Rogator.

[46980.]—**Brakes.**—I should be obliged if any correspondent will tell me what brakes are about to be tried upon the Highland (North of Scotland), and Lynn and Fakenham Railways ? Also, should be glad of any details of trials said to be made by the East Lancashire Co. some years ago ? What is the Fay, Newall, and Eames brake, mentioned p. 109 ?—A Driver.

[46981.]—**Verge Turning Collet.**—Will "Fellow-Workman," "Alfojoe," or any other horological reader of the "E.M.," tell me how to make verge turning collet, with sketch of same ? Will it be proper to have it, when on verge, projecting a little beyond foot-pallet to keep pivot-file from coming in contact with pallet when reducing pivot ?—Poor Hand.

[46982.] — **Colouring Screw-heads — Clock cases.**—Will any reader describe the colouring or blueing pot for screw-heads, &c. ? Also, a few hints on the way of making Vienna or American clock-cases.—Steadfast.

[46983.]—**Concrete Bed for Engine.**—I am fixing a new horizontal engine, which will require a bed 3½ft. by 12ft. by 10ft. Would you advise me to make it of concrete ? If so, how should I prepare the concrete ?—Desoridi.

[46984.]—**Hardening Copper.**—Is there any way of hardening or "case hardening" copper ?—Jacques.

[46985.]—**Gilding the Edges of Mounts.**—I have had gilt paper recommended, with the back covered with common gum, and cut into narrow strips and put round the edges. I have tried this way, but I find it very difficult to make stick and lie down evenly. Will some kind reader of the "E. M." inform me which is the best way to gild the edges of mounts, and what is the best composition to put on the back of gilt paper to make it stick and lie down evenly ?—E. L.

[46986.]—**French Locomotives.**—To Mr. Gobert. —Many thanks to Mr. Gobert for his interesting and exhaustive answer to my query. If not troubling him too much, I should like to know whether the Crampton engines, formerly the standard Continental type, are now in general use ? And whether the sketches given in his letter represent the present standard type of French locomotives ? Also, are the inside or outside cylinder engines in most common use, and are single driver engines unused ? Could he also give me a sketch of one or two tenders of the above engines ?—E. E. R. Tratman.

[46987.]—**Tinning or Bronzing Small Malleable Castings.**—I have several hundred small malleable iron castings to tin, or apply a good bronze of a bright brass or copper colour. Can any of your readers direct me in the right channel ?—A. C. Meeker, 321, Larimer-street, Denver, Colo., U.S.A.

[46988.]—**Straightening Shaft.**—Will any of your mechanical readers say how a shaft can be straightened, 2½in. dia., while in its bearings ? and oblige—Wm. H.

[46989.]—**Stoppage in Urinal Pipe.**—Two urinals are used by about 40 persons. The down-pipe for 3ft. is straight down perpendicularly, then passes along the floor, and is 2in. clear in the bore. A small quantity of water is running day and night. Spirits of salts are used now and again to keep the pans in good colour, and once a week two buckets of hot water and soda are passed down. In spite of all this, in 12 months the down pipes close right up with a hard gritty matter. What can be done to stop this ?—J. E. Bird.

[46990.]—**Ship's Compasses.**—Will any friend state the most effective method of magnetising the bars of compasses that do not act ?—the appliances required, where they may be had, and how to use them, and oblige—Horo.

[46991.]—**Wages—Legal Query.**—A man enters employment as foreman engineer in shop, and to serve employer's interest, foregoes payment of wages weekly, works from time to time as required until amount due is about £25. Then applies for payment, and is flatly told that wages are only payable weekly, and unless so paid are not recoverable.—G. H.

[46992.]—**Organ Query.**—Will Mr. Dresser kindly tell me how to arrange a small organ (two manuals and pedal), so that I may build it without runners or castors, and yet be able to get at the key-action and windchest of the swell without taking the whole thing to pieces. Bellows and great soundboard are made, but building-frame not yet put together ; so a hint would be very useful indeed. What is the least space advisable, or allowable between top of swell keys and bottom of great windchest for proper working of backfalls and six rollers ? Also, how much space between under side of great keys and top of bellows (when full) is needed for a set of gt. to ped. backfalls ?—W. C.

[46993.]—**Consumption and Homœopathy.**—Could any of your correspondents inform me of a dispensary or hospital where consumption is treated by Lachnanthes, or is Lachesis the same ? If not, what would be the best homœopathic remedy to take ?—A Sufferer.

[46994.]—**Brass Door-plates.**—Will "Jack of All Trades" kindly inform me of the nature of the compositions, red and black, which are used in making and filling up letters in the above articles ? Is the composition run in hot, or is the plate alone heated, and then all faced off after the filling up ?—Alfojoe.

USEFUL AND SCIENTIFIC NOTES.

A paper was recently read before the South Staffordshire Institute of Mining Engineers, at Dudley, on "Lishman and Young's Patent Air Locomotive," by Mr. Henry Lawrence, of the Grange Ironworks, Durham. The engines, it was stated, were specially adapted for underground haulage, owing to their small size and the perfect control which the driver had over them. Incidentally Mr. Lawrence mentioned their use in fiery mines, and showed how a patent metal had to be used to prevent sparks from being emitted from the wheels when the engine surged at an incline. He submitted for the consideration of the members —(1) Whether sparks would fire gas in a pit, and (2) whether copper rammers were therefore safe, inasmuch as copper could give off sparks. The Government allowed copper stemmers and rammers, and yet these gave off fire upon being struck.

The *Lumiere Electrique* says the experiment has been made of lighting a Rhine steamboat with electric light, and it is proposed to organise a night service of boats lighted by Buergin machines and lamps, which are to be powerful enough to throw from the bows a light that will illuminate the immediate scenery.

Every Workman connected with the Building Trades requiring a situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden London, W.C.

"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

Every Workman should insist on seeing "THE BUILDING NEWS" every week at his Club or Coffee House. He will find more "Lists of Tenders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Intercommunication" if he wants to know anything about his trade ; to write to the Editor if he has any suggestions to make and to advertise in the paper when he wants work.

The charge for Advertisements for Situations is One Shilling for Twenty Words, and Sixpence for every Eight Words after.

CHESS.

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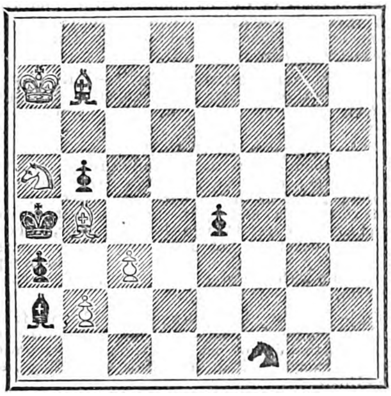
ALL Communications for this department must be addressed to the Chess Editor, at the office of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCXLVII.—By C. CALLANDER.

Black.

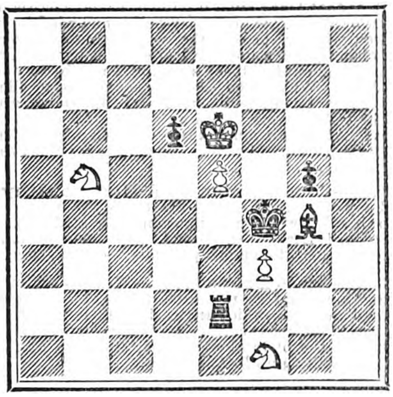


White.

White to play and mate in four moves.

PROBLEM DCCXLVIII.—By H. F. L. MEYER.

Black.



White.

White to play and mate in three moves.

SOLUTION TO 743.

	White.	*Black.*
	1. R takes Kt	1. K takes R (a)
	2. K to K 2	2. K moves
	3. Q mates accordingly	
(a)		1. K to Q Kt 6
	2. Q to Q Kt sq (ch)	2. K moves
	3. R or Q mates	

SOLUTION TO 744.

White.	*Black.*
1. B to Q Kt 7	1. Q takes Kt, R takes B, or P moves
2. Q to K R 7 (ch)	2. B takes Q mate
	1. Q takes R
2. Kt to K B 7 (ch)	2. B takes Kt mate

NOTICES TO CORRESPONDENTS.

SCHMUCKE.—Your solution of 743 is incorrect, for if 1. $\frac{}{\text{Kt. to Q B 6}}$ 2. $\frac{\text{Q to Q 7}}{\text{K to Kt 6}}$. In 744 you have overlooked that if 1. $\frac{}{\text{P-Q 3}}$ 2. $\frac{\text{Q-K R 7 (ch)}}{\text{R takes Q}}$ is not mate, as Kt can take R.

H. F. L. M.—Thanks for enclosures. We will endeavour to see about notice as soon as possible.

W. T. P.—The second game shall be inserted shortly.

H. E. KIDSON.—Thanks for the sui-mate.

Holloway's Ointment and Pills are remedies designedly placed within the reach of all sickly persons, because the treatment is easily applied, certain in its effects, and perfectly innocuous to the most delicate constitution. For all chest complaints, this Ointment rubbed briskly over the ribs night and morning gives ease, and prevents bronchitis, asthma, &c.

ANSWERS TO CORRESPONDENTS.

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⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or requies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, May 17, and unacknowledged elsewhere:—

F. W. GREENE.—J. Mounsey.—R. Keith.—Fellow Workman.—J. Parkinson.—F. H. Wenham.—Glatton.—Fred. Walker.—Kautback.—Anxious One.—Ignorance.—Clyde.—F. White.—Volvox.—J. Henshall.—Perthshire Farmer.—J. B. S.—H. T. B.—Ready.—R. R.—J. H. Huxley.—J. R. Brown.

ENQUIRER. (In the absence of any special agreement, yours is a tenancy from year to year, and you are entitled to six months' notice from your landlord, terminating at the time of year at which you took the house.)—READER. (We cannot advise you, as you do not say which branch you propose to enter. We believe Cassell, Petter, and Galpin publish a guide to the Civil Service containing information likely to be of use to you.)—QUIZ. (An air-tight window is what you do *not* want. You require more ventilation in your window, and then the nuisance complained of will cease.)—ANTI HUMBUG. (Your proper course is to sue the company; but you will probably be throwing good money after bad. They are evidently quacks.)—THOMAS PARTRIDGE. (Small quantities could probably be supplied by any of the dealers in microscopic objects who advertise in our "Sale" columns.)—W. HAUGHTON. (We know nothing of the present whereabouts of the person mentioned. We have had similar complaints about him before, but in every case but one, the persons got their goods after more or less delay, or were satisfied by his explanations. We cannot be responsible for the bona fides of correspondents or advertisers, and we advise you and all other readers to adopt the same rules, with regard to business transactions, with contributors to these columns, that you would put in practice in dealing with any other tradesman, or, at any rate, if you see fit to depart therefrom, not to blame us for the result.)—J. C. A. (We do not know of any special works on the subject; but there are lengthy articles in such books as Payen's "Industrial Chemistry" and Ure's "Dictionary.")—ALFRED MEAGER. (Better put the question privately, as it is of no interest to any one but yourself.)—A LANCASHIRE LAD. (Both are correct.)—J. M. (There is no such thing, but you will probably find what you want in No. 801, p. 497. The simplest device is a cistern above the level of the tank. 2. No doubt some of our advertisers would put them in order for you.)—A NEW SUBSCRIBER, Sheffield. (No, a nickel-plating tank should be lined with pure sheet lead, the joints being burned, not soldered. 2. Would not do at all; the copper solution would attack the iron. 3. Look through recent back numbers, or write to the correspondent direct. He advertises castings.)—G. A. MOORE. (We are obliged for your letter, but it scarcely forms a reply of the kind asked for.)—AN AMATEUR M. (Make a size from best white gelatine.)—P. C. (You can introduce the mercury through a glass funnel properly shaped, and small enough to enter the tube.)—NOVICE. (No, certainly not. It is suitable for plating purposes, not for lighting.)—THOMAS H. ROBERTS. (The resistance in wires is directly as the length, and inversely as the sectional area. A thick wire, therefore, offers less resistance than a thin one. 2. Both actions take place, but under any circumstances lightning-rods should be pointed. See article last week.)—J. L. M. (Voss's induction electrical machine was fully described and illustrated on p. 335, No. 846. See also pp. 405, 429, 453, Nos. 849, 850, 851.)—THOS. RICHARDSON. (Messrs. Ritchie, of Edinburgh, we believe, publish a pamphlet descriptive of their system, which was illustrated and described in Nos. 464, 465. If you will look through the indices you will find references to various plans and systems of synchronising clocks.)—JAS. THOMSON. (We presume you mean the Berliner violin. See pp. 256, 303, 336, 355, 404, 475, 547, 568, last volume, especially p. 568, No. 882.)—R. BARRACLOUGH. (You do not give the cubic content of your house, nor the temperature you require to keep it at. The arrangement depicted "will do" for a greenhouse, but we should prefer hot-water pipes. How can we give any idea as to cost without knowing price of gas in your district and the temperature that it is desired to maintain. If you cannot refer to back volumes, procure a sixpenny book on heating greenhouses from the office of the *Journal of Horticulture*, Fleet-street, E.C.)—WIFE OF NEW SUBSCRIBER. (For description of the processes of painting on terra-cotta, see pp. 73, 141, Nos. 861, 864.)—W. G. WOOLCOMBE. (Yes, two names for same thing. 7. Solution of washing soda, potash, or ammonia, benzoline, bisulphide of carbon, turpentine, &c.)—ODINE. (Such a query must appear in the "Wanted" column.)—ARIA. (Such information is not available: it must be calculated. You may find something in papers read before the different engineering societies, and also in articles in our back volumes. See the indices of recent volumes.)—SEFTON. (It is simply impossible for any one to say "what is wrong" when you do not describe the arrangement. From what you say it would appear that the battery is not strong enough, but we have no idea where you place the carbon. 2. See recent numbers for replies to the second query.)—ALASKA. (Probably produced by the friction of the particles of steam, but we are in doubt as to what you mean.)—A GLASGOW READER. (Use solution of indiarubber, made by dissolving in bisulphide of carbon or mineral naphtha.)—ELECTRICIAN. (If you will look through the last ten volumes you can take your choice of a great variety of telephones. The ohm is the unit of resistance, and for all practical purposes may be taken as the resistance of one foot of copper-wire 3·117 mils. thick. The zinc is the positive element, and the wire from the carbon the positive pole.)—A. W. REED. (In the first number of this volume, p. 5.)—CALEDONIAN. (Every portion of the "bends" must be above the level of the pipe where it returns the water to the boiler, for if any part is below, water will accumulate. The whole system of pipes being above the level of the inlet to the boiler, the pressure will be equal, and the water finds its way back by gravity.)—J. ELYOT. (Any ordinary closed stove, with a pipe leading into chimney.)—H. D. (Tinplate will do, but pewter lasts longer. Salt and ice will do for freezing mixture, or you can use one of those given on p. 546, No. 646.)—NEW BEGINNER. (You should look through the indices. There are many in back numbers. Perhaps that on p. 404, No. 875, will suit, or one on p. 496, No. 879.)—W. P. (See the index to Vol. XXXIII., under head Hard Soldering, &c. Both questions frequently answered lately. For whitening, heat to a good red, and boil in a mixture of sulphuric acid 1, water 40.)—W. H. (See pp. 469, 493, Vol. XIII., and pp. 425, 567, 592, Vol. XXXII. Vulcanite is a preparation of sulphur and indiarubber, which becomes hard when subjected to heat and pressure.)—CHURCHMAN. (It would occupy too much space to explain the differences in construction. They have been adopted with the view of obtaining the best results. No, to the other questions. For the chair-covers, see p. 194, No. 840.)—VILLIGE BLACKSMITH. (Your communication is incomprehensible.)—G. M. B. (Sprague's "Electricity," published by Spons; Thompson's "Electricity and Magnetism," Macmillans. 2. We do not know of any works on the other subjects.)—GRAVER. (You should fill up with asphaltum varnish or with copal and lampblack worked thick. We know of no book specially devoted to the subject.)—LONG TOM. (An ordinary forge will do; the dimensions are immaterial. See pp. 73, 95, last volume.)—J. T. C. (Give up drinking and smoke less, and consult a medical man *at once*, or very probably you will not have need to do so.)—A MOTHER. (Try the application of pernitrate of iron. There is no *quick* cure. 2. The application of a little vaseline will soon remove the roughness complained of.)—J. W. (You must be a very recent or very irregular reader if you have seen no account of the Crystal Palace Electrical Exhibition in these pages. See pp. 509 and 609 of last vol., and p. 23 of this. Many others are as desirous as yourself of obtaining a small cheap and effective dynamo-machine. The difficulty is the combination of these requisites.)—E. B. L. (Possibly the waterproof blacking given on p. 69, Vol. XXX., would suit you, or here is another, which, however, we have not tried: Mix intimately together three or four pounds lampblack and one half-pound of burnt bones with five pounds glycerine and five pounds syrup. Then gently warm 2½ ounces of guttapercha in an iron or copper kettle until it flows easily; then add 10 ounces of olive oil, and when completely dissolved, one ounce of stearine. This solution, while still warm, is poured into the former and well mixed. Then add five ounces gum senegal dissolved in 1½ pound of water and ½ ounce of lavender or other oil to scent it. For use it is diluted with three or four parts of water. It is said to give a fine polish, to be free from acid, and that the glycerine keeps the leather soft and pliable.)

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The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, MAY 26, 1882.

ON WIRE CHUCKS AND SMALL SCREWS FOR METAL-WORK.

By F. H. WENHAM.

THERE are now several workshops established in this country, devoted entirely to the construction of small screws of every size and description, made either of brass or steel, for watch, clock, and philosophical work, and therefore manufacturers in these lines seldom find it worth while to make for themselves, as they are obtained at a very low price from those who have the proper machinery, and make a speciality of the business.

It sometimes, however, happens that the amateur constructor requires a number of particular screws, all of one pattern, and would prefer to make them for himself. My object in writing this article is to offer some information that may expedite their construction by means of the ordinary foot-lathe.

FIG. 1

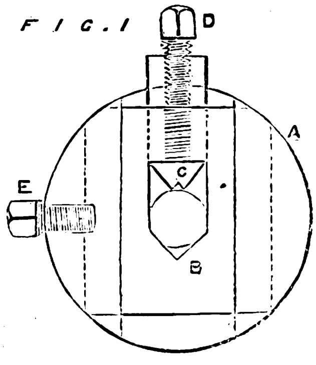
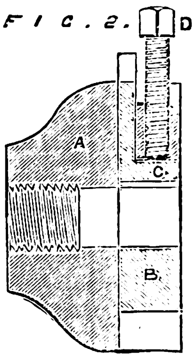


FIG. 2.



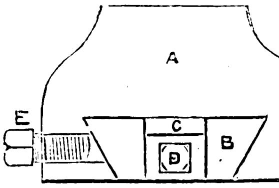


FIG. 3

FIG. 4.

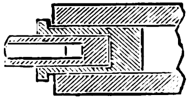


FIG. 5

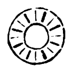


FIG. 6.

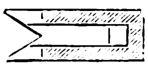


FIG. 8.

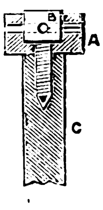


FIG. 7

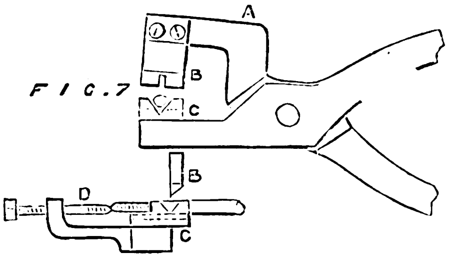
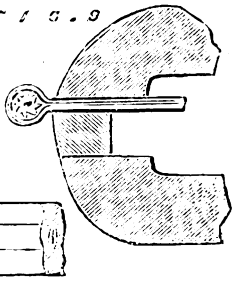


FIG. 9



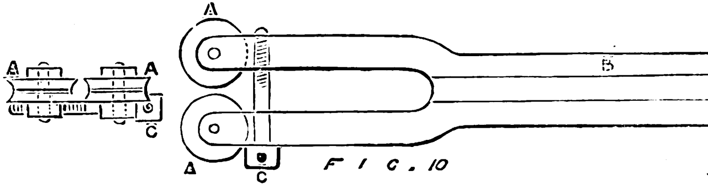


FIG. 10

The first part of the question relates to the chucks for holding the wire. The old-fashioned "die chuck" consisting of a pair of dies sliding in a dovetail block, and brought together by two opposite screws, is well known: this is strong, simple, and enduring, but rather limited in its range for different sizes of wire, so that several chucks are required. The American scroll and other wire chucks are more universal, but too refined for the rough and constant use of a busy shop, and when they do give way, no amount of patching will renew their strength; in fact, effective repair is almost impossible. I am cognisant of one large workshop that a few years back was liberally provided with these chucks of various sizes, not one of which is now in use: they have all broken down.

I visited a manufactory in Paris where they made nothing else but screws for metal-work, and I there noticed a form of wire chuck in use which seemed both strong and enduring, and as it may not be generally known to the readers of this journal, I give a description. Figs. 1, 2, and 3, are a front view, section, and plan. A is the body of the chuck made of cast-iron, and screwed to fit the mandrel; a transverse dovetail groove is cut on the face, into which is fitted the sliding steel-block, B; a hole is cut clear through this of the form shown in the front view, and at the back of the slide a square-sided groove is planed out to meet the through hole. This admits the parallel tail-piece of the steel angle-jaw, C, the short end of which is made flush with the face of the chuck. The notched apex of the chuck is hardened and tempered, as is also the lower portion of the sliding block. All these pieces should be nicely fitted without shake, and made so that the opening and sliding jaw falls true in the centre line. The work is clipped by the screw D, tapped through the sliding block B, and bearing on the back of the jaw C. The chuck as shown (half size) will take in a ⅝in. rod down to a 1-16in. wire. Of course, if the chuck is made true, the wire is always clipped true across the centre in one line; to bring it true crossways, the slide-block B is shifted to the point required, and clamped fast by the side-screw E. The adjustment for one size, therefore, always remains exactly in the centre. The grip action comes close to the face of the chuck; all the slide bearings are broad, and consequently the chuck is strong and stands wear well.

Small screws are most frequently made by shifting a short piece of wire forward each time in the chuck, and regularly turning them up one by one; but unless the mandrel is bored throughout (which every mandrel should be), the process is a wasteful one, besides taking up much time.

The following method of working up long pieces of wire into screws is preferable, as by it they can be made very expeditiously. The length of wire is held fast at the mandrel end by a wire chuck. A brass plug *a* is fitted into the sliding socket B of the shifting centre. Into this brass is driven centrally a hardened steel tubular cutter of the form Fig. 4. The hole in this cutter is drilled out to the same diameter as the barrel of the intended screw, and the projecting end of the cutter is filed into radial notches (Fig. 5), with sharp edges—this is for square-headed screws; but if the screws are to be countersunk, or have angular heads, the end of the cutter is to be filed across with a small triangular or "three-square" file in two directions, at right angles (Fig. 6); this will carry four cutting edges from the circumference down to the bore, and form the chamfer required on the underside of the head of the screw. The bore of the cutter should be deeper than the longest screw to be made, as the proper length can then be obtained by dropping in short plugs of steel wire, more or less according to the length required for the work.

The mode of procedure is as follows:—Bring the cutter up to the chamfered end of the wire by sliding the loose head along the bed of the lathe by hand-pressure. A few turns will shave off the metal till the point of the wire butts upon the stop-piece in the bore of the cutter. Slide back the head, stop the lathe, and turn the reduced end of the wire into a screw-plate held in the hand. When screwed up sufficiently, run the plate off by reversing the lathe. The next thing to be done is to cut off the piece behind the head to the exact length of the screw. For this purpose the following form of cutting nippers is needed. A (Fig. 7) is the end of the instrument, representing a stout pair of pliers (a pair of leather punching pliers may be converted into this tool). On the side of the upper jaw is screwed a hard plate of steel B, chamfered at an angle of about 60° at its lower edge. C is a block of steel attached to the lower jaw of the pliers, having a V-groove cut across it transversely. This block is notched across where the upper cutting plate falls, so that its edge may reach near the bottom of the V-groove. When this instrument is nipped upon a rotating wire a piece will be cut off with a flat top, leaving a chamfered end on the stock wire exactly true with the outside, so that when it is again entered into the tubular cutter the barrel of the screw will be cut concentric with the exterior. The edge of the cutting nippers will do its work if left plain; but it is better to make a saw notch in it exactly in the centre of the V-groove.

The length of the screw cut off, inclusive of the head, is determined by a set or stop screw, tapped through a spring nut at the end of the V block. It will be seen that by this method the blanks may be made very rapidly. The longest part of the time is taken up by the screwing. This might be expedited by using clam dies set in the end of a pair of nippers to be opened as soon as the screw is run up to a sufficient length. The lathe need not then be stopped during the process of screw-making.

A common way of making the notches in the heads of these screws is to drill a hole through a plate of brass or steel the size of the barrel of the screw, and then drill another into this to let in the head, which should sink below the top of the plate. A saw-cut is taken diametrically across, deep enough to limit the bottom of the cut in the screw-head. The screw is dropped in, and a few strokes of a fine-tooth saw is given down the cut in the plate till the teeth come to the bottom; it is better to make the saw-cut across the piece of metal before drilling it through, as then a small drill fitting the cut is sure to carry the hole midway in the centre, in which the larger or gauge-drills will follow.

If the screws are required to be capstan-headed, such as are much used in philosophical work, the cross holes in the head should be made with the following tool (Fig. 8). A is a hardened circular steel block, with a central cavity, B, to admit the head and shank of the screw. Two cross holes are drilled diametrically through the block; the projecting end of the screw passes through, and is held tight up in place by means of a tapped piece of brass rod, C, below, which serves as a handle. The use of the instrument is this: the screw thus firmly secured is drilled through the head at right angles, by passing a drill running in the lathe into the hole on one side of the block, which it nearly fits, and forcing it up by the centre set in the opposite end of the hole; it is best to carry the drill only half-way through the head, and finish by reversing the handle, as there is then less chance of injuring the drill or work.

In the absence of the foregoing arrangement, another method may be mentioned for working up a piece of wire into screws without any trouble about centring. In place of the iron T-rest, insert a turned cylinder of hard wood in the socket; file a V-notch across the top of this wood; secure the end of a wire, the diameter of the head of the required screw, on to the mandrel, by screwing it into a piece of metal, or otherwise, and lay the other end of the wire into the V-notch, bringing up the centre as a pointer, to show that the wire runs in the axis; if not, raise the wood in the socket, and shift this crossways till it does, then clamp fast; hold the wire down hard into the groove by means of a flat piece of wood with a hole in it, for the wire to pass through. This, of course, is held down close to the V-cylinder on the side next to the mandrel. A graver is used overhand for forming the barrel, trimming the head, and cutting off the screw after the thread is cut, the top of the wood itself serving as rest. This simple cylinder of wood is most useful for pointing wires, turning the ends, or sinking the centres for drilling up. This kind of work is generally too small for the cone-plate as usually supplied with every complete lathe, but it may often happen that the V-groove is not sufficiently rigid, or the form of the work will not allow it to be used, such as in forming a point or pivot, or in drilling up a piece of pinion wire. In this case, take a narrow strip of sheet-brass, bend it round the pinion wire, and pinch it close in at the neck; clamp the end down over the top of the T-rest by means of a cramp or hand-vice, as shown by the sketch, Fig. 9; leave as much of the end of the wire projecting as may be required to work upon, using the ordinary graver as a turning tool. If, however, the wire is to be drilled up, it need not project.

Oftentimes vast numbers of wires require to be screwed up a considerable distance, for the construction of some instruments, such as piano-work: it is important to effect this rapidly without any strain that will cause the wire to bend or twist. The following form of dies will effect this at one fixed cut, however deep the thread or coarse the pitch may be. A A, Fig. 10, are two circular pieces of steel similar to a pair of milling wheels, set so as to rotate freely in the ends of a forked steel holder B; this is split up and slightly elastic, so that the wheels can be brought nearer together by means of the set-screw C. The cutting teeth of the wheels are formed by running a tap or hob in the lathe, clamping the stem of the instrument in the slide-rest, and bringing this up so that the hob gradually enters between the wheels; these, of course, rotate, and are brought together by means of the set-screw till a full thread is obtained; the wheels are then taken out by driving out the hardened pin centres; they are set on an arbor, and a groove turned in each at the bottom of the hollow, and finally hardened and tempered.

The use of this strange form of diestock is as follows: it is packed and set fast in the slide-rest, so that the bore and partition of the wheels fall exactly in the centre. A piece of wire, either long or short, is held by a wire chuck or otherwise; the free end is entered between the dies; these at once commence to rotate in opposite directions, and being well fed with oil, begin to cut a screw at the end. But this will go no further till the slide-rest is advanced, which may be done as slowly as proper, and as far as the screw required. When finished, turn the rest quickly back, and the wheel dies roll clear off the wire. The lathe is not stopped during the cutting of the thread, and however deep this may be, the work need not be strained, as of course the cut is a very gradual one, depending upon the rate at which the slide-rest is advanced.

As it may not always be possible to rotate long wires, the wheel dies should in this case be set on a block or chuck running with the mandrel; the ends of the long wires are then passed through a clip socket, fixed in the slide-rest, and advanced forward to to the length of screw required, which may then be released and instantly drawn out.

ASTRONOMICAL BIBLIOGRAPHY.*

AN astonishing monument of the most extraordinary industry and patient research lies before us in the shape of the Second Volume, only just completed, of the magnum opus of MM. Houzeau and Lancaster. The design of the Belgian Astronomer Royal and of his Librarian embraces a complete list of all extant Astronomical Works, of Memoirs on Astronomical subjects which have appeared in the *Transactions* of learned societies, reviews, journals, &c., &c.; and of all observations of which any record exists, and of the Observatories in which they have been made. Commencing with their Second Volume, our authors have furnished us in its 2225 pages (!) with a practically exhaustive list of everything having reference to Astronomy which has been published in the form of essays or papers (included, that is to say, in other works) for the last 440 years. It is needless to point out to the student of Astronomy the great value and importance of such a work as this. To whatever branch of the science he may be devoting himself, he will find in MM. Houzeau and Lancaster's wonderful Thesaurus the fullest reference to everything that has previously been accomplished. He is, for example, pursuing some investigation into the Motion of the Solar System in Space; he turns to pp. 675 et seq. of the "Bibliographie," and there finds no less than 57 references to memoirs on this subject, with the most ample details as to the dates, the publications in, and the pages on, which they have appeared, together with the authors' names, &c. Or he is engaged in the study of the surface of the planet Jupiter; and here again, our authors supply him (on p. 1362 et seq.) with 25 closely-printed columns containing a similar catalogue of descriptive papers on this particular subject, beginning with one by Kircher, in 1646, and concluding with Mr. Dennett's letter (18474) on page 37 of our own XXXIIIrd Volume. A supplementary list, we may note, on pp. 1736 and 1737, brings this down to the date of the latest monograph issued from the well-known Observatory of Dr. Von Konkoly, at O'Gyalla, in Hungary. In cognate fashion will be found the fullest and most accurate lists of all that has been published concerning everything (at once the most recondite and most familiar) pertaining to the study of Astronomy. The temperature of space; a resisting medium; cosmogony; the Lunar theory; shooting stars, meteorites and aërolites; spectral photography; scintillation; the optical effects of diffraction; the Zodiacal light; the figure and rotation of the planets; the stellar universe; and the Calendar are a few—a very few indeed—of the subjects on which such information is supplied. We cannot conclude our brief notice of this noble work without the expression of our gratification at finding the ENGLISH MECHANIC so largely and frequently quoted in its pages. In a paragraph in their introduction, devoted especially to thanking those to whom M. Houzeau and his confrère are indebted for materials, we find mention of the fact that the Public Library of Antwerp placed its set of this Journal at their disposal. We can only express our hope and belief that the future Astronomical contributions to our columns may render our volumes, in time to come, as worthy of a place in the Bibliothèque of the ancient Flemish city, as they have been held to be in the past.

CART AND WHEEL-MAKING.—XVI.

(*Continued from page* 187.)

By J. CHARLES KING.

THE narrowest lines of relief are called "fine-lines," and require experience and judgment in placing them appropriately to the other lines of relief, either in the centre of the work, or on the mouldings, or on the edges, or near the edges of other lines. These lines are mostly those which terminate in scrolls or flourishes, when used. The "picker-out," or "fine-liner," whichever designation may be used for this workman, is the head workman, par excellence, if not in responsibility, in a paint-loft.

Good sight, firm hand, and sensitive touch are not the only requisites for this workman, but a knowledge of the harmony of colours and their manipulation from pigments into paints is indispensable. The band lines are painted with a swan's quill pencil, stripes and lines with sable or camel's hair pencils of suitable sizes. These pencils have the hairs from 1in. to 2in. long, and are held with thumb and finger of either hand, according to the run of the work to be done, the middle, third, or fourth finger serving to guide and regulate the distance of the lines from the outline edges of the work, whether of body or carriage. The dexterity of the carriage-painter in laying on these lines is surprising, and only to be acquired by much practice. A first-class carriage, with much fine-lining or picking-out about it, is estimated to have more than a mile's length of lines painted on it. The eye is directed always to the heel of the picking out pencil; there, the pressure, or slight defection sideways of the pencil by the thumb and finger determines the course of the line and its thickness. The guide fingers have sometimes to pass over inequalities, or spaces with nothing for their rest or guide.

From practical observation I have found the eyes have a power of *divided observation*, one looking at the *intended course of a line, the other at the line just completed.* For some fancy scroll-work a rest-stick may be used, though it is not often. For curved lines—away from any edge to guide the fingers—a guiding edge may be formed of a piece of $\frac{1}{4}$in. bent brass wire, which may be altered to any requisite curve, and allowed to rest lightly on the moulding while used. A few words upon the difference in the hair of brushes and pencils may be of interest and service to a workman. Although the microscope with its wonderful power was unknown to the ancients, they knew the distinction between hair and wool, and their suitable application. We have no record of ancient brushes, but ample traces of their use in the painted views of scenes and events, &c., in Egypt, India, and China, whose people gathered the grains of gold in their auriferous streams by means of a wool-fleece that caught the metal, but which allowed the grains of sand to be washed away by the flow of water. A camel's, tiger's, or dog's skin would have been useless. Thus the story of Jason and the "golden fleece" was but one of many simple yet tangible records of the processes of art and industry concealed beneath the embellishment of old Grecian fiction. It is inaccurate to say that the gold clings to the fleece—it is the fleece clings to the gold, as is obvious upon viewing the difference in the formation of wool and hair by the microscope. This difference determines the utility of hair for paint-brushes. The bristle of the hog, like the hair of the Caucasian type of man, consists of overlapping scales. These are termed imbrications, from *imber*, a shower, and *imbrex*, a tile. The imbrications are closely fitting scales in the bristle, which become finer and closer near the point.

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*Bibliographie Générale de l'Astronomie, ou Catalogue méthodique des Ouvrages, des Memoires, et des Observations astronomiques publié depuis l'origine de l'imprimerie jusqu'en 1880. Par J. C. HOUZEAU et A. LANCASTER. Tome second : Memoires et Notices. Bruxelles : Xavier Havermans. 1882.

Those of sable-hair are long, pointed, overlapping scales, scarcely projecting from the surface at the point of the hair. The camel's hair is again different, but by the peculiar set of the imbrications admirably suited to hold and release colour.

Badger-hair more nearly approaches the human hair in appearance. Siberian ox-hair is nearer like the bristle. The imbrications on wool, or the hair of the Negro type of man, project from the stem like the sprouting leaves up the stem of a palm-tree. Such wool or hair will readily cling to the rough surface of grains of gold, and would hold paint in the same way, but would not allow it to flow from it freely like hair or bristle does.

Bristles have a natural taper-point, mostly split into three: these points are ground off when made into brushes. The brushes should be tied up with these taper-points gradually overlapping each other for some distance from the point of the brush, as well as being ground mechanically to a level surface of hair. If brushes were made scientifically they would give greater satisfaction. Sable-hair is considered best for straight lines, and camel's-hair pencils for curved lines. The sable-hair is slender near the root, covered with long, pointed imbrications or overlapping scales, about ten of which form a complete whorl or ring. The fibrous portion is moderately thick, inclosing a double row of roundish cells. The camel's-hair has imbrications that project but little from the surface, and a different internal construction. These hairs, while taking up paint readily, hold and part with it easily. Wool or grass fibre do not take up paint easily; but when charged with paint part with it with difficulty, by the reaction, under pressure, of the projecting imbrications; for this very reason, making this wool or grass preculiarly well suited for clinging together for weaving or felting. One simple test for brushes and pencils is to dip them in oil-colour, and then rinse the colour out with turpentine. If much of the colour still clings to the brush or pencil, it is not well adapted for the flow of paint. Before treating of varnish, it may be as well to explain how some painters avoid having to face-off much of the surfaces of the three final coats of colour, except to give it what is called an egg-shell dulness of surface, yet positive smoothness without polish, and yet use very little pumice-stone dust: it is simply because they insured the surface being smooth by the colour being freed from clots of oil, varnish, or turps, fine hairs, or dust, by straining their colour through fine wire sieves. This is particularly necessary in the use of colour in which varnish is to be mixed to make glaze-colour, also in all the mixed colours that precede glazing, also with lakes, ultramarine, mauve, or any brilliant colour without much body or solidity is painted. Glazing with one colour on another produces beautiful and delicate bloom of tints, slightly analogous to the differing tints of colour in the warp and weft of silk, producing "shot-silk." A learner must practise much before he can succeed in producing a good effect, even on a small surface, without dense, cloudy, or streaky places. Such glazing, with the same colour over the previous coats, must be done with care, and when two coats are laid on, the *first coat* is mostly left without being faced-off, for fear the thin surface of colour should be cut through, and show the former coat. The facing-off is mostly done to the *second coat* of colour; but with properly filtered colour, the first coat may be faced-off very lightly, with advantage. In varnishing a glaze-colour, in most cases, pick-out on the glaze, when picking-out has to be done. All colour, even the filling-up, should be strained; the preparing colour through wire sieves of a mesh of 60 wires to the inch, and the fancy colour through sieves of a mesh of 80 wires to the inch, according to the class of work to be done, or the amount of varnish in the fancy colour which is used, either for quickness of drying for facing-off, or for glazing. If there is any difficulty about getting the wire gauze, "foundation-muslin" is exactly adapted for the job, and serves as well for ensuring purity of texture in the fluid-colour, which must, if laid-on and laid-off as already directed, insure a good painted surface for varnish to cover, and show well upon, when hard. It is singular that the carriage-makers, who take such laudable pride in their work, and succeed in producing painting which has renown all over the world, should attain the same result by different processes, and by the use of different appliances. Thus, in one shop paint-mills are used, but not sieves; in another sieves have never been heard of, or mills never tried; in another, perhaps, tried and thrown away, as they would get foul, and choked-up with dried colour. This points to the necessity of standard works of reference—technical, not merely scientific—such being published for the use of masters and men, with descriptions of the appliances and modes of operation, of which long and varied experience in the craft has proved the value; and, where it is possible, to have these appliances on view, at the Coachmakers' Hall or any suitable place within reach of workmen, always supposing the officials of such expositions have the technical knowledge to understand the use of these appliances, and are able to explain them.

The fact that the paint sieves *do get foul*, is an admission of uncleanliness of the users. Such men let their varnish brushes get "lousy," as the term is for dirty varnish-brushes. Of course a sieve would need cleansing as soon as done with, and if of brass wire, the wire part should be kept standing in a dish of clean water; if of muslin, it has to be washed with turpentine, brushed quite clean, and hung up to dry thoroughly, ready for instant use. It takes time to work the colour through the sieve; but the gain in easy flatting, or facing-off, and in the finish of a job, amply compensates for the trouble.

A sieve is not at present a stock tool; each painter makes his own at a trifling cost. When its value is better known, doubtless a small filtering-sieve similar to "Stapfer's paint, varnish, and oil-filtering machine" will become general, on accout of its simplicity, and ease of cleansing the sieves, and changing the discs of one sized mesh for another; also for pressing the paint quickly through the sieves without the risk of straining the texture of the wire or muslin used.

In facing-off a surface to prepare it to receive another coat of paint or varnish, be sure not only of having a *pail of clean water, but a clean pail* for the water. Water, however clean, may be soiled by a dirty pail, and thus cause scratches or soil the surface of the paint or varnish. In facing-off a surface with finely sifted pumice-stone dust, a piece of sponge is better than cloth for the mouldings, as by its softness it enters the corners, without pressing too hard on the edges of angles, or prominent parts of the mouldings, which with cloth are apt to be rubbed through one or more coats of paint. A paint-shop should be as clean as a dairy, and plenty of fresh water is needed to insure work being well and quickly done, more especially in washing off newly-varnished carriages, to get them ready for another coat of varnish, or for use quickly, if the carriage be wanted out in a hurry.

It may appear a contradiction of terms for a foreman to say to a painter, "You will never get that varnish hard and dry in time, unless you wet it more, and use plenty of water to the job"; yet it is so, and *fresh water* must be used. The same water used over and over again is not sufficiently pure, for this reason—paint and varnish dry and harden by the absorption of oxygen and the action of the light. Water contains from 13 to 14 per cent. more oxygen than the air; by flowing water over paint or varnish the oxygen becomes absorbed to a considerable extent each time of contact of the particles; thus is done quickly and fairly, the drying which the air would do slowly, but surely.

Varnishing is less a craft mystery or highly critical process than most of the foregoing processes of painting, unless it be that of glazing with one colour over another. The good or evil of painting is all done before the varnish has to be laid on; if good, the varnish-makers' wares have a good advertisement; if bad, the varnish-maker has the blame, due in most cases to the incompetence of the workman, of his ignorance in the application of the previous coats of filling-up and paint alluded to in the early portion of these remarks.

Varnishing, like the other processes, requires the keen eye and firm touch which has acquired dexterity in the use of the brush and tool with either hand. It need hardly be said that the tendency of varnish to flow downward necessitates the care in beginning at the top and laying on lightly at the bottom edges of the panels, while, if too much varnish is used, it gets into the "quirks" and corners, and will daub them up and produce a shrivel of the overflowing varnish. A small pointed tool, without any varnish, held in the resting hand, serves to clear away the excess at once.

Light and air promote rapid drying, so as to admit of the varnish being faced-off within a day or two. Fine pumice-stone dust, that has been carefully sifted, and water is used to level any slight crudities that may mar the surface. A piece of sponge is best for mouldings, and cotton cloth for panels, the same as recommended for the facing-off the fancy colour. If, by chance, the varnish be rubbed through into the colour anywhere, the workman who does it is a bungler or a tippler, and will never make a good painter.

As soon as dry, another coat of varnish may be put on; this, when dry, to be faced-off the same as the first coat, unless in haste to get the work out; then the facing-off may be left undone, and the third coat of varnish can be put on with care over the other, just as it is dry enough not to feel "tacky" to the back of the hand. The fingers should never be used to try if a panel is dry or not.

One wash-off with very clean water, using a new paint brush and clean sponge and leather, after the varnish will bear it, helps to harden the surface, and prevent a carriage spotting so readily when first used and mud may have dried on the panels. Successful varnishing depends upon cleanliness and good brushes, as well as upon the weather favouring rapid drying.

A well-worn and oval-shaped bristle brush is good for all purposes; but a finishing coat of varnish had better be put on with a badger's-hair brush if the bristle brush is not in first-rate condition. The same rules apply to "tools" of various sizes. The best manner of keeping these brushes and tools in order is to suspend them by a piece of wire passing through holes in the handles, so as to have them hanging in the varnish in cans by means of a hole in a cardboard cover to the can, through which the brush-handle projects. The varnish should reach up to the tying-up of the brush-hairs.

The same rules of painting apply to japan, which is but prepared black varnish, to be used over parts that are black. The objects obtained by its use are the same as any other prepared paint: a uniform density of colour, economy, and speed in drying; as it is specially manufactured with driers, which rapidly absorb oxygen, and cause the hardening of the liquid particles of japan, leaving a lustrous surface, which may be made to take the place of the colourless varnish or not, as the work in hand demands.

Japan requires either gradual drying in an equal temperature, without sun glare or draughts; or it must be, for some purposes, "ovened," or baked quickly while the japan is still almost flowing. Japan, like varnish, should always be tested by painting on a piece of glass, and leaving to dry, washing several times and exposing to sunlight, draughts, or frost; you will then, with the naked eye, be able to see if it reveals any fine cracks, or changes colour, or loses lustre; if it does not it may be safely used.

But the varnishes and Japans of English makers have so high a standard of excellence that it is only in case of failure or doubt that recourse need be had to this ready test.

(*To be continued.*)

ASTRONOMICAL NOTES FOR JUNE, 1882.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination. North.	Sidereal Time.
	h. m. s. a.m	h. m. s.	° ′ ″	h. m. s.
1	11 57 32·28 ,,	4 37 1	22 4 57	4 39 28·22
6	11 58 21·63 ,,	4 57 33	22 40 36	4 59 11·01
11	11 59 19·09 ,,	5 18 13	23 6 20	5 18 53·79
16	0 0 22·14 p.m.	5 38 59	23 21 54	5 38 36·58
21	0 1 27·42 ,,	5 59 47	23 27 10	5 58 19·37
26	0 2 31·63 ,,	6 20 34	23 22 7	6 18 2·15

The method of finding the Sidereal Time at Mean Noon for any other station will be found on p. 390 of Vol. XXXIV.

At 1 p.m. on June 21st the Sun is said, technically, to enter Cancer, and summer is then supposed to commence. This is the longest day, the Sun in London remaining 16 hours and 34 minutes above the horizon, and, of course, only 7h. 26m. below it. At this date, and for a day or two before and after it, the Meridian may be determined with considerable accuracy by the method of equal altitudes. During the month of June there is no real night in any part of the British Islands. Large and complicated groups of spots, faculæ, and prominences continue to appear on the Sun's disc.

The Moon

Is Full at 8h. 33·2m. p.m. on June 1st, and enters her Last Quarter at 5h. 9·4m. in the afternoon of the 8th. She will be New at 6h. 33·1m. p.m. on the 15th, and enter her First Quarter at 6h. 1·3m. p.m. on the 23rd.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	15·2	12 6·2 p.m.
6	20·2	3 51·5 a.m.
11	25·2	8 8·7 ,,
16	0·7	0 39·3 p.m.
21	5·7	4 30·3 ,,
26	10·7	8 8·0 ,,

The Moon will be in conjunction with Saturn at 6 a.m. on the 13th; with Jupiter at 8 p.m. on the 14th; with Mercury at 2 a.m. on the 17th; with Venus at 10 a.m. on the 18th; and with Mars at 6 p.m. on the 20th.

Mercury

Attains his greatest elongation east (23° 27′) at 10 p.m. on June 1st, and comes into inferior conjunction with the Sun at 6 a.m. on the 28th, between which dates he will obviously be an Evening Star, becoming subsequently a morning one. At the beginning of the month he does not set until about two hours after the Sun, and may be found with the naked eye at dusk glittering near the N.W. horizon. He is, further, as well situated as he possibly can be for the observer with the telescope. His angular diameter increases from 8″ on June 1st to 12″ by the 26th, insensibly diminishing afterwards.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	6 19·2	25 3·2	1 39·5 p.m.
6	6 37·0	24 2·6	1 37·5 ,,
11	6 46·9	22 45·9	1 27·8 ,,
16	6 48·7	21 24·3	1 9·9 ,,
21	6 42·7	20 9·0	0 44·3 ,,
26	6 31·5	19 11·1	0 13·4 ,,

From which it will be seen that Mercury describes a pendulum-like path, which is wholly confined to the constellation Gemini.

Venus

Is an Evening Star during the whole of June, and is well placed for the observer. She is now very markedly gibbous, but is scarcely yet a very interesting telescopic object. Her angular diameter increases from 11·2″ at the beginning of the month to 12·6″ by the end of it.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	6 28·0	24 41·5	1 48·2 p.m.
6	6 54·5	24 23·7	1 55·1 ,,
11	7 20·9	23 48·3	2 1·7 ,,
16	7 46·8	22 55·9	2 7·9 ,,
21	8 12·3	21 47·4	2 13·6 ,,
26	8 37·3	20 24·1	2 18·9 ,,

As indicated by the above Ephemeris, Venus will, during June, cross nearly the entire width of Gemini into Cancer. On the 9th and 10th she will be rather more than 1° North of δ Geminorum, while on the 24th she will be in the same low-power telescopic field of view as η Cancri. Two days later she will be south of γ Cancri.

Mars.

Is now too near the Sun to be fairly seen; while

Jupiter and Saturn

are actually immersed in his rays.

Uranus,

To be seen at all, must now be looked for the moment it is sufficiently dark. Our Ephemeris of him will be discontinued after this month until 1883.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	11 4·0	6 49·9	6 23·5 p.m.
6	11 4·2	6 48·4	6 4·0 ,,
11	11 4·5	6 46·4	5 44·7 ,,
16	11 4·9	6 43·8	5 25·4 ,,
21	11 5·3	6 40·8	5 6·1 ,,
26	11 5·8	6 37·4	4 47·0 ,,

Uranus will thus travel slowly towards σ Leonis again.

Neptune

Will not return until the autumn.

Shooting Stars

Are rare in June, but may be looked for on the 6th and the 20th.

Occultations of (and a near approach to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
3	29 Sagittarii	6	‡9 36 p.m.	Bright.	120	85	10 35 p.m.	Dark	248	220
6	c^1 Capricorni	4½	11 55 ,,	Bright.	95	59	12 56 ,,	Dark	305	273
7	κ Aquarii	5	‡11 31 ,,	Bright.	78	39	12 19 ,,	Dark	323	285
9	15 Piscium	6½	2 2 a.m.	Bright.	35	359	2 13 a.m.	Dark	14	338
9	16 Piscium	6	†3 5 ,,	N.N.W.	205	174				

† A near approach. ‡ Stars below the horizon.

Greenwich Mean Time of Southing of Eight of the Principal Fixed Stars on the Night of June 1st, 1882.

Star	Souths. h. m. s.
η Ursæ Majoris	9 1 58·94 p.m.
Arcturus	9 29 17·95 ,,
α Libræ	10 2 17·35 ,,
α Coronæ	10 48 29·88 ,,
α Serpentis	10 57 14·50 ,,
Antares	11 40 51·17 ,,
α^1 Herculis	12 27 48·22 ,,
α Ophuichi	12 47 56·28 ,,

The Method of Finding the Greenwich Mean Time of Southing of either of the Stars in the above List for any other night in June, as also that of determining the instant of its Transit at any other Station, will be found on p. 392 of Vol. XXXIV.

WATCH-CLEANING AND REPAIRING.

By "A Fellow-Workman."

(*Continued from page* 210.)

Horizontal Watch.

When I say, "Horizontal watch," I mean a "Geneve," which is really a horizontal movement; but what is known to the trade as a "horizontal watch," is similar to a verge movement, only the escapement is different, it having a 4th wheel in place of contrate, and the 5th wheel being a *brass* escape-wheel, it looks very much as though a verge watch had been converted into a horizontal; but it is not so. I believe it was the first introduction of the horizontal movement into this country; but as they are very rare, and are really a mixture of verge and Geneve, I do not think it necessary to say any more about them.

Fig. 51 represents the *back* or *top* view of a "bar Geneve." The dotted lines show a ¾-plate. A is barrel bridge, B barrel, which is called a "going barrel," in consequence of the teeth being on the barrel, which does away with fusee and chain; C click, D ratchet cover, under which is the ratchet, E is click screw, F centre-wheel, G is set-square and arbor, H centre bridge, I 3rd wheel, J 3rd bar, K 4th, or seconds-wheel, L 4th bar, M escape or steel wheel, N banking-pin, O balance, P are dots, which act as a guide for putting watch in beat, Q is hairspring stud, R regulator, S jewel cover, T tension or curb-pins in end of regulator, U cock-bar, V screw for holding movement in case, W steady-pins for same purpose, X hairspring, Y escape bar.

FIG. 51

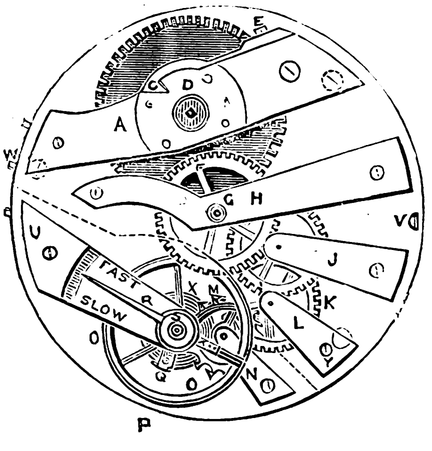


Fig. 52: A is looking plate, B barrel cover, C is dot as a guide for putting on barrel cover, D hole for dial, E hour-wheel, which works on cannon-pinion, F is motion-wheel, G seconds-

hand, H hour-hand, I minute-hand, J bottom bar.

Barrel.—We will take A, B, C, D, and E together, as they are all in one piece. There are two different barrels, one as shown, Fig. 53, with the lid or cover at the bottom, and the other with the cover at the top; but there are several different kinds of clicks. Fig. 53 is the most difficult to repair, being solid, with the exception of piece B, which is screwed on. Fig. 53: A barrel, B body of arbor, C arbor, D bridge, E click-cover, F locking plate, G ratchet. In repairing the barrel your chief point is to work from the top, *i.e.*, so long as you get the "wheel" or going part of your barrel true, the other part must follow. Suppose we say you have got to put two new holes to the barrel: you can see that the top of the barrel rubs against the centre wheel, is loose on its arbor, &c. Jobbers who have not a mandrel would generally punch the holes round; but this is not a proper way to do it, neither does it at all times end satisfactorily; but anyone who has a set of bench turns can easily convert it into a mandrel; so next week I will give full instructions for making a good substitute for a mandrel.

FIG: 52.

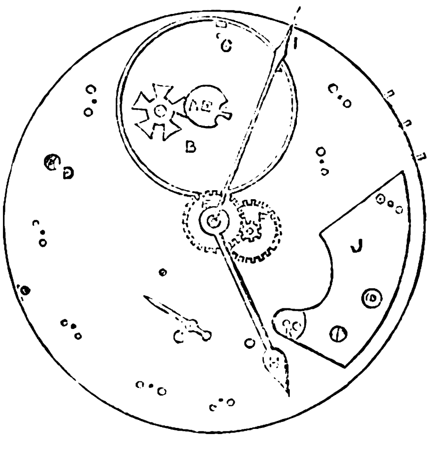
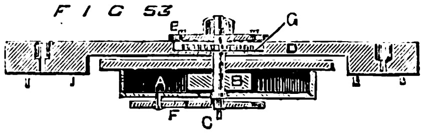


FIG 53

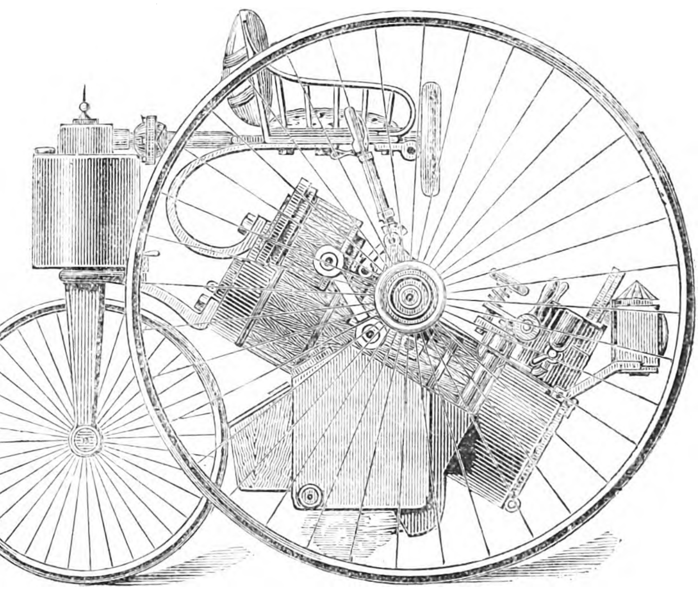


A STEAM-TRICYCLE.*

In the construction of a steam-carriage there are various things needed to make a successful machine, and it is difficult in practice to obtain good results. The greatest obstacle to success was overcome by the application of the rubber tire, in 1870, which made a practicable machine of the steam-carriage. All jars or vibrations are taken up by the rubber tire, and prevented from being transmitted to the machine. Small obstacles such as stones, etc., bed themselves in the tire, and little effort is required to force the carriage over them. Lightness is another important requisite. This can be obtained by the use of steel in the boiler, using the boiler for the frame, and the use of high speed three cylinder engines. The lighest fuel that can be carried is petroleum. It occupies less space than coal, is only about one-half the weight, and its heating capacity is greater, and it is easier handled. The boiler should be close to the ground, so that the machine will be steady from its centre of gravity being low. The wheels should be large, as large wheels pass over obstacles easier than small ones. In firing with oil it is easy to make an automatic arrangement to control the fire, so that the engineer can give his attention to steering the machine. I inclose a sketch of a proposed steam-carriage, which, as will be seen, consists of a steel boiler, suitably lagged with wood. The boiler is hung to the main axle by bearings. The boiler is an inclined tubular. It takes the place of framing for the engine, seat, etc., and is connected to the hind steering wheel by a steel brace. The water-tank and tool-box are hung underneath. The water is fed to the boiler by an inspirator, which is operated by the left hand of the rider. By casting his eye down, the rider can see the water-gauge. The steam-gauge is placed on the dasher in plain sight of the rider.

In the night time the light is reflected back from the lantern through a tube which illumines the glass dial of the steam-guage. A whistle is also in front and is operated by the foot of the rider. The fire is controlled by either the foot or hand of the rider. On the right of the seat is the starting bar, which also controls the amount of steam entering the engine. On the left is the hand steering wheel. This wheel works a worm and worm gear on the single wheel behind. The engine works a train of gearing which is rendered noiseless by the use of a rawhide gear. In climbing hills, to obtain the necessary power a clutch motion changes the movement into a slow speed for the carriage, the engine making the same number of revolutions.

The fire is made from a jet of air and oil, blown into a chamber of fire-clay by a jet of steam, regulated by the steam pressure of the boiler. The oil is in the holder over the steering wheel. The exhaust is rendered noisless by passing through a perforated pipe, and is blown out underneath the carriage. The supply of water and oil will last four hours, the machine making an average of twelve miles an hour. The oil and water are then easily replaced, as they can be got anywhere.



The front plate of the boiler turns down, so that the fire can be started on the usual plan (a cap taken off at the back allowing the smoke to ascend). As soon as steam is up the front plate is shut and the oil-and-air feed started. Nearly all the weight is borne on the large wheels, which have rubber tires, protected by a chain of sheet steel. The wheels are constructed similar to a bicycle wheel.

The engine is reversed by the starting bar. The safety valve is in front. The proportions to which the machine is built could be varied to suit the wishes of the builder. Say, for instance: Driving wheel, 5ft.; steering wheel, 2ft. 6in.; width of rubber tire 4in.

Boiler of steel, with 66 copper tubes ½in. diameter, 30in. long; shell 9½. diameter, ⅛in. thick; weight 100lb.; engine, 1½ horse-power. Water tanks to hold one cubic foot of water; the whole weight, about 550lb.

This design of boiler and engine could be much reduced in proportion; less weight of oil and water could be carried, and the whole vehicle made much lighter; but I think it better to make too large than too small. A proportion of 1 horse-power engine, 1¼ft. boiler, with two hours' supply of oil and water, might do.

ELEMENTARY LESSONS IN DRY-PLATE PHOTOGRAPHY.—X.*

Defects and Remedies.

At the end of the last chapter we described the conditions which gave rise to the occasional necessity for intensifying a negative. A good intensifier will increase the density of every part of a negative proportionately.

We may say at once that there is no thoroughly satisfactory intensifier for gelatine negatives, and that such a thing is a great desideratum; but we shall give a formula which has at any rate the advantage of simplicity, and which will be found to give fairly good results. It is one of the "mercury" intensifiers. It has two drawbacks. First, the results are not always permanent. Second, there is great difficulty in regulating the amount of intensification given by it. The first objection is much lessened, however, from the fact—not, we believe, generally known—that when a mercury intensified negative fades, it can generally be brought back to its original condition by performing again the process of intensification. We shall suppose that a negative on printing is found to give a poor-looking print, lacking contrast. Let the following solution be prepared:—

Bichloride of mercury	1 ounce
Water	10 ounces

The whole of the bichloride of mercury will not dissolve, but the residue may be left in the bottle, and as the solution gets low through necessary waste, water may be added.

Let the negative be thoroughly washed. Let it be placed in a dish, and let the mercury solution be poured over it. It will gradually become whitened or bleached. When the film is bleached throughout—as indicated by its being white at the back—let the solution be poured back into the bottle, and let the negative be most thoroughly washed. On the thoroughness this of washing seems to depend to a great degree the permanency of the results.

The negative has now to be treated with ammonia solution, which will blacken it, but the strength of the ammonia solution must be varied according to the amount of density required. Thus, if the print got from the negative previous to treating with mercury was very nearly up to the mark, a very weak solution of ammonia must be used; one or two drops to the ounce of water will be enough. This solution is poured over the negative, and it will be seen gradually to darken. When all action ceases, the process is complete. The negative will now be of a curious orange tinge by transmitted light. If, on the other hand, the negative was one giving a very shadowy print, a solution of ammonia of one to twenty may be used. On this being poured over the plate, darkening will take place almost instantly, and the result will be a fine black-coloured negative.

Too great density of image is a fault sometimes met with. It is always due to error of judgment in development. It may be corrected by performing the first part of the process for intensification. This method is objectionable, however, as the results may not be permanent. A better plan is to immerse the negative, after fixing and washing, in a solution of one part of eau de javelle to three or four of water. After the desired amount of reduction has taken place, the plate should be again fixed and washed.

Spots of various kinds are liable to be found in the finished negative. They are of various forms, and are produced in various ways. Minute transparent spots or pinholes are caused by dust on the plate during exposure. The plate should be brushed with a broad camel's-hair brush before it is placed in the slide. Small transparent spots with irregular outlines are due to defect in the manufacture of the plate, and cannot be well corrected by after manipulation. Small transparent perfectly circular spots, with well-defined outlines, are due to air-bubbles in the developer, and are only produced when too small a quantity of developer is used. Air-bubbles do not, as is commonly supposed, form on the surface of the plate under the surface of the developer; they form on the surface of the developer, and, if there is too little solution, come in contact with the surface of the plate, and there adhere. Opaque spots are always due to defects in the plates, and cannot be corrected by after manipulation.

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* By J. H. Davis in the *American Machinist*.

* Condensed from the *Photographic News*.

A yellow stain, or rather a yellow veil, in the shadows of a negative is often found after pyrogallic development, especially if the process has been very prolonged, or if much ammonia has been used. Such stains should never occur if our instructions are carefully followed, but if it does it may be removed by placing the negative, after fixing and washing, in the following solution :—

Saturated solution of alum	10 ounces
Hydrochloric acid	¼ ounce

Mr. Herbert Berkeley has recently introduced a new developer, which totally prevents any yellow stains from occurring, and which deserves strong recommendation. The pyrogallic stock solution is mixed with four grains of neutral sulphite of soda to each grain of pyrogallic. The whole is rendered slightly acid with citric acid, for it must be understood that so-called "neutral" sulphite of soda is really alkaline. Care must be taken to use the *sulphite*, not the *sulphate*.

A white powdery deposit is sometimes found on the surface of the negative after drying, especially after ferrous oxalate development. It is, in such a case, caused by lime in the washing water. It may be removed by dipping the negative in a 1 per cent. solution of hydrochloric acid. If the solution of alum used before fixing be acid, and the negative be not sufficiently washed between the alum and the fixing-bath, a deposit of sulphur will form in a fine powder. This may be removed by gently rubbing the face of the negative with a plug of cotton-wool, while water is running on it from the tap.

Irregular action of the developer, causing zig-zag lines across the plate, may occur if the developer has not been made to flow over the plate in one wave at first.

Halation is caused chiefly by reflection from the back of the plate. It makes itself evident only when the subject includes very strong contrasts; for example, when an interior with windows open to the sky is photographed. It shows itself in the form of a halo round the highest lights, and produces a very unpleasant effect, sometimes known as blurring. It occurs only to a small extent with plates that are very thickly coated. In the case of an attempt being made to photograph a very trying subject, such as the interior mentioned, it is well to "back" the plate; this is, to paint or otherwise cover it at the back with some substance which will absorb light. The following is a good method to adopt. Procure a piece of black carbon tissue, cut out a piece slightly smaller than the size of the plate to be used (there should be about ⅛ of an inch margin all round) moisten the black surface of the carbon tissue with glycerine, allow all that will to drain off, and press the tissue against the back of the glass. It will adhere, and may be removed just before development.

ELECTRICAL ACCUMULATORS, OR SECONDARY BATTERIES.*

By PROF. OLIVER J. LODGE, D.Sc.

THE distinction between a primary and a secondary battery is in no sense an important one when we are considering either as the producer of a current; and we may have in our minds an old Volta cell, or a Smee, Grove, or Daniell, just as satisfactorily as a Planté or a Faure, while we consider the ensuing few theoretical remarks.

I shall use the term "radicle" in preference to "element," as being more general. Radicles may be elementary, but they may also be compound. The atom of hydrogen, of oxygen, or of lead, is a radicle, but so is the group SO_4 or NO_3. A radicle is any group of atoms that can combine, or be removed from combination, with another group. Chemists have long been accustomed to divide radicles into electro-positive and electro-negative, or "basylous" and "chlorous," though they have been slow to recognise the full physical meaning of this distinction. They have also classified them into monad, diad, triad, radicles, and the like; and without entering into the disputed question of whether atomicities are fixed or variable, it is absolutely certain that in a definite compound, and when released from definite compounds, certain radicles are monad, diad, or triad, as the case may be.

It is, moreover, known that radicles can exist temporarily in the free state, when they are said to be dissociated; and that many liquids—not to speak of gases—contain a number of such dissociated molecules, the number depending on the temperature as well as on the nature of the liquid, and being on the average pretty constant—that is, they are equally distributed through the whole liquid, and if some are by any means removed, more will at once be formed to keep up the average. Not that any one radicle need remain long dissociated—there is, no doubt, a continual interchange—but the average number dissociated is definite under definite physical conditions.

Now there is a large class of liquids whose dissociated radicles are all charged with electricity—half of them with positive, and these are they which chemists call electro-positive or basylous radicles—half of them with negative, called therefore electro-negative or chlorous. Moreover, it was shown by Faraday that the charge possessed by every monad radicle, of what kind soever, is precisely the same in quantity, though it may differ in sign; and that diads have twice, triads thrice, this atomic charge, and so on. The existence of these charges are certain from the facts of electro-chemistry, and the electrical charge appears to be the essential condition for even the momentary existence of a free radicle. It further appears that when two opposite radicles combine their charges are either lost or are masked by proximity; and that before two radicles of the same kind can unite into a molecule their charges must be given up to some third body. A liquid which possesses such dissociated and oppositely charged radicles, sauntering about in it, is *ipso facto* susceptible of being decomposed by electrical means, and is called an electrolyte. Liquids which have no such charge and dissociated molecules are not electrolytes, and will not conduct electricity. Electrolytes conduct electricity by a bodily transfer in opposite directions of the oppositely charged radicles; they conduct it, in fact, as a convection current, or rather perhaps of two equal opposite convection currents, one of the positive radicles the other of the negative. The resistance of the liquid depends upon the slow shearing asunder of these two sets of radicles by a process closely analogous to diffusion, for it is possibly only assisted or directed by electricity in the immediate—molecular—vicinity of the electrodes.

What are these electrodes? They are conductors introduced into the liquid, with the property of exerting upon the charged radicles in their immediate neighbourhood unequal, or else opposite, forces. Thus, suppose they are two plates of platinum connected with a battery, so that one plate is always +, the other always −; and suppose for simplicity that the dissociated radicles are hydrogen—electro-positive, and oxygen—electro-negative, respectively. Oxygen atoms close to the positive electrode are attracted by it; they deliver up their charges to it, and uniting into molecules, rise as gas. Their places are taken by others from the slightly more remote region, and so on, a virtual procession of oxygen atoms continually taking place towards the positive plate, each carrying its charge with it. The same thing happens on the hydrogen side, only that twice as many dydrogen atoms take part in the action, the charge of each being half that of an oxygen atom.

This, then, appears to be the state of things in ordinary electro-chemical decomposition; only the radicles liberated on the surface of the electrode will combine with it, if in any way possible, instead of merely combining with each other and becoming free. Thus the hydrogen alloys itself as well as it can with the platinum; and the oxygen, if it finds any copper or other less noble metal on the surface of the electrode, will readily combine with it, the ordinary chemical affinities being enhanced by the electrical attractions.

But now, instead of two oppositely charged plates of the same material, let us immerse in the liquid a plate of zinc and a plate of copper, or any two metals which have a different affinity for oxygen. The oxygen atoms are now attracted to the zinc just as they were to the positive plate, but apparently by a chemical, not an electrical, force. It may be possible ultimately to reduce chemical forces to electrical ones, or *vice versa*; but at present it seems necessary to draw a distinction between them. This attraction for the oxygen is, as before, only to be supposed to be effective within far less than a microscopic distance of the plate. The replenishment of the oxygen into this region is wholly carried on by diffusion and fresh dissociation. The copper on the other side pulls the oxygen too, but less powerfully. Nothing more than slight motion and very slow combination, however, is found to go on so long as the two plates are kept separate, provided both are pure and homogeneous; but the tending of the negatively charged oxygen towards the zinc makes it transfer negative electricity to the copper as soon as they are connected by a wire.

The copper so connected, being now negatively charged, actually repels the oxygen atoms, and is protected from their attack, while it attracts the hydrogen. We now therefore have the continuous opposite processions again, the oxygen atoms combining with the zinc, and neutralising by their charges positive electricity at its surface, in other words, partially giving up negative electricity to it; the hydrogen atoms going to the copper, hydrogenising it to some extent, but soon giving up their positive charges to it, uniting with each other and escaping from the liquid. A constant current must therefore be flowing along the connecting wire, of negative electricity from the zinc to the copper, of positive from the copper to the zinc.

Next, suppose two plates of the same metal, say both platinum or both lead, not connected with any battery, but with their surfaces in different chemical conditions—say one coated with hydrogen, the other with oxygen. Plainly the same kind of action can go on. The oxygenised plate will be attracting the hydrogen like the copper, or like the negatively charged plate connected with the pole of a battery; the hydrogenised plate will behave like the zinc or the positively charged plate. The positive current will flow along the connecting wire from the oxidised plate to the hydrogen-coated one.

We have thus a battery which will maintain a current so long as the plates continue coated or combined with the two gases; but the action of the current is obviously to destroy these gases and restore the plates to a condition of equality. A battery may be made, then, either of two different metals, one of which attracts oxygen more than the other—this case we will not now further consider —or else of two pieces of the same metal, one more oxidised than the other or one more hydrogenised than the other; or, still better, one oxidised and the other hydrogenised. Take, for instance, two plates of lead and immerse them in dilute sulphuric acid; let one be bright and metallic, the other rusted over with a coat of oxide of lead. As soon as metallic communication is made between the two plates, a positive current of electricity continually flows along it from the oxidised plate to the other, the bright plate becoming gradually oxidised and the other becoming gradually reduced. If the plate has been oxidised by exposure to hot air, or by ordinary chemical means, such a battery would be called a primary one; if the coat of oxide has been produced by passing through the cell an electric current from some independent source, then the battery is called a secondary one.

DIFFERENCES BETWEEN POSITIVE AND NEGATIVE ELECTRIC DISCHARGES.

WHILE, according to former observations of Herren Wächter and Reitlinger, the glowing electrode particles which form the electric spark are exclusively detached and carried off by escape of positive electricity from the electrodes, the experiments of Plücker, Gassiot, Hittorf, and others, appear to prove that, under certain conditions, a projection of particles takes place exclusively at the negative electrode. The question thus arose how these observations were to be brought into harmony, or what differences exist between the electro-positive and electro-negative projection of particles. Herr Wächter has recently given his attention to the subject, and his experiments yield the result that the projection of particles detached from the positive electrode (anode particles), differ from that of particles detached from the negative electrode (cathode particles), in the following points:—

1. The projection of anode particles occurs in atmospheric air at a pressure of 4500 to 10mm. of mercury; the projection of cathode particles is only observed at a pressure of 63 to 0 005mm.

2 The quantity of electrode particles detached in equal times, and under otherwise similar conditions, *decreases* at the anode with diminishing air-pressure, but *increases* at the cathode.

3. The anode-particles are, under like conditions, carried considerably further than the cathode-particles (at 63mm. pressure about 3,400 times as far).

4. The anode-particles go out uninfluenced by air-pressure, always from a comparatively very small surface. The cathode particles, on the other hand, are, with decreasing air-pressure, projected from ever-greater surfaces. (The size of the latter may even attain 10,000 times that of the surface whence the anode-particles are projected.)

5. The anode-particles always go out only at a particular part of the anode—*viz.*, at that situated nearest the cathode, whereas the cathode-particles appear, according to the density of the gas, on the whole surface of the cathode.

6. The emission of the anode particles is favoured by a bent or pointed form of the electrode; that of the cathode-particles by a clean, that is, unoxidised surface.

7. The direction of motion of the anode-particles is determined by the position of the cathode relatively to the anode, as the anode-particles move in the direction of the electric current, in the path of least conductive resistance to the cathode. The direction of motion of the cathode-particles is, in all circumstances, at right angles to the cathode-surface, and is not influenced by the position of the anode and the direction of the electric current.

8. The anode-particles can move in all con-

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* Condensed slightly from the *Engineer*.

ceivable curved paths, but the cathode-particles can only move in straight paths.

9. The anode-particles are deflected by the magnet like diamagnetic substances; the cathode-particles like paramagnetic.

10. The anode-particles are carried over both in the luminous and in the non-luminous state; the cathode-particles only in the non-luminous state.

11. The anode-particles have a measurable size, and are probably detached mechanically by separate impulses; the cathode-particles are immeasurably small, and seem to come off by a process of vaporisation.

12. The heating of the electrode acts in a distinctly favourable way on the projection of cathode-particles; but this cannot be said of anode-particles.

13. The cathode-particles are the means of passage of the electric current from the electrode to the gas-molecules; but this is not the case with the anode-particles.

14. For detachment of the anode-particles, a greater electric tension previous to discharge is necessary (according to the experiments of Wiedemann and Ruhlmann), than for detachment of cathode-particles. The emission of the former, therefore, takes place, other circumstances similar, at greater intervals than the emission of the latter.

These facts, in Herr Wächter's opinion, indicate a difference between positive and negative electricity, which is not to be regarded as an opposition of plus and minus of two similar conditions of matter, but rather as a *qualitative* difference of the two kinds of electricity.

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

THE eighth meeting of the session of the above society was held on the 10th inst., at King's College, Strand, the chair being taken (in the absence of the President) by James Glaisher, Esq., F.R.S.

The minutes of the meeting of 12th April last were read and confirmed, and were signed by the Chairman.

The list of donations (exclusive of exchanges and reprints) received since the last meeting was submitted, and the thanks of the Society given to the donors.

Mr. Crisp read letters from Prof. C. Robin and Dr. L. Dippel in acknowledgment of their election as Honorary Fellows.

Mr. Dowdeswell read a paper "On Davaine's Septicemia."

The Chairman said he was very glad that they had had a paper on so important a subject. Observations upon *bacteria* were daily acquiring more and more value, from their supposed connection with various kinds of disease. He hoped that Mr. Dowdeswell would continue his observations upon the subject, and that he would be able to explain the great discrepancies which he had observed to exist between the size of the specimens he had described and those which had been referred to by other observers.

The Chairman referred to a letter received from Mr. Ralph, the President of the Victoria (Australia) Microscopical Society, in which he mentioned that he expected to be present that evening. At the last moment, however, he had been prevented from coming.

The Chairman said that he was sure they would all hope that Mr. Ralph would be in England at their next meeting, so that they might welcome him both as one of their ex-officio Fellows and also as the representative of almost the only Colonial microscopical society.

Mr. Burnett's note on a new form of rotating live-box was read, and the apparatus exhibited.

Mr. Sigsworth exhibited a spring paper-clip which he had found very useful in fastening card cells upon slides and much more convenient for the purpose than the so-called "American" clips.

Dr. Van Heurck's views on the use of the incandescent electric light for microscopy were briefly referred to by Mr. Crisp, who explained, by means of black-board drawings, two cases in which, in consequence of its superior intensity, the electric light might be made use of to extend somewhat the resolving power of an objective. Dr. Van Heurck had recently obtained an improved form of battery which superseded the one he originally described. He found the Swan form of lamp to be the most suitable for microscopical work.

Prof. Abbe's paper "On the Relation of Aperture and Power in the Microscope," part I., was read by Mr. Crisp, who referred to it as being one of the most valuable and useful papers that had ever been brought before the Society, dealing as it did not only with the theoretical part of the subject but establishing also a rational standard for the practical construction of objectives.

We give an abstract of Prof. Abbe's paper as follows:—

Part I. of the paper contains a general consideration of the relative values of wide and narrow apertures, in regard to which Prof. Abbe lays down the following propositions:—

(1) Wide apertures are necessary when *high amplification* is required; low or moderate apertures when low or moderate amplifications are sufficient, or cannot be over-stepped.

(2) Wide apertures are necessary with *objectives* of short focal length; low and moderate apertures with those of low and moderate power.

(3) Wide apertures, together with high powers, should be used for those preparations only which do not require perceptible depth of vision, that is, for exceedingly flat or thin objects, and for transparent objects which can be studied by optical sections; moderate and low apertures when a wide range of penetration cannot be dispensed with.

(4) Never use wider apertures than are necessary for the effectiveness of the power, because excess of aperture is always waste of time and labour.

(5) Scientific work with the microscope will always require not only high-power objectives of the widest obtainable apertures, but also carefully-finished lower powers of small and very moderate apertures.

Amongst other points dealt with by the author, he calls attention to the uselessness of objectives of 1-50in., with which no more can be seen than with an objective of half the power, or even less; also to the positive damage connected with the use of unnecessarily-wide apertures, they being prejudicial to the ease and convenience of microscopical work in two essential respects: first, they necessitate a progressive reduction of the working distance of the objective, which decreases from 0·7 of the focal length for an aperture of 30° to 0·1 for an aperture of 116°; and, secondly, the sensibility of the objectives for slight deviations from the conditions of perfect correction is greatly increased; so that, whilst with 30° differences in the cover-glass are practically inappreciable, with a dry lens of 100°, a change of thickness of 0·02mm. only introduces perceptible aberrations and a visible loss of definition; to avoid which a change of the correction-collar would be required for almost every change of focus in the inspection of successive layers, unless the preparation is exceedingly thin

He also calls attention to the misunderstanding of the principles involved in the construction of objectives, which has given rise to the notion that a wide-angle objective can also be made to do duty as a narrow-angle one by such arrangements as the Davis "aperture shutter," or diaphragm All such contrivances are entirely illusory, and have for their result to produce a bad low-angle objective instead of a good wide-angle one. If a low-angle objective is required, it must be *originally* constructed for that purpose, and cannot be converted out of a wide-angle one in the way suggested.

[We are informed by the secretary that in the second part of the paper, which will be read at the next meeting, and then, we hope, more fully reported, Prof. Abbe deals more in detail with the proper ratio which must be maintained between aperture and power, giving tables showing the maximum apertures which can be effectively used with given powers, and conversely. He first considers what relation the *total amplification* of the microscope (that is, both objective and eyepiece) should bear to the aperture—a point which is determined by defining the visual angle required for distinct recognition of an object, and the smallest dimensions of microscopical detail which a given aperture will delineate. Having determined the relation of the total amplification to aperture, he next considers how this total must be apportioned between the objective and the eyepiece, and as the result of the discussion, arrives at conclusions in regard to the power of eyepiece that can be usefully employed for the best definition, which are not a little at variance with popular views on the subject.]

The Chairman considered that Prof. Abbe's paper was indeed a most useful one, and that it would be greatly appreciated by practical opticians.

Mr. Beck said that he considered it was an exceedingly valuable paper, and one that would enlighten a great many persons as to the relative value of aperture and magnifying power in regard to which great confusion had existed. There were people who thought that if they could get a 1in. objective with an aperture of 120°, they could resolve difficult diatom tests. He had heard it claimed that such glasses had been made, but although he had ordered one he had not yet been able to get it, and hopes that might have been raised by these announcements would be damped by the contents of Prof. Abbe's paper. He was very glad that it had been written, because it had been his impression for some time that Prof. Abbe had been working exclusively in the direction of wide apertures.

Mr. Ingpen was surprised to hear Prof. Abbe, of all persons, charged with an exclusive approval of large apertures, for if anyone looked at Zeiss's catalogue, they would see at once that all the dry lenses were of remarkably small angles, nothing exceeding 110°.

Mr. Crisp said that the most opposite notions had been held as to Prof. Abbe's views on wide or narrow apertures. Some years ago it was stated, at one of the Society's meetings, that he advocated only narrow apertures, and some correspondence took place in regard to it in the *Monthly Microscopical Journal*. Again, later, it was insisted that Prof. Abbe considered all but wide apertures useless to the microscopist. The fact was that Prof. Abbe had, since the date of his earlier observations on aperture, advocated the maintenance of a proper ratio between aperture and power—wide aperture for high powers, and small apertures for low powers—and had always insisted on the great importance of perfecting the construction of moderate apertures.

The confusion had arisen from the fact of Prof. Abbe having shown, in connection with his theory of microscopical vision, that wide apertures, and wide apertures only, gave true images of minute objects; but it did not, of course, follow from that that wide apertures were to be universally used, with low powers and with objects, if unsuitable either from their requiring depth of vision, or for other reasons.

Mr. J. Mayall, jun., exhibited Ross's "Hospital Microscope." The speciality is the fine adjustment, which is of so simple a construction that Messrs. Ross are enabled to issue the microscope at a less cost than any previous form issued by them.

Dr. Maddox read a paper "On Some Micro-organisms from Ice Water and Hail," illustrated by a number of photo-micrographs.

The Chairman inquired how Dr. Maddox accounted for the existence of the organisms which he had described. Did they come from the atmosphere?

Dr. Maddox thought that with regard to those from the ice of the water-butt, they probably were in the rain-water before it froze, and they alone survived; those found in the water from melted hail most likely came down from the atmosphere with the hail.

After a few remarks on Dr. Maddox's paper by Mr. Beck, the Chairman adjourned the meeting to June 14.

THE METEOROLOGICAL SOCIETY.

THE usual monthly meeting of this Society was held on Wednesday week at the Institution of Civil Engineers, Mr. J. K. Laughton, F.R.A.S., President, in the chair. Miss W. L. Hall, Mr. E. J. Pearson, Dr. J. R. Somerville, and Mr. W. J. V. Vandenbergh were elected Fellows of the Society.

The following papers were read:—"On the Diurnal Variation of Wind and Weather in their relation to Isobaric lines," by the Hon. Ralph Abercromby, F.R.S. By constructing synoptic charts at different hours of the same day, and by comparing the wind and weather records at the different hours, and examining their relation to mean curves of diurnal variation, the author shows that the mean diurnal increase of the wind's velocity is explained by the fact that for the same gradient there is more wind by day than there is by night. The mean diurnal velocity of the wind is explained by the fact that in cyclones the wind is a little more incurved, and in anti-cyclones a little more outcurved by night than by day. The mean diurnal increase of the frequency of rain during the day hours is explained by the fact that in any given cyclone the area of rain is larger by day than by night. The diurnal changes of every element are superimposed on the larger general changes, and are independent of each other. Great stress is laid on this point, both as explaining and classifying many meteorological questions and as simplifying the problem of weather forecasting. The author gives a simple hypothesis, from which it appears that the diurnal veering and increase of rain follow as a natural consequence of the diurnal increase of velocity. A paper on "Mechanical Conditions of Storms, Hurricanes, and Cyclones," by W. F. Stanley, F.M.S., was also read.

Catalogue of American Tools, &c.—Messrs. Churchill, of 28, Wilson-street, Finsbury, have issued a new catalogue of American tools, machinery, &c., containing about 100 pages of illustrations and descriptive matter. It is the largest and most complete list of the kind issued in Europe, and will be found useful by amateurs who are not acquainted with the many appliances now provided for the mechanic. Besides tools, the catalogue contains a number of fretwork designs, clocks, and clock movements, and altogether affords ample reason why Messrs. Churchill should have found it necessary to erect larger premises in Cross-street, to which they will remove in the course of two or three months.

THE production of Bessemer steel ingots in the United Kingdom during 1881 was 1,441,719 tons, being an increase of 397,337 tons on the quantity produced in the preceding year.

SCIENTIFIC NEWS.

FROM Dun Echt Circular, No. 51, we learn that Dr. Oppenheim has completed the following elements of Comet Wells from observations at Harvard College on March 19, the mean of three observations at Dresden and Leipsic on April 15, and the Kiel observations of May 12: T = June 10·56221, Berlin M.T. $\pi - \Omega$ 209° 0′ 31·2″, Ω 204° 54′ 54″, i 73° 47′ 29·4″ log. q 8·783216. His ephemeris for May 27 (Berlin mean time) and following days reads as follows:—

	R.A.			N. Dec.	
	h.	m.	s.	°	′
May 27	3	57	21	56	13·3
28	4	3	24	54	25·7
29	4	8	54	52	35·2
30	4	13	58	50	41·6
31	4	18	36	48	45·0
June 1	4	22	53	46	45·2
2	4	26	53	44	41·3
3	4	30	40	42	32·9

At the last date the comet will have a brightness of 113, March 19 being taken as the unit-date, but on June 11 it will be 1565. Mr. Hind has also calculated an orbit, and an ephemeris which, for Greenwich mean time on May 27, is R.A. 3h. 57m. 39s., N. Dec. 56° 8·1.

Dr. Wentworth Erck, lecturing last week at the Royal Dublin Society, said the distance of the comet from the surface of the sun at perihelion will not exceed five millions of miles. At this period it is calculated, having regard solely to the distance of the comet from the Sun and from the Earth, that the brightness of the comet will be 3,600 times greater than at the time of its discovery, when it was equal to an eighth magnitude star; but some time before and after perihelion the comet will be lost in the rays of the Sun, and the great amount of twilight at this season of the year will probably prevent the tail from ever becoming a very conspicuous object. But the calculation of brightness, based upon the mere distance of the comet from the Sun and from the Earth, though perfectly correct in the case of a constant reflecting surface, by no means holds good in the case of a comet whose dimensions and internal constitution undergo the most violent transformations in passing from the cold of space to a temperature far higher than we can have experience of. In point of fact the brightness is found to increase in a greater ratio than that due to diminished distances. The rule, however, seems not to be of universal application, and to fail in the case of the present comet.

Judging by the telegrams from Egypt, the eclipse expeditions have been successful beyond their expectations, for the French astronomers believe they have detected a lunar atmosphere, a fine comet was discovered close to the sun, a series of good photographs of the corona was obtained, and for the first time the spectrum of the corona was successfully photographed. Dr. Piazzi Smyth writes from the Royal Observatory, Edinburgh, that the observers on the Calton Hill speak of the so-called sunspots being in greater size, force, and energy of movement and change than they have been seen for the last eleven years.

In the course of some investigations of electrical phenomena Mr. Willoughby Smith has made a remarkable discovery—one that may possibly have an important bearing on telephony. The name given to the apparatus, as at present used, is the inductophone, which partly explains the character of the phenomena. In the electrical circuit, Mr. Smith has a large tuning fork with springs for making and breaking contact, and a large flat coil or disc of rather thin silk-covered wire. This coil produces a large field of electrical lines of force, constantly changing owing to the make and break arrangement of the tuning-fork. If a telephone is brought into this electrical field, but without having any metallic or other visible connection with the circuit, it faithfully reproduces the musical sound of the tuning-fork. A telephone is not necessary,—the diaphragm of one is sufficient, or even a bar of iron. Further, the receiver may be placed at any distance apparently, within, say, a house, for so long as the diaphragm is properly situated as regards the lines of force, it reproduces the sounds though brick walls and many yards of air intervene. When the plane of the diaphragm is placed at right angles to the plane of the coil, both being on the same axial line, no sound is heard; but when the diaphragm is placed so that the lines of force can, so to speak, impinge upon it, the sounds are reproduced, although the diaphragm may be turned to almost any angle.

During the recent telephone case it was stated that the electrical resistance of gas carbon does not vary under pressure. Mr. W. F. Nosworthy has repeated his experiments, and has found that the resistance of gas carbon is sensibly reduced by compression, so that the statement above referred to holds true only in such conditions as "compression" produced by sound-waves.

The largest locomotive in the world is now on the Pennsylvania Railroad, having been recently built at the company's works, Altoona. The engine weighs 120,400 pounds, and is what is called a double-ender. The driving-wheels are 5ft., and the truck wheels 33in. in diameter. On her trip from Altoona to Philadelphia, a mile was run in 59 seconds. A special train, consisting of three cars and engine, made the following certified times recently on the West Jersey railway:—16½ miles in 14 minutes, 61·1 miles in 60 minutes, and 76·1 miles in 76 minutes. Mr. Barnet Le Van read a paper before the Franklin Institute, in which he contended that 90 miles an hour is not only safe, but perfectly feasible.

Dr. J. Barrois will be the director of the new zoological laboratory the French Government are to establish at Villefranche-sur-Mer.

Sulphurous fumigation is adopted by the Abyssinian elephant-hunters when they descend to the malarial lowlands, and M. D'Abbadie suggests that European explorers might find a similar immunity from fever if they followed the same practice.

The Exhibition of Electric Lighting at the Crystal Palace, will cease on Saturday, June 3, so those who have not already seen it, should remember that the opportunity will end with next week.

Mr. H. H. Warner, of Rochester, New York, has again offered a prize of two hundred dollars for each discovery of a new comet made in North America or the United Kingdom; also a prize of the same amount for the discovery of a meteoric stone, found in the countries above named, which, in the opinion of Professor H. A. Ward, Principal Dawson, and Mr. J. L. Smith, contains fossil remains of animal or vegetable life. A sum of fifty dollars is offered for a specimen of any meteoric stone seen to fall in the United States during 1882. The discovery of the comet must be made known by telegraph to Dr. Lewis Swift, director of the Warner Observatory, Rochester, N.Y.; and specimens of the meteoric stones, not less than 2oz. in weight, must be sent to him by mail with full particulars.

The influence of thunderstorms on the magnetic needle is generally too instantaneous and too weak to deflect it, even when most delicately suspended. That such storms do affect magnetised bodies, however, has been proved by M de Lalagade thus: At the end of a long magnetised bar he arranged a thin iron membrane, mounted as in the telephone. At each flash of lightning, a small but distinct dry sound was heard in the membrane. A more sensitive apparatus was obtained by arranging, horizontally on a tower, twelve magnetised steel bars, each about 6ft. long, and covered at the end, in a fifth of the length, with twelve coils of fine wire. The ends of the wires were brought to two conductors, which were connected with a pair of telephones. Not only was a dry sound heard at each flash, but before each flash there was a slight buzzing (*bruissement*). The author suggests that an apparatus like the second described might be advantageously used in the simultaneous observations to be made in Polar regions.

The way in which M. Mascart, at the College of France, obtains records of magnetic perturbations is as follows. Three bar magnets, for the declination, the horizontal component, and the vertical component respectively, one furnished with mirrors which receive three rays of light from the same gas-lamp, and the three reflected rays fall on one sensitised place moved by clockwork. The clockwork has an electric contact, which every hour sends a momentary current into three coils (one near each apparatus), producing an interruption, and indicating the hour.

The Congress of the French Association for the Advancement of Science meets at La Rochelle this year on Aug. 24. A list of grants by the Association to savants for special researches will be found in *La Nature*, May 6.

Some observations of the effects of cold on birds in the valley of the Marne during the winter of 1879-80 have been lately published by M. Lescuyer, and M. Milne-Edwards, remarking on the importance of such an inquiry, has added some notes of his own, made in Paris. It seems that exotic birds, such as peacocks, silver and golden pheasants, suffered little from cold, though they had little shelter, some perching at night on trees or on the iron bars of inclosures. On the other hand, fowls in well-sheltered inclosures died in great numbers. A still more singular fact is the resistance of Australian cockatoos to cold. Several of these birds remained from October to March in the open air in a large cage, which is occupied in summer by monkeys; there was no shelter, except a building on the north side, yet all the birds had continued good health. Their feet were often on iron bars, the temperature of which was so low that water froze immediately when poured on the metal; several nights the cold was more than 25° below zero C. The black swans of Australia and the coscoroba of South America did not suffer, and in spring they set about constructing their nests; though frequently, in the winter mornings the keepers had to detach them from the ground to which their feathers had been frozen. The cassowaries of Australia were often, during the night, entirely covered with snow; but in the morning they shook their wings and seemed none the worse. In a word, the cold was more hurtful to many indigenous birds, than to species imported from hot climates but of more robust constitution.

In Colorado, it is said, there is a ten-acre field which is really a subterranean lake covered with soil about eighteen inches deep. On the soil corn is cultivated, producing 30 bushels to the acre. If a hole be dug to the depth of a spade handle, it fills with water, and fishes four or five inches long may be caught in it; these have neither scales nor eyes, and are perch-like in shape. The ground is a black marl. In all probability vegetable matter at one time began to accumulate on the open water, and has increased from time to time to the present thickness of productive soil. The cultivation has to be done by hand, the crust not being strong enough to bear the weight of a horse. A person rising on his heel and coming down suddenly can see the growing corn shake all round him. Anyone having sufficient strength to drive a rail through the crust, will find, on releasing it, that it will disappear altogether.

To burn petroleum economically, Herr Deutsch adds 4gr. oil of turpentine and 2gr. camphor, per litre. The wick is covered with dissolved tallow, to prevent passages of gas out or in. The inventor maintains that petroleum so used will burn six or seven hours longer, and with a brighter light, than an equal quantity in the ordinary way.

An interesting new process has been invented by M. Puech, of Mazamet (in France), whereby the wool of sheepskins is transformed into a kind of velvet. Hitherto, sheepskins, tanned with the wool on them, have only been used for mats, the lining of coats, &c., and the adherent wool, not subjected to treatment, is curled or compressed. Now, as the numberless fibres are placed, naturally, in a most regular way, very suitable for production of velvet, M. Puech conceived the idea of cleansing both skin and wool from impurities, and making all the woolly hairs stand independently. After long efforts, he has succeeded in producing this wool-velvet on natural skins. There are 10 principal operations, the first four being concerned with cleaning the skin on the woolly side, the fifth to the ninth with tanning and preparation of the skin, so that a full adherence of the wool to the skin is insured. Lastly, the skin is treated with certain machines, which make a kind of velvet of the wool. (Fuller details will be found in the *D. A. Pol. Zeitung*.)

The following arrangement has been proposed by M. Ledieu for a simple and cheap *pyroscope*, or "preventer" of fire (as he calls it). A cylinder of strong insulating matter is interposed in a circuit. It is filled with a liquid which resists electrolysation, and has good conductivity, increasing considerably with the temperature. (Absolute alcohol is found to serve very well.) At either end, a tight packing is penetrated by a platinum rheophore, connected with the end of the divided circuit. The effect of increased temperature on the liquid is indicated by a galvanometer, the needle of which, at a certain point, sets a bell ringing.

The Royal Library in Brussels, following the example of our British Museum, is to be lit with the electric light. In the National Library of Paris the light is not yet adopted, as the present reading-room is merely provisional.

A curious experiment, illustrating the pressures on the walls of a vessel that contains water, is described by a writer in *La Nature*. To a water-tap you attach a pretty flexible tube of caoutchouc, the lower end of which has a small piece of glass tube bent at an angle. On opening the tap, the action of the water on the tube displaces it, but, owing to the elasticity of the caoutchouc, the direction of this force changes very rapidly, and the tube performs the most varied and strange movements, now like those of a swan, now like those of a snake. With a very thin tube the glass tube may be dispensed with, provided the pressure of water is sufficient, and the movements are very complicated.

A water-bath is kept at constant level by Herr Schimmel, of Elberfeld, by the following simple contrivance: In the water dips a bent tube communicating laterally with the lower part of a stoppered vessel of water on the stand above. The tube has a lateral aperture, which from time to time gets uncovered as the water is vaporised, and the level goes down. whereupon a little air enters the vessel, and a little water enters the bath, restoring the level.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

COMET 1882 a (WELLS).

[20065.]—In my letter last week I find that through forgetting the extent of the field of my comet eyepiece (which in my large instrument has only half the extent, that was in the 7½in.), I had erroneously estimated the tail at 100′ instead of about 55′.

I had a fine view of the comet last night (13h.—14h.); the nucleus was very small and sharp, having the appearance of a brilliant point of light, seen through a nearly opaque opal glass, so as to give it a strong red tint, contrasting curiously to the bluish white of the coma, as also to the light of a star near. The idea conveyed to the mind was certainly that the coma was partially opaque and shining by reflected light from the Sun.

Herbert Ingall.

Champion Hill, May 17th.

[20066.]—Comet a has been observed here on the following nights, with a 3in. aperture and power 80:—

May 17th, 10 15 p.m. to 11.15 p.m.—Nucleus not decided, but similar to a bright star out of focus. No particular change during the observation, but apparently a great amount of luminous vapour surrounding the nucleus, and gradually growing fainter towards the extremity of the tail.

May 18th, 10 p.m. to 10.45 p.m.—Nucleus now decided, and slightly brighter. The tail shorter and narrower. Occasionally, a glimpse of a faint star was had through the tail. The observation generally was not so imposing as previous one.

May 19th.—Not visible; very cloudy.

May 20th, 10 p.m. to 10.45 p.m.—Apparently very little change, either in brightness or in size. The nucleus seemed a little brighter than on previous night, and the tail shorter. There was a small star in the *n.f.* field, towards which the comet seemed to be rapidly approaching; but a dense cloud intervened, which prevented continued observation. During this observation, the tail could not be traced as far by the aid of averted vision as on May 18th. **A. Manock.**

High-street, Doncaster, May 21.

[20067.]—This comet has been frequently observed here since the beginning of April. On April 6th, as seen in my 10in. reflector, the tail was 13′ long, and the nucleus about equal to a star of mag. 7½. This was at 11h., when the moon was above the horizon in E.S.E.

On May 6th, at 10h., the tail was estimated at 40′ long, and the nucleus brighter than a 6th mag. star. The comet was just barely visible to the naked eye.

On May 18th, 19th, and 20th, it had become far more conspicuous. To the unaided vision it looked like a hazy 5th mag. star, with a tail nearly a degree long. Viewed in the telescope at 11h. 30s., on the latter night the tail was traceable over fully 1° 25′, though the sky was not very clear.

As a telescopic object this comet has been extremely interesting, and will continue to be so; but, considered as an object for popular observation, it will prove disappointing, for it will altogether fail to present that magnificent appearance which has been predicted for it. Though it is now brightening very fast, it is approaching the sun so rapidly, and is becoming every night more under the overpowering effects of twilight and moonlight, that it is very questionable whether this comet will ever become a large and attractive object to the naked eye. In this respect it will certainly not be comparable to B 1881, and will probably fall short of Schäberle's comet also.

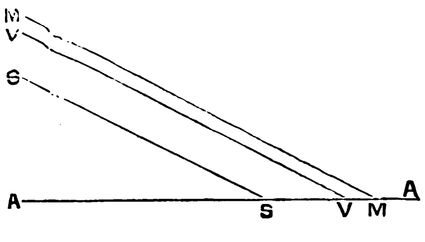
The announcement that a fine comet was discovered near the sun by the eclipse observers in Egypt on the morning of May 17th is important. The probabilities are that this comet is one of great inclination, and has approached the sun, without being observed, from the southern hemisphere, for in view of the vigorous search for comets pursued in America and elsewhere it is difficult to understand how this new visitor could have eluded detection, if visible before perihelion, in northern latitudes. The telegrams announce it as a striking object perceptible to the naked eye. Its position relatively to the sun was determined by photographs; but nothing could be ascertained (owing to the very brief interval during which it could be seen) as to its direction or rate of motion. The rediscovery of this body is, therefore, most important, and observers will do well to scan the whole northern horizon during the next week or two with this purpose in view. Any small telescope, having a large field, can be effectively employed in this work, the comet being a brilliant one, and, should it make its appearance above our horizon, will doubtless be visible to the naked eye.

W. F. Denning.

Bristol, May 21st.

THE PLANET MERCURY.

[20068.]—Comparatively speaking, few persons have ever seen the planet Mercury. It is at present, and will be during this month, in positions most favourable for observation. It can now be seen with the aid of a small pocket telescope, and it will improve for a fortnight. Those who possess equatorials have no difficulty, but many, like myself, are not so fortunately mounted, and have to do the best they can with their alt-azimuth. On the evening of the 16th being very clear in the west, I got my first view of Mercury, and annex a method, by which any one with a small telescope may do so also.



Draw a line A A, and from it upwards, slanting to the left, draw other three lines S S, V V, and M M. A A represents the horizon S S the path of the sun. V V that of Venus, and M M that of Mercury.

Watch the sun, as he apparently comes down the line S S, and note the point on the horizon where he sets. The path of Venus represented by the line V V is parallel to and a little (4°) to the north of S S, while that of Mercury M M is a little more than this (1° 2′).

At the present time Venus can easily be seen after the sun has set. Mercury sets before Venus, and must be looked for to the north of the path of Venus (on the line M M) down towards the horizon. On the 31st of this month, they both reach the horizon within one minute of each other—viz., 10h. 8m. and 10h. 9m. respectively. Venus sets 10° farther north than the sun, measured along the horizon, while Mercury sets 1° farther north than Venus. **L. T. Fleming.**

Berwick-on-Tweed, May 19th.

ASTRONOMICAL EYEPIECES.

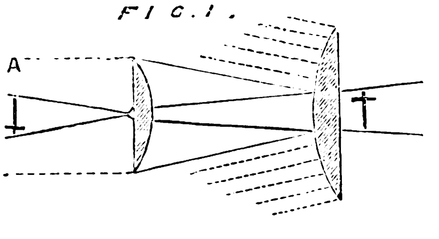
[20069.]—I am glad "Ascalon" has called attention to the very unsatisfactory manner in which the subject of telescope eyepieces is generally treated. Certainly, in this respect, writers of astronomical works have much to answer for, and though, according to Mr. Proctor, the subject may be one of admitted difficulty, this should hardly form a sufficient reason why the diagrams and descriptions should almost invariably be at cross-purposes with each other.

To give one example out of many. The reader of such works will very likely be told that "to magnify an object" means really nothing more than to practically decrease the distance between it and the eye. And that the reason this cannot be done without the aid of a convex lens, is because the rays would not enter the eye sufficiently parallel to produce distinct vision. So far, this is quite clear, and easy of comprehension; but, as if to further elucidate the theory, the attention of the student is next directed to the rays that emerge from the eye-lens of an eyepiece, and which, in the diagrams, are made so convergent that they cross immediately in front of it. This constitutes dilemma number one, for here are two distinct statements, each the opposite of the other, and it is easy to conceive how perplexed a student must be in endeavouring to reconcile them. Further reference to the text will not help him, unless, perhaps, to make it clear that there are gaps in the evidence which the author himself was glad to fill up with a few platitudes concerning the action of prisms and lenses on rays of different angles.

In all telescope eyepieces there are two sets of rays to be dealt with. 1st. The cone of direct rays from the object-glass, which, by the way, is the only one represented in text-book diagrams. 2nd. The rays diverging from the image, and which alone can be utilised for vision. It does not seem to strike these writers—if one may judge by the careful way they delineate the cone-rays—that after the image has been projected, it matters little or nothing whether the cone that conveyed it is refracted sooner or later to a focus, or whether it is stopped off altogether.

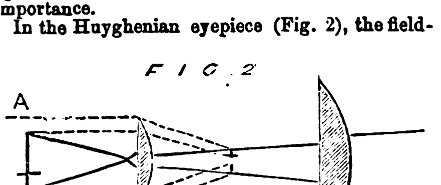
In the positive or Ramsden eyepiece the image is formed immediately in front of the field lens, and hence considerably within its principal focus. The emergent rays, therefore, though not visible, must be extremely divergent (see dotted lines, Fig. 1.) This, no doubt, causes a portion of the light to be wasted, but the loss is more than compensated for, since the spherical aberration is lessened in an equal degree, and results in the agreeably flat field so peculiar to this eyepiece. The action of focussing an eyepiece of this character consists in regulating the distance of the field-lens from the image, and by so doing, closing or opening the paths of the rays until they are sufficiently parallel to suit the eye of the observer. The position of the apex of the cone itself not being of the slightest importance.

FIG. 1.



In the Huyghenian eyepiece (Fig. 2), the field-lens is pushed in until it has passed the image; consequently, both it and the cone are converged simultaneously, the former being formed just at

FIG. 2



the principal focus of the eye-lens, and within the boundary of the cone, whilst the cone itself is continued, as in the Ramsden eyepiece, to an apex, and is not appreciated by the eye. A re-inverted, or erect image may, however, be rendered visible by holding a screen to receive the rays after they have crossed (as at Figs. 1 and 2). They may also be refracted to the visual angle by interposing a plano-convex lens between them and the eye.

Combination, or, as they are termed, pancreatic eyepieces, are usually made on Huyghens' principle, but with an eyepiece of this description the lenses can never be placed closer together than the focus of the eye-lens, since it is evident that the magnified image can be seen distinctly from no other position; consequently, if the lenses are closed beyond this limit the image must be viewed from outside the field-lens, and this would change its character into a modified form of the Ramsden eyepiece.

Aldebaran.

REFLECTORS v. REFRACTORS — DOUBLE-STAR WORK PERFORMED BY AN 18¼in. SILVERED GLASS "CALVER" REFLECTOR: Σ 3121, κ LEONIS, ω LEONIS, φ URSÆ, γ LEONIS, 145 (B) LEONIS, ξ URSÆ, ι LEONIS, Σ 1555, γ VIRGINIS, 35 COMÆ BER., 31 VIRGINIS, 42 COMÆ BER., 25 CANUM VEN.—NEW DOUBLE STARS—DIFFICULTY OF DOUBLE-STAR MEASUREMENT.

[20070.]—The object to which I have chiefly devoted my 18¼in. silvered-glass "Calver" Reflector is the measurement of close binary stars. I have done this not only on account of the interest and importance of this branch of astronomy, but also for the purpose of contributing somewhat to the much-debated question of Reflectors v. Refractors. It is frequently stated that reflectors are unsuited to this class of work for want of adequate defining power, and no less an authority than Mr. Burnham seems to be of this opinion. I wished, therefore, to test the question with a really fine mirror, and as Mr. Calver has furnished me with one of unsurpassed excellence, I have had the opportunity of doing so. After two years' experience with this instrument, I have ventured to form the opinion that Mr. Calver's mirror will perform work which would go hard to rival that of the great Chicago refractor, were the two instruments placed side by side, and tried by the same person on the same objects. I do not mean to say that in my hands, and in this climate, my instrument can rival Mr. Burnham's work with the Chicago refractor, for I do not think that the atmospheric conditions are, in England, ever so favourable as to render such work possible with any instrument, refractor or reflector. Nor, perhaps, shall I be far wrong in supposing that no other eye than Mr. Burnham's could have performed it even in Chicago;—but, place the two instruments side by side, an observer unaccustomed to either, would not perhaps find so very much difference in their performance.

However, as the above test is impossible, I will, with your permission, from time to time, lay before your readers such measurements of binary and other stars as I am able to make. The instrument is, as I have said, an 18¼in. silvered-glass reflector, the mirror having been figured by Calver. It is mounted on a Berthon "saddle-back" stand, and driven by clockwork. The observatory is a "Romsey," with a transit-room attached. The micrometer is an excellent one, by "Cooke," of York, and I can use either bright wire or bright field illumination. The whole of the apparatus belonged formerly to the Rev. Henry Cooper Key. I may also premise that I never give a measure of a star without I am certain that I have divided it, and that I endeavour as far as possible to divest my mind of previous knowledge before taking the measures.

Commencing with the IXth hour of R.A., I have the following measures:—

Σ 3121. R.A. 9·10, Mags. 7·5, 7·8
P = 33·5° D = 0·51″ Ep. 1881·23
P = 214·0° D = 0·51″ Ep. 1881·25

(1) *κ Leonis.* R.A. 9·17, Mags. 4·9, 10·7
P = 207° D = 2·89″ Ep. 1881·15

ω Leonis. R.A. 9·22, Mags. 6·2, 7
P = 88·3° D = 0·52″ Ep. 1881·23
P = 82·0° D = 0·31″ Ep. 1882·36

φ Ursæ Maj. R.A. 9·44, Mags. 5, 5·6

I fancied this star to be dumpy in direction 90° and 270°, but cannot be sure.

Ep. 1882·36

γ Leonis. R.A. 10·13, Mags. 2, 3·5
P = 111·0° D = 3·1″ Ep. 1881·13
P = 114·3° D = 3·5″ Ep. 1882·36

(2) 145 (B) *Leonis.* R.A. 10·14, Mags. A 7·8, B 8·3, C 9·3
AB. P = 281·5° D = 0·4″ } Ep. 1881·23
AC. P = 12·0° D = 7·7″ }
AB. P = 274·0° D = 0·4″ Ep. 1882·26

ξ Ursæ Maj. R.A. 11·11, Mags. 4, 5
P = 88·6° D = 1·8″ Ep. 1881·39
P = 76·0° D = 1·4″ Ep. 1882·36

ι Leonis. R.A. 11·17, Mags. 3·9, 7·1
P = 66·0° D = 1·82″ Ep. 1881·24
P = 63·0° D = 2·58″ Ep. 1882·36

This is a double star of exceptional beauty.

(4) Σ 1555. R.A. 11·30. Mags. A 6·4, B 6·8, C (?)
AB. P = 162·0° D = 0·52″ } Ep. 1881·24
AC. P = 148·0° D = 20·51″ }
AB. P = 160·0° D = 0·72″ } Ep. 1882·27
AC. P = 145·0° D = 21·03″ }

(5) *γ Virginis.* R.A. 12·35. Mags. 3, 3.
P = 156·3° D = 5·1″ Ep. 1881·39
P = 158·0° D = 4·8″ Ep. 1882·36

(6) 35 *Comæ Ber.* R.A. 12·47. Mags. 5, 7·8.
AB. P = 62·4° D = 1·0″ Ep. 1881·40
AB. P = 60·0° D = 0·9″ Ep. 1882·36

(7) 31 *Virginis.* R.A. 12·35. Mags. 6, 12.
P = 30·0° D = 4·3″ Ep. 1881·24

(8) 42 *Comæ Ber.* R.A. 13·4 Mags. 6, 6.
P = 13·5° D = 0·53″ Ep. 1881·41
P = 20·0° D = 0·4″ Ep. 1882·36

(9) 25 *Canum Ven.* R.A. 13·32. Mags. 5, 7·6.
Comes not seen. Ep. 1881·39
P = 152·0° D = 0·35″ 1882·26
P = 162·0° D = 0·31″ 1882·36

1. Very easy: a beautiful pair, 4·9 golden, 10·7 blue.

2. Beautifully separated: two lovely little discs.

3. H_2, quoted by Gledhill in his invaluable "Handbook of Double Stars," says of this famous binary:—"A double star, in which the two stars are nearly equal, connected undoubtedly in a binary system by their mutual gravitation, and revolving round their common centre of gravity, with a motion so rapid as to admit of being traced and measured from *month to month* must be allowed to be a phenomenon of no common interest, and deserving every attention both from the practical and theoretical astronomer." Period about 60 years.

4. Gledhill, in the "Handbook," says that of A C no other measures but Smyth's are known, which are: P = 145.0°. D = 17·0″. Ep. 1834·31. C, however, is egregiously palpable.

5. A splendid pair of suns: single in 1836.

6. Difficult: requires a fine night to see close and small companion.

7. One of β's discoveries: 12m.; bears illumination well.

8. Σ., the discoverer, quoted by Gledhill, says, "This star is worthy of all attention, for there is a suspicion that its period is smaller than that of ξ Ursæ Maj." Period about 25 years.

9. This star is very difficult, and cannot be seen unless def. is very good.

The following are, I believe, new doubles discovered by me:

Nova. R.A. 9·27. Dec. 15·0. Mags. 9, 14.
P = 108°. D = 8·2″ Ep. 1881·25.

Colours: White, bluish-white.

Nova. R.A. 18·3. Dec. 9·20. Mags. 8·5, 10.
P = 305·0°. D = 2·0″. Ep. 1881·38.

This is a new double. β kindly measured it as follows:—

P = 306·5°. D = 2·75″
Nova. R.A. 15·39. Dec. 31·52. Mags. 8·5, 14.
P = 121·0° D = 3·1″ Ep. 1881·40.
Nova. R.A. 17·57. Dec. 33·14. Mags. 5, 12.
P = 108·0° D = 15·0″ Ep. 1881·40.
Nova. R.A. 16·59. Dec. 19·46. Mags. 7·5, 10.
P = 224·0° D = 1·2″ Ep. 1881·41.
β measured this as follows:—
P = 225·0° D = 1·81″
Nova. R.A. 12·53. Dec. 19·0. Mags. 10, 10.
P = 105·0° D = 1·2″ Ep. 1882·34.

The magnitudes of the new stars are estimations: for those of the other pairs I am indebted to the "Handbook of Double Stars," by Messrs. Crossley, Gledhill, and Wilson, a work which is quite indispensable to all double-star observers.

Those of your readers who have ever been themselves engaged in the work of double-star measurement, will know its extreme delicacy and difficulty; and unfortunately the atmospheric conditions required for very close doubles are such as are found here only on an exceedingly limited number of nights in the year.

Jevon J. Muschamp Perry.

St. Paul's Vicarage Observatory, Alnwick.

WENHAM'S NEW MICROSCOPE.

[20071.]—Letters signed by Mr. Wenham and Mr. Moss give "an unqualified denial" to the obvious fact that the stands recently patented by these gentlemen are unacknowledged appropriations of the principle enunciated by Dr. Edmunds at the Royal Microscopical Society. Mr. Wenham attempts also to minimise the value of the principle. Mr. Moss, on the other hand, asserts that his stand "was devised long before Dr. Edmunds's words were uttered, and primarily for a purpose in the perfecting of microscopical vision which, judging from my letter, I have as yet failed to grasp."

Messrs. Ross and Co. also write, but carefully abstain from touching questions of fact. There remain, therefore, only the three allegations to answer.

I. If Mr. Moss ever had in view any object other than the appropriation of the principle enunciated by Dr. Edmunds, he has forgotten to claim that object in the specifications of his patent.

II. The statement:—"There can be but little claim to invention in this idea, and it might readily occur to any one looking at the illustration of the Wale microscope then published," comes very badly from Mr. Wenham, about an idea which he rushed down to the Patent Office to appropriate. I quite admit that any fool can see the principle at once, *after it has been pointed out*, though it is not every fool who would attempt to appropriate, by means of small mechanical contrivances for applying it, a leading principle in microscopical construction which had been enunciated *pro bono publico* at a scientific society, and amply published in its journal. But the answer to Mr. Wenham is this:—Mr. Wale never saw it, Dr. Carpenter never saw it, no other Fellow of the Society saw it; Mr. Moss, who was there in person, and "Messrs. Ross and Co.," who were there in proxy, never saw it, nor, after the principle had been enunciated by Dr. Edmunds, did either of these astute gentlemen rise to say that it had ever before been suggested. Mr. Swift, at the close of the meeting, asked Dr. Edmunds for permission to adopt the construction in his students' microscopes—a permission which was then given, together with further explanations on the various ways in which the principle could be applied. While this explanation was going on, Mr. Moss was sufficiently interested in the matter to stand by and carefully listen among other gentlemen who were there.

The pages of the *Journal* of the Royal Microscopical Society for the previous years show scores of drawings of stands, in no one of which had this principle ever been shadowed out. An inspection of the stands now in the window of Messrs. Ross and Co.'s warehouse will further demonstrate that their newest stands show no trace of this principle, but are all swung on the same absurd eccentric arrangement as for a whole generation made our revolving stages only a ridiculous complication. Had Messrs. Ross and Co. ever yet realised the importance of this new principle of construction which they seem to have had some share in the attempt to appropriate, it could not be imagined that they would have continued to accumulate on hand such a stock of those really awful and ridiculous swinging substage stands—a stock which will have to be either remelted or sold off by Dutch auction, as was recently done with a cartful of other stands. So much for the originality of the principle. As to its value,—not yet admitted by either of the gentlemen who have attempted to appropriate it—I venture to predict that it will govern the construction of all future microscopes as completely as the concentric principle now governs the construction of revolving stages.

III. The value of the "unqualified denial" which is given by Mr. Wenham and by Mr. Moss will be shown by comparing the dates and the specifications of these gentlemen's patents, each of which may be got from the Patent Office by sending 6½d. in stamps.

1. In the discussion upon Dr. Carpenter's demonstration of the Wale microscope,—

"Dr. Edmunds pointed out that this most useful microscope-stand would be vastly improved if only the arc upon which the body turns were so constructed that the centre of the circle of which the arc forms part were made to coincide in position with the centre of the stage. The object would then undergo no movement of translation, either in rotating the stage or in turning the tube from the vertical to the horizontal. In rotating the stage, the object would turn upon the optic axis; in moving the tube into various degrees of obliquity, from 0° to 90°, the object would rotate upon its horizontal axis. The result would be that, with a thin stage and a hemispherical lens in immersion contact with the under-surface of the slide, all the complicated swinging substages and other contrivances now upon the table might be swept away, and every angle of illumination could be got by merely inclining the body of the microscope upon its sustaining arc. There would only be needed a lamp on a level with the object, with a condenser at its focal distance standing upon the table in line between the lamp and the object."

In this paragraph there is enunciated, amply and unequivocally, the concentric principle—*i.e.*, that of making the object the centre about which the optic-plane revolves, as well as the centre about which the stage-plane revolves. The optic-plane being vertical, and the stage-plane at right-angles thereto, it follows that the optic-plane will always turn upon that point in a horizontal line in the stage-plane at which the object is located, while the stage-plane will turn reciprocally upon that point of the optic axis at which the object is located. In microscopes previously constructed, the optic plane rotates, not upon a point in the optic axis, but upon the point at which the optic tube is pivoted—i.e., from 3in. to 5in. behind the optic axis, and, therefore, on inclining the microscope body, the object is displaced or translated along an arc of from 3in. to 5in. radius, instead of remaining in its place as a general centre to the microscope, so as to be susceptible of exactly those refined orientations in reference to a fixed light which are needed in order to command all its optical reactions.

2. The above cited remarks having been made on Nov. 10, 1880, were published in the *Journal* of the Royal Microscopical Society on Dec. 13; and on Dec. 22, just nine days later, Mr. John Matthew Moss left at the Patent Office a provisional specification, the following being the text of his claim:—

"This invention relates to improvements in microscopes, and consists of a method of mounting the body or portion carrying the lenses on a stand so constructed as to be capable of presenting the instrument together with the object in every possible position with regard to an illuminating ray proceeding in a fixed direction, so that every possible variety of illumination—from direct front light to the last degree of obliquity at which a ray of light will enter a surface of glass—can be obtained without the interposition of any substage or subsidiary apparatus whatever, without once losing sight of the object or the light. To effect this, I mount the body together with the stage upon an arm capable of rotation in a vertical plane, the centre of which rotation is exactly in a horizontal line with the object when the latter is in the focus of the objective. In other words, the line of rotation of the body and stage is exactly in the focal plane of the objective.

"The cradle or other joint upon which the instrument turns to effect this is attached by means of a pillar or pair of pillars to a horizontal rotating plate, the centre of rotation of which is exactly beneath and in a line with the optical axis of the microscope when the instrument is in a vertical position.

"I thus obtain two motions, one in altitude the other in azimuth, so related to each other as to be capable, when used separately or in combination, of presenting the object together with the body in any position towards a ray of light proceeding from a fixed point or in a fixed direction. This ray I obtain by means either of a lamp mirror, &c."

There follows a claim for improvements in the stage invented by Tolles, and in the specification itself, filed on June 22, 1881, Mr. Moss thus formulates his claim (lines 11-15, p. 4):—

"I declare that what I claim as the invention, to be protected by the hereinbefore-recited letters patent, is,—

"1st. Mounting the body of the microscope together with the stage upon a stand so constructed as to permit of their rotation about two axes, so arranged with regard to each other and to the other parts of the instrument that the body and stage may be presented at any angle to a fixed ray of light, substantially as herein specified and illustrated in the drawings.

"2nd. In a mechanical stage the combination of two pinions on the same vertical axis with two racks at right angles to one another operating independently or in combination to impart motion in any direction to the slide, substantially as specified. In witness, &c."

Now, setting aside the claim for improvements in Tolles' mechanical stage with which we now have nothing to do, and ignoring the fact that Mr. Moss imagines that there is a limit to "the obliquity at which a ray of light will enter a surface of glass"—a statement which throws much light upon his knowledge of optics—his patent amounts to absolutely nothing but an attempt to appropriate the important principle laid down by Dr. Edmunds, and he attempts to do this by means of the invention of a lateral pivot for the "horizontal axis" defined by Dr. Edmunds. The "drawings" consist precisely of the one figure already given in the *Journal* of the Royal M.S. and in the ENGLISH MECHANIC. In the formal specification, filed six months after the original one, Mr. Moss solemnly reproduces his delusion with regard to "the last degree of obliquity at which a ray of light will enter a surface of glass." Of course, every tyro in optical science knows that there is no such limit. So much for Mr. Moss and his assertion of having compassed some other "purpose in the perfecting of microscopic vision which I have as yet failed to grasp."

3. Mr. Wenham did not leave his provisional specification till Jan. 12, 1881, some two months after the meeting at which the principle had been enunciated by Dr. Edmunds. Mr. Wenham's provisional specification runs thus:—

"The first improvement relates to the stand for carrying the limb body of the microscope. The stand consists of a segment of a circle or sector extending behind the limb and beneath the stage. The centre is from a point in the axial line of the microscope body, slightly above the stage, and in the plane occupied by an ordinary slide thereon, so that when the microscope is inclined by a rack or pinion movement, or otherwise to or from the observer, the object in focus is at the centre of rotation. The sector passes between guides or jaws upon a base with an arrangement for fixing the instrument at any inclination. The microscope is attached to the sector by an axis, so that it can be inclined on either side; the centre line of this axis also intersects that of the body in the plane of the object on the stage. The base turns on a foot-plate, the axis of which is also in a perpendicular line intersecting the object. The edge of this foot-plate may be divided into degrees for measuring apertures, and indicating angles of illumination. When the microscope is inclined backwards by the sector movement or turned sideways on the back axis, or rotated on the base footplate, these movements, used either separately or combined in all directions, admit a ray of light from a fixed source to reach the object, as all the movements radiate from this as a centre."

"The second improvement is for an application of anti-friction rollers for the fine focussing movement of microscopes, &c., &c."

"The third improvement is for a simplified form of thin mechanical stage, &c., &c."

With neither of the latter claims have we anything to do; but I may remark that Mr. Wenham's stage claim is to me indistinguishable from that of Mr. Moss's; both also seem to me to be little more than appropriations of the Tolles stage by means of the Tyrrel milled heads, so long used horizontally by Powell and Lealand. With regard to Mr. Wenham's new stand, it is simply an appropriation of the principle of co-ordinate axes and reciprocal rotations enunciated by Dr. Edmunds. It is quite true that the base is very large and heavy, and that, as Mr. Wenham claims, this base brings the centre of gravity very low. But this only secures the stand against being overturned; it does not give stability to the parts that are jointed on above. The additions in Mr. Wenham's stage are not new, and are, in my opinion, useless and expensive complications. So much for the "unqualified denials" of Mr. Moss and Mr. Wenham.

Another F.R.M.S.

[20072.]—So far as regards the backward inclination of this microscope in an arc whose centre is the object on the stage, I beg to say the principle cannot be the discovery of Dr. Edmunds because of some words spoken by him in November, 1880. My reason for this assertion is a very plain one: When I was in New York, about four years ago, I saw a good deal of Mr. George Wale, the designer of the "Wale" microscope. The possibility of making his sliding limb move concentrically with the object—the very point mentioned in the quotation of Dr. Edmunds's criticism of Wale's microscope, cited by "Another F.R.M.S." on page 217—was the first scheme tried by Mr. Wale, and he gave it up because he found he could not succeed with it without producing an unsightly limb.

Mr. Wenham appears to have overcome the difficulty by making his sector *not* the limb itself, but an exterior carrier for the limb.

I do not see any resemblance between this arrangement and that actually adopted by Mr. Wale, nor do I see the slightest justification in the claim made on behalf of Dr. Edmunds.

Yet Another F.R.M.S.

[20073.]—As I understand "Another F.R.M.S.," the claim he sets up on behalf of Dr. Edmunds to be the originator of the main principle of Wenham's new microscope is based on a suggestion made by Dr. Edmunds, on Nov. 10, 1880, for improving Wale's microscope.

The main principle of Wenham's new microscope is, that all the movements radiate from the object as a centre.

The suggestion made by Dr. Edmunds was, that Wale's stand would be improved by striking the radius of the sliding limb from the object as a centre. The reason he gave for the suggestion was the sufficiently obvious one,—that, with the limb so altered, "every angle of illumination could be got by merely inclining the body of the microscope upon its sustaining arc."

Dr. Edmunds made this suggestion as though he were the first to have thought of it. But, unfortunately for his originality, a curious coincidence occurred with reference to this very subject. Mr. Wenham worked out the idea on the drawing-board some two years before, when Wale's stand was first figured in the *American Journal of Microscopy*, and abandoned it as unsatisfactory.

Strangely, too, within a day or two after the meeting of the Royal Microscopical Society on November 10, 1880, when Dr. Edmunds first made his suggestion, he communicated his idea to Mr. Swift, the well-known optician; Wale's microscope was placed in Mr. Swift's hands, expressly that he might have a fair opportunity of improving upon it. The result was *nil*,—Dr. Edmunds's plan was found to be a failure. In proof of this, I adduce the fact that, in the microscope issued by Mr. Swift, based on Wale's, the sliding limb is not modified, as Dr. Edmunds recommended, but is an exact copy of Wale's. Clearly, then, when Dr. Edmunds himself deliberately undertook the alteration of Wale's microscope, in the direction he had recommended, unforeseen difficulties cropped up with which he was unable to cope, and hence his suggestion was abandoned—precisely as Mr. Wenham's attempt in the same direction had been abandoned some two years before! And yet this criticism on Wale's microscope, this suggestion which Mr. Edmunds himself failed to embody, and which Mr. Wenham had tried two years before, is adduced by "Another F.R.M.S." as "the source of the inspiration from which Mr. Wenham drew his design"!

"F.R.M.S." has pointed out some of the devices by Grubb, Nachet, Tolles, and Zentmayer, in which the problem of oblique illumination, by means of movements radiating from the object as a centre, has been dealt with more or less effectually. And it is abundantly evident that Wenham's new microscope must be regarded as the natural outcome from these devices.

That "Another F.R.M.S." should claim "for Dr. Edmunds, and for him alone," "the merit of this important principle of construction," which he elsewhere terms "the great new principle of microscopic construction," shows simply that he is unfamiliar with the progressive genesis of the microscope.

The plain fact is, the principle embodied in Wenham's new microscope cannot justly be claimed for any single individual; it has been gradually developing from the quite early days of the microscope—more rapidly from the date of Grubb's invention of the substage-arc, and still more rapidly since Zentmayer's swinging tail-piece was exhibited at the Philadelphia Exhibition in 1876.

Akakia.

MICROSCOPE POWER.

[20074.]—IN the R.M.S. *Journal* there is now presented, in tabular form, the assumed magnifying power of eyepieces of the principal London makers with the magnifying power of various objectives *alone*, of different focal lengths, on a 10in. tube; and the united magnifying power of each objective combined with each eyepiece. The table is, perhaps, more useful in suggesting how the amateur may conveniently specify, for ready reference, the capabilities of his "battery," than in affording definite information; and I venture to offer for your columns a partial statement, founded upon this example, of the details of magnifying power provided by an ordinary well-furnished instrument of full size.

The *Journal* article, in which this information was first introduced, expresses surprise that the combined magnifying powers of eyepieces and objectives, as published by their makers, should in some instances give actually different values for the magnifying effect of the same eyepiece. There can be no doubt of the fact, paradoxical as it may seem, if the comparisons be made with objectives of widely different focal length, using the same eyepiece, and the draw-tube closed, in each case. The reason appears to be, that the length of the draw-tube practically varies, according to the length of the objective itself, and the distance at which it stands from an object in focus. And, of course, as the length of the draw-tube varies, so does the magnifying power of the objective. For example, suppose the magnifying power of a 1½in. o.g., at a distance of 12in. from object to image, to be 7·5 times; and of a ¼in. o.g., under like conditions, to be 100 times. Suppose also that the magnifying power of an A eyepiece has been determined independently to be five times exactly. The eyepiece, being of low power, enters some 2in. into the draw-tube. The image from the objective must be formed in the focus of the eye-lens of the eyepiece, and that point happens to be 0·9in. below the top of the draw-tube when the eyepiece is pushed home. Also, in the example supposed (which is derived from experiment), the top of the draw-tube—*i.e.*, the milled edge against which the rim of the eyepiece abuts, is 11·9in., from the object when in focus with the draw-tube closed. Moreover, the effect of an alteration of 1in. in the length of the draw-tube, is a change in the magnifying power of the 1½in. objective of 0·7 times. Consequently, as the image is formed 11in. instead of 12in. from the object, the actual magnifying power of the objective is reduced to 6·8 times. If now, the combined image, as seen in the eyepiece, be projected by the camera-lucida at 10in., the total power will prove to be about 34 times—which is the product of the two magnifying powers taken separately; and if this be divided by 7·5, neglecting the change which has been virtually made in the length of the draw-tube, the power of the eyepiece comes out 4·53 times instead of 5.

Similarly, with the ⅛ objective, the distance from the object in focus to the top of the draw-tube is 11·2in., and the magnifying power of the objective, alone, is altered seven times by a change of an inch in the length of the draw-tube. Using the same eyepiece as before, that length (from object to image) is 10·3in., instead of 12in.—being reduced 0·8in. by the shorter length of the objective, and its nearer approach to the stage; and, 0·9in., as before, by the formation of the image in the middle of the eyepiece below the top of the draw-tube. Consequently, the actual magnifying power of the objective is now only 88·1 times; and a projection at 10in. of the combined image will show a total amplification of about 440 times: this, divided by 100, gives 4·44 for the effect of the eyepiece; another value again. It is, therefore, obvious that, when measures are taken with a closed draw-tube, whose virtual length will vary with different objectives, the effect due to the same eyepiece may apparently differ, because the effect due to the objectives individually has been calculated at the same fixed distance.

That distance in the article referred to is taken at 10in. But the large stands, now so general, do not permit this comparatively short length of tube for the interval between the conjugate foci at which the object and image are placed. A more convenient assumption is 12in., and for very low powers, such as a 4in., a distance of 14 may be necessary.

It would be unreasonable to ask you to print particulars of a full series of objectives; the details of a few will suffice.

OBJECTIVES.

Focal length in inches.			Aperture.		For ·005 cover-glass.			Magnifying power.		
Nominal.	Actual (no adj.) (*a*)	Less for 10 div. adj. (*b*)	In air. (*c*)	Numerical. (*d*)	Best adj. (*e*)	Working distance. (*f*)	Diam. field. (*g*)	At 12in. (no adj.) (*h*)	Difference per in. of d. t. (*k*)	Add for 10 div. adj. (*l*)
3in.	2·25	—	12°	·11	—	2·01	·36	3 46	0·5	—
$\frac{2}{3}$	·669	—	32°	·27	—	0·26	·077	15·9	1·4	—
$\frac{1}{4}$	·251	·008	76°	·61	7·5	0·07	·039	45·3	3·8	1·7
$\frac{1}{8}$	·121	·009	146°	·96	6	0 012	·015	100·	7·0	8·0

Eyepieces (*m*)	A	B	C	D	E	K_1	K_2
Focal length (*n*)	2in.	1·28	·806	·588	·429	1·25	·71
Varies length of d. t. (*o*)	−0·9in.	− 0·2	+ 0·1	+ 0·2	+ 0·3	− 0·8	− 0 3
Magnifying power (*p*) ..	5	7·8	12·4	16·7	23·3	8·	14·

Draw-tube closed.			Combined magnifying power of objectives and eyepieces.						
O.G.	Distance to top of d. t. (*q*)	Power of o.g. alone. (*r*)	A	B	C	D	E	K_1	K_2
3in.	13 3in.	4·11	18 3	31·3	51·6	70·3	99·2	29·7	55·4
$\frac{2}{3}$	11·4	14 78	67·6	113	185	251	354	109	201
$\frac{1}{4}$	11·05	42 05	193	322	529	715	1006	312	572
$\frac{1}{8}$	11·2	94·4	440	725	1178	1600	2218	710	1292

(*a*) This value was determined, (i.) by Mr. Cross's well-known formula $f = \frac{n\,l}{(1 + n)^2}$: where n is the ratio of image to object, and l the distance in inches between them. A convenient method of obtainining n is with a ruled stage micrometer, and Jackson's eyepiece micrometer; the actual distances of their respective divisions being first carefully ascertained. It is important that nothing besides the objective should intervene between the scales, and therefore the "field-glass" must be temporarily removed if a Huyghenian eyepiece be employed. The true focal length of each objective was also tested (ii.) by using it as an eyepiece upon a telescope of known (147·7in.) focal length, and calculating the magnifying power, after adjustment to stellar focus, with the aid of a double-image dynameter. For all but extreme cases, such as 1-20in. and a 4in. objective, with which the difficulty of measurement is considerable, the agreement was all that could be desired.

(*b*) The above values were taken with the lenses of the objective "open"—i.e., at "uncovered." A movement of the adjusting collar, to correct the o.g. for covered objects, approximates its lenses, thus shortening their combined equivalent focal length, and increasing the magnifying power of the objective. This column shows the effect in diminution of focal length of one whole turn, or 10 divisions, of the adjustment collar; and the effect of more or less "adjustment" may be taken proportionately: though certainly there are some objectives to be met with, in which the collar can be moved through several divisions before and after a corresponding effect is produced by correcting the mutual position of the lenses.

(*c*) This was found by admitting parallel solar rays to the back of the objective placed horizontally, receiving the emergent cone of light upon a vertical screen, measuring the height and base of the cone and calculating its angle.

(*d*) This is a matter of faith rather than sight. The figures in the column are the readings for each objective on a glass semicircular disc known as the Apertometer of Prof. Abbe. The apparatus has been described in the "E. M."; and also, with copious discussion of the "Aperture Question," in recent volumes of the R. M. S. *Journal*. I may mention here an experiment which is somewhat perplexing. Suppose an oil-immersion o.g. is tested by the apparatus, and in the first instance focussed *dry*, and the reading taken; then let a drop of pure water be interposed, the readings instantly increase considerably, and the field becomes brighter. Next, let the water be completely removed, and oil of cedar substituted; the readings generally increase again, to some extent, but not much; and oil-immersion o.g. are to be met with, and good ones too, which show no increase of aperture whatever, by this apparatus, with oil as compared with water. Of course this digression is not meant to imply that oil lenses can be *used* either dry or with water.

(*e*) It is convenient to register the amount of collar-adjustment with which an objective is found to perform most successfully over a given thickness of cover-glass. At the same time, unless this thickness be previously marked upon a slide, it is not easy to ascertain it precisely. Directions have been given to measure the apparent thickness by the "fine movement," first focussing the object, and afterwards dust upon the cover-glass, so as to determine the real thickness by calculation. But the result so obtained will depend upon the index of refraction assumed for the glass; and this assumption may be largely erroneous.

(*f*) This is readily measured by the fine movement, aided, for low-power o.g., by a scale and vernier on the principal limb and racked slide of the microscope—if that convenience should exist.

(*g*) The actual diameter of field shown at one view, by the lowest eyepiece; the objective being uncorrected; i.e., having its adjustment-collar at zero.

(*h*) The most intelligible way of considering magnifying power is to separate it into its component parts—so much due to the objective, and so much to the eyepiece. The latter will evidently magnify an image the same number of times wherever it happens to meet with it, in focus; whereas the size of the image formed by the objective will depend upon the distance from the object at which the image is formed and viewed. Throughout the present examination, the stage-micrometer and the eyepiece-micrometer were kept precisely 12in. apart, giving a uniform comparison for all the objectives. Those possessing adjustment divisions were used with the collar at zero; and a ruled glass stage-micrometer, which had been detached from its slide, was inverted and focussed as an "uncovered" object. The figures in this column denote the number of times the object was thus magnified by each o.g.

(*k*) An increase in the length of draw-tube leads to a corresponding increase in magnifying power. The additional number of times per inch of tube, here specified, may be considered constant for such distances from the object as are practicable—viz., about 11in. to 15in., with the instrument employed.

(*l*) As remarked under note (*b*), the magnifying power of an objective is also increased by adding to the divisions of its adjustment collar, and this column shows the additional number of times due to the first 10 divisions of adjustment.

(*m*) The eyepieces, A to E, are Huyghenian; K_1 and K_2 are of the Kellner form, giving plenty of light and a large field.

(*n*) Their focal length was obtained by combining them successively with a hom. imm. objective of nearly 1-14in. measured focal length; and in each case the draw-tube was so adjusted that the eye-lens of the eyepiece should receive the image transmitted by the o.g. at the same distance of 12in. from the stage micrometer. The stand carrying the tube in a horizontal position, the image from the eyepiece was projected by the camera-lucida on a rule placed horizontally 10in. below the axis of the microscope, and the position of the rule was tested with a thin plumb-line for each eyepiece. This gave the total magnifying power in the usual way, and the power due to the objective alone at the prescribed distance having been previously determined, a process of simple division gave the magnifying power due to the eyepiece alone, when the combined image was projected at 10in. Lastly, dividing this number 10 by the power thus found for each eyepiece, the quotient was the focal length of each. And the value thus obtained agreed, to the first place of decimals, with that derived from the telescope, applying the eyepieces to the latter as described in note (*a*).

(*o*) The measurements of tube-length have been taken uniformly to the top of the draw-tube. But that point did not coincide with the focus of the eyelens of the eyepiece; generally this focus was below the tube-top, thus virtually shortening its length; though in the "deeper" eyepiece, this focus is outside the draw-tube. Consequently, a correction becomes necessary in determining, by calculation and without experiment in every case, the total power employed.

(*p*) See note (*n*) above.

(*q*) When the draw-tube is closed, and an object in focus on the stage, these are the least distances, for the several o.g., at which an image can be formed at the top of the draw-tube. Collar adjustment, zero.

(*r*) This shows the corresponding magnifying power, due to these altered distances, slightly different for each objective, as compared with those given in column (*h*) for the uniform distance of 12in.

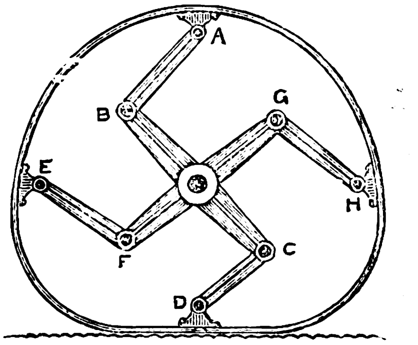
And finally, the table of combined magnifying power shows at a glance the total amplification derived from each objective (without adjustment) when associated with any eyepiece (the draw-tube being closed.) When the draw-tube is not closed, and when divisions have been taken on the objective-collar, corrections are necessary. For example, the power of a 4-10in. o.g. alone, at its nearest distance of 11·2in., with closed draw-tube, is 26·95 times; the increase for 1in. of draw-tube is 2·5 times, and for 10 divisions of adjustment 0·75 times. It was used at a distance of 11·7in., with 8 divisions of adjustment, and with the B eyepiece, required the power. The nett increase of draw-tube is 0·3in., eqvivalent to 0·83 times; and the increase due to 8 divisions of collar is 0·6 times; adding these to the 26·95, we have 28·38 for the o.g alone, and multiplying that by 7·8 (the power of the eyepiece), the combined power proved to be 221, and it was exactly verified by projection.

Antares.

P.S.—Can you persuade "F.R.M.S." to give us a paper explaining how the conditions of a slide can best be distinguished—viz., whether the object is on the slide or on the cover; whether it is mounted "dry" or in balsam, or other medium; and what would probably be the best method of illumination in each case?

THE PARADOX WHEEL.

[20075.]—So called from its appearance; for seeing that all the internal parts *a b c d*, and *e f g h* are pivots which support the whole of the internal parts, and that the cross in the centre is also free on the axle after the manner of a pair of scissors, a collapse appears inevitable; whereas the axle continues as firmly in the centre as in the ordinary wheel with fixed spokes, and the elastic tire gives way, and flattens on the ground with the same freedom as if the load were merely placed on the top of the elastic tire: and (as I shall show) gives us a base equal to the sleepers which (on a railway) support proportionately a locomotive engine. See Fig. 1. This wheel might also be named the leg wheel, or the walking wheel, from its appearance.



By publishing this invention, I am showing to our readers my "trump card"; for so important is a means of reducing the horse-power required for traction on a common road to the same low amount (for the same load) as is required on a railway, that its general adoption would amount to a revolution in locomotion on common roads.

I am aware that others have tried to effect the same object; but one mistake has been, to make the internal part of a wheel elastic; whereby the load only descends nearer to the ground, instead of the tire becoming uniformly flat next the ground, as is the case in this invention. In other designs, the two wheels on each side have not been independent of each other, whereby guiding has been prevented.

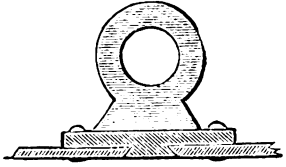
In order to show that my object has been attained, I will explain why it is, that so great a proportionate tractive power is required on the common road.

The common wheel acts somewhat after the manner of a cheese-cutter, and grinds to powder annually millions of tons of road metal, and also falls into, and has to be dragged out of, every rut, little and big: this amounts to a lot of uphill work, and accounts for the extra power required. By the adoption of my invention, these evils are avoided; as there is always a base or foundation sufficient to make the tractive power no more than that of a railway on the same gradients—mind, I say, on the *same* gradients; which we know are more favourable on a railway.

To compare: Let us suppose a cart has 5ft. wheels, and the tire to flatten ⅛th or about 2ft.; width, say, 4in.; total surface bearing 1ft. 4in.; and, say, total weight, 1½tons. Now, a locomotive engine will weigh about 24 times this, which, × 1ft. 4in. = 32ft. super. for sleepers, which, divided by, say, 5 sleepers, gives each 8ft. 7in. long by 9in. wide, which is not far from the truth.

The tires should be one piece of spring steel, tempered clock-spring, of width and thickness as engineering data may dictate. The ends of the tire may be riveted to the bearing, same as the other three, but the ends must be shut into the dovetail, cast as part of *one* of the four bearings, which is shown at bottom of Fig. 2. The other parts of the tire should be *malleable* cast iron.

FIG. 2



Other advantages resulting are, that carriage-springs are needless, the tires being themselves the springs; and all noise, jolting, and vibrations, are done away with, so that the motion will be as easy as can well be imagined.

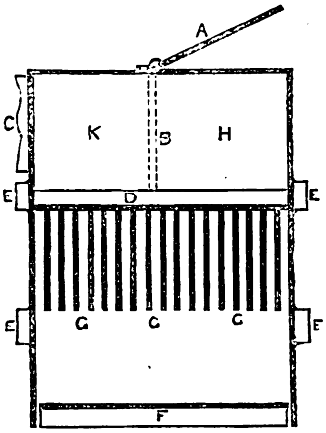
About nine years ago I had a model pair of these wheels made, 21in. diam., which were put by, waiting for a change in those blessed Patent Laws existing in this heavenly-governed country; but now I shall expect to have joined the great majority before this desirable change takes place.

To conclude, I will (from an inventor's point of view) speculate on the results of the delay. Millions laid out in tramways, millions of tons of road metal powdered, to be replaced by new, to "rattle our bones over the stones," thousands of men and horses for this work, millions of horses for general traffic, where less than half so many would suffice. I could go on thus yet further, but must leave the rest for the imagination of the reader, including the cost, only remarking, in conclusion, that, by the adoption of this invention, the unfortunate Upper Ten may save the new carriage-tax.

Barry-road, S.E. **J. H. Huxley.**

DOMESTIC SMOKE-CONSUMING STOVE.

[20076.]—The fire is contained behind and above bars G. Above is chamber divided into two parts H and K, by vertical partition B. A door (A) admits coal, which is heated in H, and whose more volatile constituents have to pass through or over incandescent coal, and are burnt before reaching the chamber K, and passing out by the chimney C. By raking along the opening (D) with a poker, burning coal in chamber H may be moved along to make room for fresh fuel.



Doors are hinged to E, E, E, E, which fold across the front bars, to give an increased draught when necessary. An ashpan (F) is placed below. Unimportant details and ornamental ironwork not shown. This stove combines the advantages of an open fire and consumption of smoke without great complication of parts. It may be made any size.

W. A. Lee.

NEW ELECTRO-MAGNETIC CLOCK.

[20077.]—Among the various methods which have been adopted in the application of electro-magnetism as a motor for clocks, I believe that little or nothing has been accomplished in applying it to the upper part of the pendulum; and certainly no method as shown by this invention, where as will be seen (in Figs. 1 and 2) the pivot of the pendulum is also the armature of the electro-magnet.

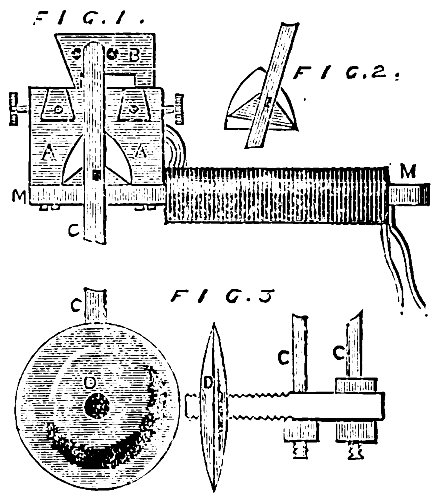


FIG. 1. FIG. 2. FIG. 3

I have only figured enough to show one method of applying the principle here introduced; leaving out the train and its attachment to the new apparatus, merely observing that the pendulum is connected with the escapement rod in the usual way; and whereas in this case (instead of the train moving the pendulum) the pendulum moves the train, it is necessary to reverse the escapement action; and further that that part of the train only is required, from the escapement to the hour and minute wheels inclusive.

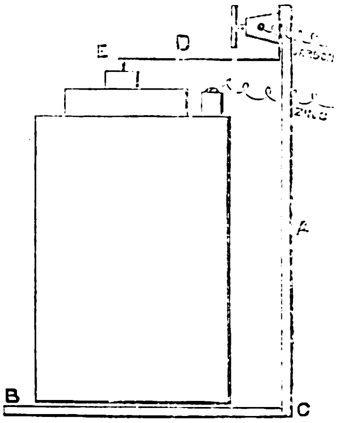
Insomuch as this method utilises the greatest force the magnet is capable of exerting on the armature, it is perfect; and I doubt not that it will be found that a very weak current will suffice, such as a small earth battery, or the gas and water pipe and earth, &c. &c.

In Fig. 1, A A is a piece of ivory screwed to one leg of magnet having a gothic arch, at the top of which are dovetailed two pieces of brass, having binding screws for the wires. The pendulum rods are fixed at the ends of a triangular prism of iron, seen resting at the bottom of the arch; which rods embrace loosely *one* leg of the *e* magnet M. Above the ivory arch is a brass bridge, B, actuated by rods of pendulum, which by reason of space between the pins (shown) allow this bridge to make connection of circuit during the return of the pendulum to its perpendicular position *only*, at which time current ceases; and allows freedom to complete its arc, and return by a *nearly* complete arc before the current is on again. Fig. 2 gives an idea of the position of the iron prism at the end of the arc, where the surfaces are seen apart. Fig. 3 shows my substitute for the gridiron pendulum, namely, a rod of iron and of brass, *c c*, which, expanding at different ratios, allows the bob when properly adjusted on the screw to remain unaffected by temperature: the nuts make the ordinary adjustment for length. I should have said that the prism armature is on both legs of *h s* magnet. The wires for battery connection and also to the binding screws are also shown. D is the pendulum bob.

Barry-road, S.E. **J. H. Huxley.**

LECLANCHE BATTERY CONNECTIONS.

[20078.]—As I have more than once seen complaints against the lead caps on the above batteries, and have had much trouble myself that way, I thought perhaps the following may be some use to amateurs who construct their own, as it makes a most efficient connection without the trouble of melting and using lead. A and B, two pieces of boards screwed together at C. B forms a stand of sufficient length to carry the number of cells required. A, upright piece forming back, same length as B, which may rest as a bracket against a wall, also to carry carbon and zinc terminals. D, piece of brass spring about ½in. wide, 1-16 thick, bent at right angles and clamped to A by a strong binding-screw.



At the other end of the spring is soldered a small piece of platinum wire E, about ¼in. long and 1-16 diameter, so as to press down on the carbon block. Let the spring be covered with sealing-wax varnish to prevent corrosion. The above drawing shows one cell, but when more are used, the wire from zinc rod goes to binding-screw of carbon-spring.

W. J.

A CHEAP FORM OF BUNSEN BATTERY.

[20079.]—To make this, obtain two dozen salt jars for the outer containing vessels; these can be obtained from any marine store for about 1s. 6d. They hold a quart, and are about 5in. by 3½in. external.

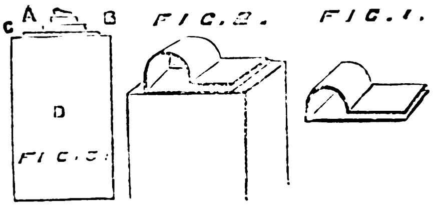


FIG. 3. FIG. 2. FIG. 1.

The porous cells should be 5 by 2, two dozen of these will cost 6s. The carbon blocks to go in them must be 6in. long by 1in. square. The same number of these will cost 9s. Now get ½lb. of paraffin wax (1s.), and melt it in an old pot. Then soak the tops of the carbons in it for about an inch up, then take them out, and with the blowpipe drive the wax back ⅛in. from the top. Then deposit on the tops a coat of copper, put on slowly to insure hardness.

When they have all been coppered, bend two dozen strips of stout copper sheeting ½in. wide into shape, and exactly twice the size shown in Fig. 1. Then solder one on the coppered top of each carbon, as shown in Fig. 2. Then brush over the coppered tops a coat of sealing-wax varnish, except in between the jaws of the clamp, which, of course, must be clean, so as to make good connection. Now you have your negative elements complete, place them in the porous cells, and these in the salt jars.

When a number of cells are used, the carbon connection described above gives much greater satisfaction than the usual clamp, because the copper surface in contact with the carbon is so much greater, and also because the paraffin wax prevents the acid creeping up and destroying the connection by forming a non-conducting salt of copper.

For the positive element, if not very particular about first cost, use a rolled zinc cylinder 2½in. in diameter by 5in. high, with 6in. of 16 copper-wire soldered on to it, bearing at the end a little slip of copper sheet for connecting it with the carbon of next cell.

If the battery is not going to be used very often, three zinc plates, each 1in. by 5in., at equal distances round the porous cell, the three connected by a wire with the connecting-slip, may be used; they will give nearly as much power, but will require renewing very much oftener.

The zincs should be amalgamated once every three times they are used. The price of zinc plates cut to size is from 4d. to 6d. per pound.

The charge for this battery is nitric acid, saturated with bichromate of potash, for the porous cell, and dilute sulphuric acid for the outer cell. I use it, as a rule, directly after mixing, and find that I get the same power with very much less acid.

If the plates are used, the battery will not cost more than £1 5s. or £2, using cylinders, and it will give a good little arc light of about 200 candle-power for 4 hours, at a cost of 3d. an hour if the acid is bought by the carboy, or 7d. an hour if bought in Winchester quarts.

If all is not quite plain, or if instructions are wished for coppering or making sealing-wax varnish, let me know, and I will send. Fig. 1, copper clamp (half exact size); Fig. 2, top of carbon, with copper clamp; Fig. 3, cell complete; *a*, carbon; *b*, porous cell; *c*, zinc; *d*, salt-jar.

H. T. B.

REFRIGERATION — DYNAMOS — CARBON RESISTANCES.

[20080.]—In letter 20055, J. H. Huxley describes an apparatus for refrigeration, which, though simple, would, I fear, be ineffective. In the first place, the reason why snow lies perpetually on the tops of mountains has little to do with pressure, but is caused by the fact that dry air cannot absorb heat; thus the rays of the sun do not heat the air, whilst when they fall upon the snow the heat is reflected and scarcely any is absorbed. But there is plenty of heat since water may be boiled in a blackened test tube (the blackening causes it to absorb heat) without the aid of lenses, but by the direct rays of the sun. In J. Huxley's apparatus I can find only one possible source of cold. When the pump is worked, the air inside is caused to expand, it is true, but since it *does no work in expanding*, no heat will be lost, and thus no cold produced. Now for the possible source of cold. Suppose we have damp meat, &c., or even a vessel of water, the removal of pressure will promote evaporation, and thus produce cold; but in this case the moisture must be removed, or only at first will the effect be produced.

"E." contributes valuable information on dynamos, though if he will excuse criticism, I think he would have added to its value if he explained more fully the reasons why certain proportions between the resistance of magnets, coils, &c., are best.

I recently saw a query in this paper about carbon for resistances, which, as it has not been answered elsewhere, I will attempt to answer. First, I do not think carbon resistances good for any even fairly accurate work. If, however, they are to be used, I would say that the great difficulty is obtaining satisfactory contact between carbon and leading wires. Perhaps the best way is to make (or get) rods of carbon of the required sizes, and deposit copper on the ends by a battery, then wash very thoroughly, dry, and solder on the wires. On no account be tempted to use rods of a mixture of carbon and sulphur, for though a high resistance is easily obtained, they are extremely sensitive to temperature. I would also suggest to any one who wishes and has the time, to try whether the resistance of such rods is not altered, even by the *passage of a current*, say from 1 Daniell cell. I believe recently I detected an alteration, but have not had time to pursue it. In next week's number (if possible) I will describe a method of making a reliable set of resistance coils, at a very cheap rate.

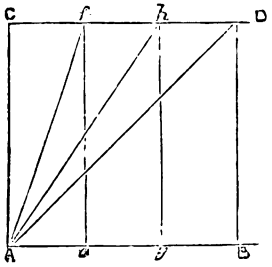
LL. B. A.

NOTES ON DYNAMO-MACHINES.—III.

[20081.]—24. The armature, brushes, field-magnets, and lamps in the ordinary dynamo form one continuous circuit. When the E. M. F. of machine is spoken of, the total E. M. F. is meant, and not merely the difference of potentials between terminals of machine. To find the total E. M. F., add to the difference of potentials between terminals the product of $C \times r$ where C = current and r = resistance of armature and field-magnets. If d = difference of potentials between terminals the E. M. F. of machine $= d + (C \times r)$.

25. The relations between the resistance, E. M. F., and current at different speeds can be graphically represented by diagrams. Take, first, the simpler case of a magneto-machine, and, in drawing a diagram representing these relations for a fixed speed, let distances on the horizontal line A B. (Fig. 1) represent current in ampères to any convenient scale, and on the line A C represent to the same scale the E. M. F. in volts. Since, in the magneto, the E. M. F. is constant for a constant speed, if a horizontal line be drawn from C to D, distances *ef*, *g h* will represent the E. M. F. for any current and any resistance. Join A*f* by a line: the total resistance in circuit to get a current equal to $Ae = fe / Ae = \tan fAe$. In the same way the tans of *h* A *g* and D A B give the resistance in the circuit for currents equal to A*g* and A B respectively.

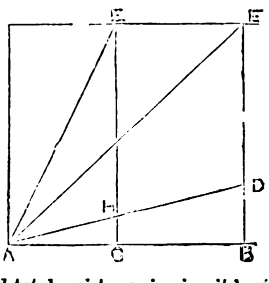
FIG. 1



26. If the speed of the magneto be increased we know that E.M.F. is increased in the same proportion; hence a new diagram can be drawn for the increased speed without troubling to find out by experiment with the machine. The ordinates A C, *ef*, &c., have to be lengthened or shortened in proportion, as speed is increased or diminished.

27. In Fig. 2 let internal resistance of the magneto-machine be represented by tan of D A B, and total resistance in circuit by tan F A B. Vary the resistance in circuit, so that current is diminished from A B to A G. The internal resistance, of course, remains unchanged. In the first case, when current A B is flowing, E. M. F. spent usefully in overcoming the resistance outside terminals is, to E. M. F. wasted in heating the machine, as F D is to D B. In the second case, with smaller current equal to A G, the proportion of work to waste is E H to H G. Thus, as the total resistance is increased and the current diminished, the percentage of waste is lessened.

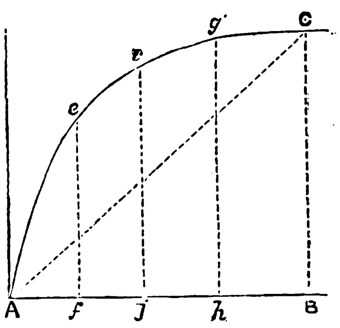
FIG. 2.



28. In a dynamo-machine, where the field magnets are in circuit with the lamps, the E. M. F. line will rise in a curve, as represented in Fig. 4. For any constant speed, let distances on the horizontal line A B represent, on any convenient scale, the current in ampères and ordinates *e f*, *g h*, &c., on the same scale the E.M.F., when correspondingly different currents, as indicated by the distances on the line A B, are flowing through the machine. These ordinates must represent total E.M.F., and their magnitude for different currents must be measured by careful experiment, in order that the curve may be plotted out accurately.

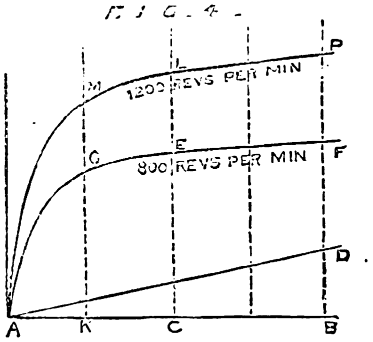
29. If B C be taken as the E.M.F. when the current equals A B, then tan C A B will give the total resistance in circuit necessary that this relation holds good, and the same for all the other ordinates. We see by this curve the characteristic action of the dynamo. The E.M.F. rises very rapidly at first, the strength of the magnetic field being approximately proportional to the current. Soon, however, the curve begins to flatten, owing to the partial saturation of the field-magnets. The line further on becomes nearly parallel with the horizontal line A B, the magnets being now completely-saturated. When this state of things is reached, higher and higher currents will only increase the strength of the field, inasmuch as the coils on the field-magnet act as a solenoid. With large currents we approach the condition of things in a magneto machine, the E.M.F. remaining constant.

FIG. 3.



30. Let A G F in Fig. 4 be the characteristic curve for a Gramme machine at 800 revs. per min., and let internal resistance of machine be equal to the tan of the angle D A B. A glance at the diagram will show the proportion of useful work in the lamp circuit to waste in heating the machine, and it will be noticed that the proportion decreases more rapidly as the flat portion of the curve is reached, i.e., as total resistance is diminished and current increases. When the current is equal to A B, for example, the work expended in heating the machine is nearly one-half of the total work done in the circuit.

FIG. 4.



31. To draw the characteristic curve for 1,200 revs. Remembering that when the current is constant the E.M.F. is proportional to the speed, we have simply to lengthen the ordinates K G, C E, and B F by one-half, making them equal to K M, C L, and B P respectively. A comparison of the ordinates at the increased speed will show at once the economy in working the dynamo at high speeds, the proportion of work to waste being greatly increased. From the foregoing it will be seen that having once plotted out the characteristic curve of the particular dynamo-machine for one speed we have all that is necessary for determining (1st) what speed we must run to obtain a certain current with a given resistance; 2nd, What resistance we may put in circuit to obtain a certain current with a given speed; 3rd, What current can be obtained with a given speed and resistance. It is necessary to add that a new characteristic curve must be drawn for each machine.

E.

IRON MOULDING.—NO. V.

[20082.]—Having allowed the four pieces of the mould to remain in the stove about twelve hours, if there has been sufficient heat, each should be ready for parting. The first thing to be done is to see that the marks that have been made round each joint are in good order: if the mould, before going into the stove, is soft (with the jerking it is liable to get from the crane, and while on the carriage that bears it in and out of the stove), the joint is liable to bag, and requires to be remade. I would say the best time to mark the joint is when the mould has been dried. In the round holes that are in the ends of the lifting-plates of the cope S hooks are put, to which is attached the tackle for lifting; ropes are superior to chains. The two top lifters are made fast to the crane first, the bottom ones with a separate rope. Care should be taken when lifting the cope that one side does not start before the other, but evenly; if not, the marks are liable to get broken off. The rope that is attached to the bottom lifters is now unloosed and taken off. It now hangs by the top lifters and is rested on the bottom ones and turned over on its back, and supports put under the top lifters so as to get dressing the face. The sand that formed the blade is now taken off the face of the bottom part. Any cracks that are in the top or bottom part of mould are wet with water and filled up with red loam. After they have become stiff any unevenness on the surface is pared off, and the sharp edge, where the blade joins the boss, is now rubbed off, taking care that all are alike. Generally, a gauge is supplied for the purpose. The face is now wet all over with clean water. A light coat of soft loam that has been sifted is rubbed over the surface. A dressing-stick a little rounded on one side is now rubbed over the surface, and is kept working till the surface becomes even and regular. Separate dressing-sticks are required for the boss and edge of blade. If there is any heat in the mould when this is being done, it will soon be ready for the blackwash. If the mould is cold and damp, a fire is required to harden the surface a little. Clay-water blacking is now put on with a large brush, doing all of one piece at once: experience will tell when there is enough on. A trowel and two smoothers—one for the boss, and one for the edge of blade—are all the tools the moulder now requires. These, in their turn, are drawn lightly over the blackwash till it has become stiff, when the mould will have a finished and glossy appearance. Any blackwash that may have fallen on the bearing is pared off, and a light coat of blackwash put over the bearing, as it serves to pin and keep it from crumbling away; after which, a light touch of the brush dipped in clean water, and this part of the mould is now (what is termed) finished. All the other parts go through the same process. The copes are now turned over on their face, and put on their respective places, keeping the joints a little apart, so as to allow the steam to escape while in the stove, as they are now put in to be thoroughly dried. When taken out of the stove and about to be closed, each cope is twisted so as clean out any dust, and then put into its place, taking care that the marks correspond, so that each cope will be in the exact place where it was built. The base-plates are now lifted, and each one put into the place where it was built. The stakes that were driven in formerly will guide them into their proper place. Where the blades join each other at the centre, the joints require to be made damp and rammed tight with loam, and blackwashed if not. Owing to the great pressure, the metal, when casting, would force its way through the joints; and, besides, when the joints are made up, the casting looks more finished. The core is now put into the centre; it is made large in the centre, so as to equalise the thickness of metal in the boss and to facilitate the boring of it out. When secure in its print, so as no metal can enter into the tube the core has been built in, and which serves as a passage for the air to escape. The top covering of the boss is then put on and the mould is closed. The lifters of the cope are made fast with screws or clamps to the base-plate. The covering of the boss, and the end of the core-tube that projects through the cover, are also made fast to the bottom plate, and if not made secure, the metal would force the cope up from its seat, the metal escapes, and perhaps lose the casting. Slag or cinders are put round the open joints of the brickwork in the bottom part, and a tube from that up above the mould to allow the gas to escape that it formed when casting. Sand is now put round the mould to the depth of 12in., and rammed hard; this is repeated till the top of the mould is reached. In some propellers the pouring-gates are put on the top of boss; the best plan is to run them from the outside of boss, one slot cut in the centre of each joint. Gate pegs are put against these holes, while the mould is being rammed, these and the flow-gates are rammed up with sand to the same level which has been spoken of. A basin is made on the top of the mould in connection with the four pouring-gates, and the mould is ready for casting.

To find the weight of metal that will be required to cast a propeller: Add together the length of sections 3, 4, 5, 6, and 7, and divide by 5, the number of sections so added, which will give the mean breadth of blade. Find the mean thickness of each section separately, when the sum divided by 5 (the number of sections added) will give the mean thickness of blade. Multiply the mean breadth in inches by the mean thickness in inches, and the product by the length of blade in inches, which, when multiplied by ·263, will give the weight of one blade in pounds. Find the mean diameter of boss, square the diameter, and multiply by ·7854, then by the length of boss in inches, which, when multiplied by ·263, will give the weight in pounds; subtract what would be the weight of arc in metal. If, instead of multiplying by ·263 you divide by 4, it will give the weight in pounds very nearly.

Foundry.

EVOLUTION—THEORY AND PRACTICE.

[20083.]—A CONSTANT reader of "ours" can find nothing new in the writer's discovery in 19898. The example which he chooses (14348907) can only have two places of figures in its root, the first of which is found by inspection, and the unit of the root must be the same as the unit of the power; for the unit of the fifth power of any number will have the same figure for its unit. Without commenting further on the theory, I shall subjoin the working of an example taking his formula $a^5 + 5a^4x + 10a^3x^2 + 10a^2x^3 + 5ax^4 + x^5$.

Find the fifth root of 7717186558368; here a, the root of the first period, is 3.

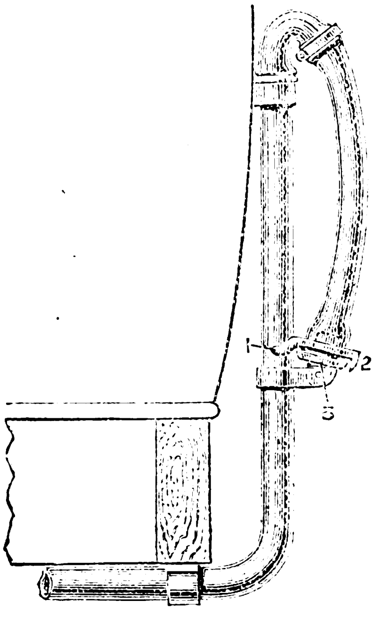
Write the coefficients of x in an inverted order, namely:—

1 $5a$	$10a^2$	$10a^3$	$5a^4$	Now as $a = 3$ we have $3^5 = 243$
15	90	270	405	771,71865,58368 (378
150	9000	270000	4050000	243
7	1099	70693	2384851	52871865
157 × 7	10099 × 7	340693 × 7	6434851 × 7	45043957
7	1148	78729	2935954	782790858368
164 × 7	11247 × 7	419422 × 7	93708050000	782790858368
7	1197	87108	4140807296	
171 × 7	12444 × 7	506530000	97848857296 × 8	
7	1246	11070912		
178 × 7	1369000	517600912 × 8		
7	14864			
1850	1383864 × 8			
8				
1858 × 8				

Samuel Blanco, Liverpool.

RAILWAY BRAKES—UNIVERSAL COUPLINGS.

[20084.]—IN my letter on page 195 the hose-pipe and coupling used for both the Westinghouse automatic air and vacuum brakes was illustrated; the following diagram shows the Midland (Clayton) coupling, as seen upon the end of a vehicle.



To couple the hose-pipes, the porters are instructed "to take one in each hand and lift them sufficiently high to hook the bottom horns (1) together first, and then, by lowering them, place the top horns (2) in the slots." The brake-pipe is 2in. internal diameter, which large size prevents the satisfactory use of a tap at the end of each vehicle; therefore a "blank coupling or stop-plug" (3) is provided, upon which the hose-pipe at the rear of the train is placed, as shown in the diagram. It will be remembered that upon the 2nd of April, 1881, a so-called *Conference* was held at Euston Station to consider the question of universal couplings, and that this Midland coupling was selected. Further reference to this Conference is quite unnecessary now, as the fact has already been stated in your columns that invitations were only issued to those persons who were well known to be in favour of, or interested in, the vacuum system. Of course, under these circumstances, a coupling which can only be used with vacuum brakes was chosen.

One very great objection to the Midland coupling is that the hose connections between the vehicles cannot be separated (for shunting purposes or the changing of engines) without the automatic vacuum brakes being applied with full force upon every carriage in the train. To avoid this inconvenience and delay (upon the Midland Railway) a small leak hole is drilled in each piston, which purposely allows all the brake-power to leak away in less than two minutes.

This is a very dangerous arrangement. Suppose, for instance, that a train, when ascending an incline, breaks loose, the automatic vacuum brake will bring both portions of the train to rest, but in less than two minutes the power will have all leaked away, and the brake blocks will cease to touch the wheels. Now, the question is, What is there to prevent the rear portion running back down the incline? Messrs. Bramwell and Cowper were employed by the Midland Company to consider the merits of the Sanders and Clayton brakes. The report is dated May 3rd, 1881. These gentlemen found that the latter system leaks off as above described, but they made the very extraordinary suggestion "that the two minutes are sufficient to admit of the application of scotches to the wheels." Every railway servant knows that the idea of using hand scotches in place of an efficient continuous brake which will remain "on" until purposely released is perfectly absurd. It should be mentioned that the fact that this brake leaks off in two minutes is the origin of the name, "The two-minute brake," by which it is generally known on the railway.

Clement E. Stretton.

Saxe Coburg-street, Leicester.

LATHE MATTERS.

[20085.]—IN reply to "Orderic Vital's" letter (20026) respecting lathe with front V's and saddle borne on the front of the bed, I fear the Editor would not allow the space required for a full illustration of the parts and details; also, before such are sent I should like to have it in perfect working order, which, ere this, I had hoped to have. If you will write me personally, I will give full particulars, &c., when you would be able to judge of its usefulness or otherwise.

1, Parade, Canterbury. **Geo. A. Story.**

SMALL MILLING MACHINE.

[20086.]—IN answer to 20051, I will show "Gereb Admi" all my kit any time he likes to write to me at Pitcairn's Library, King's College-road, N.W., to make an appointment. I cannot now see him without an appointment, as I am not quite at liberty at all times during the month of May.

J. K. P.

LEGAL REPLIES.

[20087.]—OATHS IN COURTS OF JUSTICE (46937).—There is an Act under which a Quaker may, as witness or juryman, make an affirmation. But those who are not Quakers have no right to affirm as jurymen, and must either take the oath or be excused from service. Every witness, however, who objects to take an oath, and who satisfies the judge that an oath would not be binding on his conscience, may make a solemn declaration. The result is that "T. W. W.," not being a Quaker, but a Congregationalist, can claim the right to affirm if he is a witness, and brings himself within this provision; but cannot act as a juryman without taking the usual oath.

Wages (46991).—It is mere nonsense to say that because wages are not paid weekly they cannot be recovered. "G. H." has clearly a right to sue for whatever he has earned; and if the amount of the wages is settled, then he can recover for the number of weeks in arrear. Should no precise sum have been mentioned, he will be entitled to claim the fair and usual rate of wages payable in his trade.

"Sunlight" has, I understand, removed from Bath. I should be obliged if any reader could give me his present address.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall, E.C.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[45672.]—**Balloon.**—I do not think you can arrive at the weight by any direct method. The way I should do it would be to assume a weight which you consider likely to suffice for ballast, net, and balloon, add to this the weight of one man, and calculate the amount of gas required to raise the total weight. If the weight of calico you assumed will contain this volume of gas, well and good; if not, add to it and try again. I see "A. B. C." asks for a varnish. Spon gives the following ("Workshop Receipts"):—1 part, by weight, indiarubber in 5 parts spirits of turpentine; keep these some time together, then boil gently 1 part of this solution (query, will the rubber dissolve?) with 8 parts of boiled linseed oil, for a few minutes; strain and set aside to cool. It must be applied warm.—Glatton.

[45695.]—**Ivory.**—Nothing better than to wash with a small brush and soap in warm water. Ivory is much tougher than either bone or vulcanite.—B. R., 3, Back-street, St. Stephen's, Norwich.

[45702.]—**Yacht.**—I have always seen good red-lead paint applied to the interior and exterior of small steel boats. The plates are galvanised before putting together, and will stand either salt or fresh water. Of course, the red-lead can be used as a ground for any colour you please.—Assoc. M. Inst. C. E.

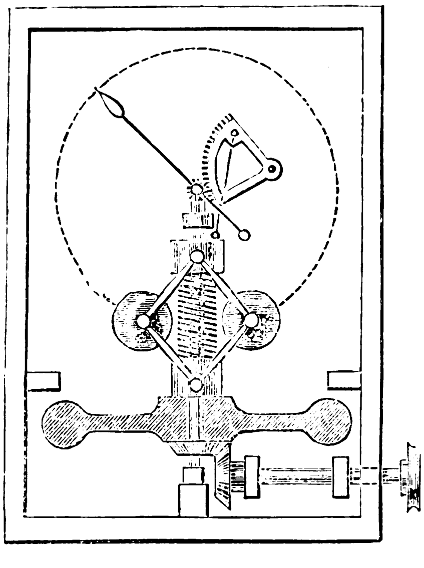
[45951.—**Shot-making.**—Shot are made of either iron or lead. All shot for cannon or great guns are made of iron; but for small arms, leaden balls are used to fit the bore of the weapon. For sporting purposes small shot are made of different sizes· They consist of globules of lead, with a small proportion of arsenic mixed with it. The object of mixing arsenic is to make the shot divide better, as it has been found by experience that lead alone does not divide so well. This mixture, while in a fluid state, is poured through a colander or sieve made of iron, and having the bottom perforated with small holes to suit the size of the shot to be made. The colanders are placed at the top of a high building like a tower, and the melted metal runs through the perforations in fine streams, and separates into single drops as it falls. At the bottom of the building the shots are received into vessels of water to cool them. In these vessels all the globules are not exactly of the same size, although the holes in the colanders regulate this to a certain extent. Moreover, they are not all round; they have, therefore, to be sorted, which is done by placing the shot by handfulls upon a board slightly tilted, so that the round ones roll to the bottom and are received in a box. Those that are crooked, &c., lie behind on the board, and are put aside to be remelted. The shot in the box have next to be sorted as to size. This is done by means of two sieves; the holes of one sieve are a little larger than the size required, and this retains, therefore, all that are too large. The next have holes a little smaller than the shot required, and this retains the right size, and lets all the shot that are too small pass through. By these simple means the shot are separated into many sizes, which are numbered. The shot have now to be finished, which is done by turning them with a little blacklead in a sort of barrel (something like what butter is churned in), which gives them the black shining surface, and rubs off any roughness.—B. R., 3, Back-street, St. Stephen's, Norwich.

[46009.]—**Guttapercha Socket.**—You might coat canvas with the guttapercha and roll it up to form your socket, afterwards amalgamating the whole by heat. Or, perhaps, wire gauze, treated in the same way, would answer your purpose.—Glatton.

[46105.]—**Power from Falling Weight.**—I see that this favourite old idea has cropped up again. A weight would be most unsuitable for your purpose. It would take just as much work to wind it up as it would to work the machine all day. Assuming that a horse would be able to drive 33 sewing-machines comfortably, each machine would be using 1,000 foot-lb. of work per minute. A weight falling 35ft. in nine hours would fall ·0648ft. in one minute. The weight must, therefore, be 1000 / ·0648 × 112 = 137¼cwt. Each time the weight was wound up you would have to raise over 6¾tons. 35ft. If, after this, you care to go on, I will give dimensions.—Glatton.

[46236.]—**Watch Mandrel (U.Q.)**—I notice a question by "Troubled" on this subject which has remained unanswered since the 3rd of March. He is quite right in supposing that chattering is occasioned by the cutter being ground to a wrong angle. In turning brass the angle should be about 80°, or nearly a right angle; when operating on steel, 60° is a more usual angle. Of course, the mandrel is well up to its bearings; if not, chattering will occur with any form of cutter. As bearing on this and kindred subjects, I would direct "Troubled" and all other watchmaking readers to a most useful book recently published, which deserves every word of the praise bestowed upon it by the "E. M.," in the review given on page 46 of the current volume. It is Saunier's "Watchmaker's Handbook," and is, I see, now being advertised in the "E. M." I am sure no one will regret purchasing it, as it affords an immense amount of information of everyday use that is not to be obtained anywhere else in the English language.—E. Devaux.

[46348.]—**Strophometer.**—Motion is communicated by a gut-band from the engine to the small pulley outside the case. This is fixed to a horizontal shaft, which, by a pair of bevel wheels, drives the vertical spindle. Resting by its own weight on the bevel wheel, near the base of this spindle, is a heavy flywheel (shown in section).



It partakes of the motion of spindle; but any little irregularities in the revolutions of the latter are eliminated by the inertia of flywheel, which slips on bevel wheel and revolves with approximately the mean speed of the spindle and bevel wheel. Attached to the boss on top of flywheel are the lower arms of a small governor, the balls of which are kept closed towards spindle by the action of a spiral spring, which forces the boss carrying the upper arms of governor away from the lower one. As the speed increases, the balls fly out and draw down the spring. The amount of this motion is shown by an indicator, actuated by a segmental rack, as shown. The connecting-rod I have sketched wrongly. Instead of being attached direct to boss, it should have a swivel, to allow of boss revolving without smashing up rack, &c.—Glatton.

[46395.]—**G. W. Tank-Engines.**—2030 (2042 class, but on a smaller scale) came out about 1853. Perhaps there are earlier ones than this; if so, I have never seen them. "Hesiod" may be one of the latter. I have made inquiries, but can obtain no information respecting her.—Clyde.

[46396.]—**Terrestrial Eyepieces.**—I notice that "Paugul" says nothing more about the rays crossing in the eyepiece, and that he now concedes their divergence between it and the erector. Perhaps I was to blame for not being more explicit; but I thought it was sufficiently well known that rays would be relatively emergent to the lens they had last passed through. The reason I did not show them crossing in the diagram was because I was not concerned with the path of the cone-rays at all, but endeavoured to illustrate the loss of light consequent on the employment of the erector. In the letter "Paugul" refers me to, I perceive he indulges in a sneer at "self-taught students of optics." I will not pretend to misunderstand its application; but, since he has been so kind as to take an interest in the matter, will confess it is not without a certain degree of truth—though not, perhaps, to the extent of making three blunders in twelve lines. I see that he is still exercised about the position of the diaphragm, and is not very choice in his language towards those who are unfortunate enough to differ from him. It would be easy to show why a central position would not be suitable for a terrestrial eyepiece; but as I am afraid the explanation would be too practical for "nous autres," I will recommend "Paugul" first to ascertain (by easy stages) whether the position in question is not the one invariably adopted, and then to go back to his tutor and inquire why it should be so, if "the merest indication would suffice to point out its absurdity."—Aldebaran.

[46418.]—**Photography (U.Q.)**—As this does not appear to be receiving attention from anyone competent to give the information, I may, perhaps, be permitted to refer the querest to an excellent series of articles on collotypic printing by Mr. Bolas, in the *British Journal of Photography* for 1879.—W. Robinson, jun.

[46468.]—**Brake for Omnicycle.**—I do not think a thumb-piece would be as simple as the ordinary mode pursued by carriage builders of allowing handle to act as a spring to hold click in notches. I send sketch of lower part of handle,

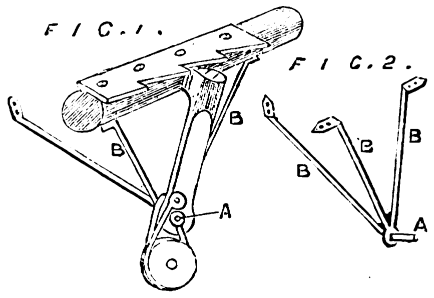


FIG. 1.
FIG. 2.

ratchet-plate to be attached to side of frame. Lever to be hinged on pin (*a*), which is carried by bracket adapted to the framework of machine, this pin to be as close to brake-pulley as the end of lever will allow. One end of friction-band on pin (*a*), the other, as shown a trifle higher up the lever. Though I answer your query, I do not at all recommend you to adopt a fixed brake. Such an arrangement might be the cause of a severe accident.—Glatton.

[46497.]—**Fortified English Cities.**—Berwick-on-Tweed is one of the few English walled towns. Its ramparts were built in the time of Elizabeth, and are still in good repair. On the north and east they are of earth faced with stone; they extend about 1 mile 5 furlongs, and are pierced by five gates.—J. A. T.

[46503.]—**Jamming of Tapered Journals.**—To "Glatton."—Such a rule as you require will not, I venture to think, be readily obtainable. In the first place, the kind of metal and its degrees of hardness, would be an important factor; most decidedly you are wrong when you assume that the weight, or the pressure brought to bear upon it, won't have a deal to do with the sticking point. Then again, the nature of the lubricant used would materially influence the result of the rub. As a practical corollary, I may mention that I am tormented with an old tap on the water-pipe, daily, as the female faction will persist in pressing it down when shutting it off, and it takes a tap of the hammer to release it.—J. J. A., Liverpool.

[46531.]—**Yacht's Deck.**—"W. R." page 199, as well as "Working Tom," page 243, both fall into the mistake, from careless reading, of fathering the query anent "Decking," upon me, the fact being that I have built a yacht or two, probably before either of them sniffed the ozone of the ocean. As a matter of fact, however, I have been lately decking a fore-and-aft schooner; but then, the material which I pin my faith upon is "tin," of which, by the way, "Working Tom" assumes that I am short of. Finally, as to the sneer anent apprentices, any one who has read the "E. M." for, say, 12 years back, will admit that I am not likely to want the advice of "any sich."—J. J. A., Liverpool.

[46581.]—**Oxalate Development.**—(1) It will not altogether prevent the solution being used in dry plate oxalate development; but copper oxalate would be thrown down, and the solution should be filtered before used. (2) You may employ other oxalates as well as potassium oxalates. The sodium and ammonium salts will do as well (theoretically), but they are not used because they are not commercial. It is just the same as with KHO and NaHO, which may be used with the same result.—A Medical Student.

[46603.]—**Induction Coil Failure.**—I am very much obliged to Mr. George Tolman for his hint as to increased battery power. I have now used two quart bichs. (series and multiple arc), but the spark is still under ⅛in. I have since made another coil, using paraffined tissue-paper for insulating secondary coils; in this I used two coils 18 silk-covered for primary, and 1lb. 36 silk-covered for secondary. Using the same condenser and batteries for both, the resulting secondary spark is about the same in both coils, viz., ⅛in., without condenser, just visible. I may mention that the shocks from the secondaries are decidedly stronger than pleasant. Why I used No. 16 with bichs. was, because on looking through back volumes of "ours," the results of the conjunction appeared so good, and they and "Dyer" were my only instructors. One correspondent (some five years back), gets a 3¾in. spark from two coils of 16 for primary, with 3lb. 38 for secondary, and two quart bichs. I don't want to use nitric acid, on account of the fumes.—B. H.

[46611.]—**Lettering Tombstones.**—If the stone is marble, perhaps the best material is black sealing-wax dissolved in alcohol; but any of the black varnishes may be used, and there is nothing better than ivory-black ground up thick in copal varnish. If the letters are covered first with plain varnish, the black mixture will hold in better. The best of all inscriptions, where permanency is desired, is to cut the letters deep, and wider at the inner than the outside surface, then fill up by driving in lead strips.—Nun. Dor.

[46624.]—**Heating Room for Drying Powders.**—Something must depend on the nature of the powders; but, speaking generally, the best and cheapest way of drying powders is to expose them to a steady current of dry air.—Nun. Dor.

[46633.]—**Organ in St. James's Hall, London.**—As I have never played this organ myself, I am afraid I am unable to answer "C. H. D.'s" queries satisfactorily. As he says, the scheme is rather unusual, but it is, nevertheless, thoroughly satisfactory. The tone throughout is extremely beautiful, probably as much on account of the swell (which covers almost the whole organ) as anything. It must be remembered that this organ was not built for solo purposes, but for use with an orchestra, which circumstance will readily account for the enormous size of the pedal organ. The builders are Bryceson Brothers and Ellis.—L. R. D.

[46638.]—**Fresh-Water Fish.**—This question is one of those that it appears to me can be answered only by making an experiment. Mere hardness of water would, I fancy, be no obstacle to the existence of fish, if there is plenty of vegetation in the pool. If there are no plants, some should be put in, and when the pool is fairly stocked you could certainly try eels, carp, and tench.—T. P.

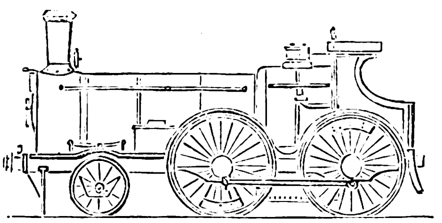
[46690.]—**Waterproofing Fabrics.**—Some years ago (possibly in the English Mechanic), I read of a plan which seems to be rational, and is exactly on the lines suggested by "Kerux," on p. 224. It was as follows:—Rub beeswax on the wrong side of the cloth until the whole surface is clouded with the fine particles of wax. Now, with a warm iron go over the other side of the cloth—the iron to be only sufficiently warm to melt the wax, which will then run up over the surface of every fibre of the cloth, coating it with a water-repelling medium, and yet leaving the air-spaces unchoked, and not altering the appearance or feel of the cloth in any way. Will some one interested in the matter try this and report?—W. T. B.

[46702.]—**Drills.**—I notice on p. 224, "Beetle Crushers" says that the edge of a brass-drill should be at a sharper angle than an iron-drill; so I read it. It is just the opposite; the edge of a brass-drill should be *more dull* than the edge of an iron or steel-drill. The old process of hardening is:—"heat the drill to a glowing red-heat, then bring it down to the colour of a raven's wing, and that will cut anything."—A. F. W.

[46704.]—**Blake Transmitter.**—(1) The microphone is attached to the spring by a screw, and the hole in the bar F is to enable the screw to be tightened, or the microphone to be removed without the trouble of taking off the bar, and running the risk of breaking the wire connections. (2) The spring tipped with platinum presses gently against the diaphragm, and the microphone against the platinum bead. This pressure can be increased or reduced at will, by the aid of the adjusting screw at the lower end of F, the proper pressure being ascertained after setting up the transmitter.—Yoshi.

[46739.]—**Nitro-glucose.**—The acids have either not been sufficiently cool, or else the sugar has been added too quickly. See that the acids are thoroughly cold, and add the sugar gradually with constant stirring, stopping on the slightest development of red fumes.—W. Robinson, jun.

[46774.]—**Bristol and Exeter Locos.**—To "Carstairs."—Although unable to give full dimensions, I send a few particulars of these engines. The B.E.R. had two classes of single expresses, the 9ft. double bogie-tanks, and a class of engine very much after the "Lord of the Isles" type on the G.W.R., but on a rather small scale; the leading wheels are also placed further to the rear. The driving-wheels are 7ft. 6in. diam., the pair of leading-wheels and the trailing-wheels are 4ft. in diameter; the axle-boxes are all outside, as in "Lord of the Isles"; the cylinders are 17 by 24. There were formerly twenty engines of this class (B.E.R., 1 to 20), but 2007 to 2014 are the G.W.R., numbers which they now bear, some of this class having been converted into six coupled goods engines, with inside axle-boxes, the dimensions of which are as follows:—Diam. of wheels, 5ft., cylinder 17 by 24; wheel-base—leading to driving, 7ft. 4in.; driving to trailing, 8ft. 2in.; firebox length, 5ft.; breadth, 4ft. 8in.; depth from crown to bars, 5ft.; length of boiler barrel, 10ft. The 7ft. 6in. singles are good runners, and it is said that they can beat the G.W.R. 8 footers. The engine of which I send sketch, 2015, is a coupled passenger-engine, having drivers 6ft. 6in. diam., and cylinders 17 by 24; 2018 was built by the company at Bristol works about the year 1870. I believe there were twelve of this class. There were some narrow-gauge engines on the Yeovil branch. I never saw any of these, but they were failures in every respect. I have to thank you for your sketches of Caledonian engines, and in a week or two I will send L.N.W.R. large "Bloomer" and "Cornwall," as I noticed in a back number your desire for sketches, which had previously escaped my observation.—Clyde.



[46846.]—**Engineering.**—Any one can set up as an engineer in this country, and put the letters "M.E." or "C.E." after his name, without knowing anything of engineering; but he can't become a M.I.C.E. without having some knowledge of the profession.—T. P.

[46847.]—**Equation.**—To Mr. J. Lane Davies.—I have read the solution which you gave of the adfected quadratic, and which you wished to submit as satisfying the equation as an adfected quadratic. Now, "satisfying" is a relative and vague expression; and your solution may have satisfied yourself and your "large circle of mathematical friends"; but I am sure that there are many who will not accept your solution, unless they shrink from the equation which at first glance looks terrible enough. The following are my objections:—1. Every quadratic must have, in one form or other, two roots (of which fact you will be well aware); 2. You apparently never noticed that equation E, and the one following E are identical—viz., $9 - xy/2 = zy/3$, and $9 + 3/2\,xy = 36 - zy$. But should you have done so, why, in all the world that bulky operation of multiplying these two equations together; why not go on in the following manner? $-xy/2 = -zy/3 + 9$; $\therefore xy/2 - 3 = -zy/3 + 6$; and, therefore, $x^2y^2/4 - 3xy + 9 = z^2y^2 - 4zy + 36$, &c. Thus, if your solution be right, it is certainly a very circuitous one; and that is a great mistake in the science of mathematics. Your mode is, further, a very artificial one, and although the quadratic should be an adfected one, you ought not to affect it too much. But is not your completing the squares on each side, in order to destroy them in the next line, an impoliteness to quadratics? After passing these remarks on the defects and mistakes in your and your mathem. friends' solution, permit me to submit the following solution to your and their criticism. I may, however, add that I am not in the least convinced of its satisfying the required conditions, as I have no large circle of mathem. friends to give me the benefit of their criticism and assistance. Anyhow, I have obtained two vals. for x, y, z resp., and the typical form of quadratic equations ($ax^2 + bx^2 + c = 0$) occurs very plainly. Where is that in your solution?

$$\left.\begin{aligned} x + y + z &= 11 \\ x^2 + y^2 + z^2 &= 49 \\ zy &= 3x(z - y) \end{aligned}\right\} \quad \begin{aligned} &\text{Let } \alpha = z + y \\ &\text{and } \beta = z - y \\ &\text{Then } z = \frac{\alpha + \beta}{2}, \text{ and } y = \frac{\alpha - \beta}{2}. \end{aligned}$$

Thus the equations become

$$\left.\begin{aligned} x + \alpha &= 11 \\ \alpha^2 + \beta^2 &= 98 - 2x^2 \\ \alpha^2 - \beta^2 &= 12\beta x \end{aligned}\right\} \begin{aligned} &\ldots\ldots\ldots\ldots\ldots\ldots (a) \\ &\ldots\ldots\ldots\ldots\ldots\ldots (b) \\ &\ldots\ldots\ldots\ldots\ldots\ldots (c) \end{aligned}$$

Hence from (a) $\alpha = 11 - x$

$\therefore (11 - x)^2 + \beta^2 = 98 - 2x^2$ or $3x^2 - 22x + 23 + \beta^2 = 0$ ………………………… (I.)

and $(11 - x)^2 - \beta^2 = 12\beta x$ or $x^2 - 2x(6\beta + 11) + 121 - \beta^2 = 0$ ………………… (II.)

$$\therefore \text{ from (I.) } x = \frac{11 + \sqrt{52 - 3\beta^2}}{3} \quad \ldots\ldots\ldots \text{(V)}.$$

Now solve for x and β from (I.) and (II.) by multiplying (II.) by 3 and subtracting. Thus $x(36\beta + 44) + 4\beta^2 - 340 = 0$, and $x = \dfrac{85 - \beta^2}{9\beta + 11}$ …. (A).

Again, multiplying (I.) by $121 - \beta^2$, and (II.) by $23 + \beta^2$, and div. by x, we get $x(340 - \beta^4) - 4(539 - 69\beta - 11\beta^2 - 3\beta^3) = 0$, or

$$x = \frac{539 - 69\beta - 11\beta^2 - 3\beta^3}{85 - \beta^2} \quad \ldots\ldots \text{(B)}.$$

But since (A) = (B), if we arrange, we get $7\beta^4 + 33\beta^3 + 143\beta^2 - 1023\beta + 324 = 0$, or $(\beta - 3)(7\beta^3 + 54\beta^2 + 305\beta - 108) = 0$. $\therefore$ necessarily $\beta = 3$. Substitute this in V, then $x = 2$ or $= 5\frac{1}{3}$; $y = 3$ or $= 4\frac{1}{3}$; and $z = 6$ or $= 1\frac{1}{3}$.—A Medical Student.

[46850.]—**Electro-Magnet.**—Probably the magnet was not wound in the right direction. After wrapping one pole with wire, the wire should be brought over to the opposite side of the magnet and wound in the opposite direction. If the wire was wound right on the magnet it ought to have become magnetised, one pole being much weaker than the other. The power to work it depends on what use you would put the magnet to. If for supporting a weight or driving an electromotor the three bichromates would do very well; if for a bell, a Leclanché or Daniell's cell should be used.—Beetle Crushers.

[46851 and 46874.]—**Queensland—Australian Railway Prospects.**—The Agent-General of Queensland, Charing-cross, and Agent-General of New South Wales, Westminster-chambers, London, will send books and information free. "Australian Hand-Book," 1882, gives much information. Published by Gordon and Gotch, Bride-street, Ludgate-circus. English trade-unions would do well to have agents in Colonies to provide labour news. Without being posted in labour market, I should say that sober men, able and willing to adapt themselves to new circumstances, should succeed. In Australasia, there are over 5,000 miles single line railways (belonging to the State), and new lines forming, besides steamers, flour, saw, sugar mills, &c. Why not work passage out on Orient line steamers running fortnightly to Sydney, and look at the Colonies before settling?—Colonist.

[46854.]—**Mechanical Action.**—My best thanks to "Glatton" for so promptly noticing my query; but his plan does not meet my want. In my query I say that "the pushing down of the rod is to control the lid." In "Glatton's" plan the lid controls the rod; consequently, when the lid opened full the zinc is wholly immersed: that will not do. I want the act of depressing the rod the first ½in. to fix the lid, at the same time allowing the rod to be further depressed as the power may be required, and on its being fully drawn up, the lid to be released.—S. J. M.

[46855.]—**Cayenne Feeding of Canaries.**—Commence to feed the young birds at the age of one month or six weeks, and continue till six months old. Chop an egg fine and grate two wine-biscuits. With this mix one teaspoonful of cayenne. Most birds will not eat it at first; but if you take all other food away, they will soon like it. Let them have plenty of canary seed and no rape.—Chas. F. S.

[46858.]—**Organ-Playing.**—If you can play hymn tunes well, and wish to be able to execute pieces, you should get some of Bach's exercises. I think, if you ask at any respectable music-shop for Bach's "Klavierwerke," you will get what you want. There are several books, and you must be sure to begin at the beginning, and not attempt any hard ones until you can play the easy ones well. They are really little fugues, and whilst there is a deal of practice in them, you will find they are also very good study, and good training for the taste. They secure for you a clear touch, which is quite as necessary for the organ as a smooth touch and take care of the time. By no means give up playing hymn-tunes: work them in together, and when you can play them well, you will be able to pass on to fairly difficult pieces, as well as less classical music. Practise scales on a piano if possible. Any more information with pleasure.—Geo. T. Fleming, Heidelberg.

[46858.]—**Organ-Playing.**—I should recommend the querist to purchase Mr. Best's book of instruction for the organ. It has proved a valuable aid to many amateur organists. Many persons who have a desire to learn music run away with the idea that they can play certain pieces quicker and better by giving their first and foremost attention to the notes of the treble stave. This erroneous idea is one of the greatest, if not the greatest, stumbling block in the progress of musical study and practice. If intending players would discard this fallacious idea and practise the bass and treble together, they would sooner attain a greater proficiency. The amount of practice daily is another important point which should not be overlooked—a practice of less than two hours per day will not produce very good results. True, some people require more practice than others, just according to the taste they have for it; if studying for the profession, eight hours per day is not an unreasonable amount necessary; probably less may do for those possessing a little talent.—G. FRYER.

[46861.]—**Cockroaches.**—The following is from the "Encyclopædia Britannica":—genus Blatta, order Orthoptera, family Cursoria. The wings of the B. orientalis, which are shorter than the abdomen in the male, are merely rudimentary in the female, and are wanting in the larvæ of both sexes. The difference between coleopterous and orthopterous insects is that the former have usually two superior wings which meet in a straight line along their inner margins. The inferior wings, which are the true organs of flight, are membranous, transparent, transversely folded, and covered and protected by the elytra or wing-cases. The latter have also four wings, but the upper pair are softer and more flexible than in the preceding order. They are semi-membranous, reticulated, and for the most part do not form, by their junction when closed, a straight line along the dorsal suture. The true wings are folded longitudinally, and usually after the manner of a fan, and are divided by longitudinal membranous nervures.—ROSICRUCIAN.

[46862.]—**Telegraph.**—You should use No. 3; silk-covered wire for the coils of your telegraphic instrument, about one ounce of wire to each. The line wire ought to be No. 20; cotton-covered will do if well insulated with paraffin wax. Certainly the No. 26 offers too much resistance, as it is not half thick enough. Once I tried to fire some powder through a line wire of that size 100ft. long, with 4 quart bichromates, and it would not go off until I had shortened the wire to 10ft.—BEETLE CRUSHERS.

[46864.]—**Canvas Canoe.**—Why not try water as ballast, by having canvas receptacles well covered with linseed oil, or have a hollow keel for the same purpose?—BEETLE CRUSHERS.

[46865.]—**Cod-liver Oil.**—I am in the habit of largely prescribing cod-liver oil. I do not remember one case in which large doses have not been perfectly well borne and digested. Take 5 grains of pancreatine (Savory and Moore) three times a day, with food for, say, three days before you commence the oil, then take the same with each dose of the oil.—M. D.

[46865.]—**Cod-liver Oil.**—In the case of this child, who refused to swallow the oil, it is very probable that her system is now to some extent saturated with it; and then, in the next place, it is not so much required in mild weather, and not so useful in summer as it is in winter. If she suffers from defective nutrition, she might take Parrish's food during the summer, and next winter she will probably take to the oil again.—H. BARNABY.

[46866.]—**Photographic.**—1. Lack of density might arise from too thin a film, but is more likely to be owing to over-exposure, insufficient or improper development. 2. 1oz. of emulsion will cover approximately one dozen quarter plates. 3. Certainly; the emulsion would not acquire anything like the same degree of sensitiveness. 4. Yes, generally speaking; but it is always advisable to have some means handy for modifying the light at will. 5. Captain Abney recommends soaking the plates or emulsion in a dilute solution of bichromate of potash 2 or 3gr. to the ounce of water. 6. See letter 19958 by "Gelatino Bromide," p. 155. The sensibility entirely depends upon the extent to which the "cooking" is carried.—W. ROBINSON, JUN.

[46866.]—**Photographic.** — (1) The principal cause of want of density in dry plates is—First, Over-exposure; Second, not being sufficiently careful of the light you change and develop by; Thirdly, by development unsuited to the plates used. Generally speaking, the development is hurried too much, and not sufficient bromide used. It is quite possible to have too little emulsion on the plate; (2) Opinions differ as to the best quantity of emulsion to use on each plate. I like a moderately dense one, and use, roughly speaking, 1oz. emulsion to 10 quarter plates; (3) Washing before heating the emulsion will change the properties of it; it being very difficult to obtain any great degree of sensitiveness after the emulsion is washed; (4) I should cover the ruby glass with one thickness of orange paper. My reason for recommending paper before another thickness of glass is that paper stops the direct rays and diffuses them; (5) Soaking shreds of emulsion in a solution of bichromate of potassium, and then well washing has been recommended, but I have not tried it; (6) I take for granted that you understand the outline of emulsion preparation. The following formula is the best I have tried for landscapes:—Gelatine, 140 grains; bromide of ammonium, 50 grains; water $2\frac{1}{2}$ ounces;—nitrate of silver, 75 grains; water, 10 drachms. Let the gelatine soak in the water with the bromide dissolved in for half an hour; then dissolve the gelatine at about 110° Fahr.; now add the silver solution (in the dark room) a little at a time, shaking the emulsion well after each addition. Now cook the emulsion eight hours at 100° Fahr., then wash by any of the usual methods. The sensitiveness is increased by longer cooking, but the above is what I prefer. See that you get pure chemicals. I have traced several failures to impure chemicals.—J. HENSHALL.

[46871.]—**Platinising Silver.**—The platinising to which you refer is merely blacking silver. It is done by applying a hot solution of perchloride of platinum. It certainly is not so suitable as the battery process when battery-plates are in question. I make a précis of the directions given in Sprague's "Electricity." Rough the silver with fine glass-paper, or dip in nitric acid. Insert in a vessel with dilute acid, and connect by a wire to a small slip of zinc in a porous pot standing in same acid—in fact, make up as a battery; but at first expose only a small portion of the zinc to the liquid. Drop into the liquid surrounding the silver a few drops of platinic chloride and stir; a faint colour forms over the silver. Add more platinum salt, and lower the zinc further into its liquid; so on, until a good coating is formed, increasing the surface of zinc exposed until the whole of the silver is covered with the black.—NUN. DOR.

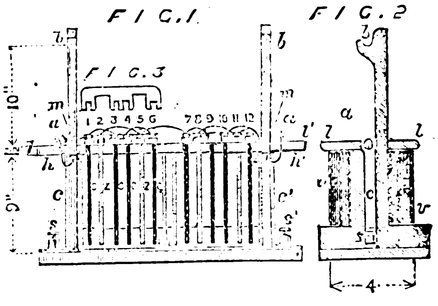
[46880.]—**Analysis of Water.**—For the purpose stated, 6 pint Bunsens would be sufficient. It would be necessary to have a small induction coil to explode the gases by passing the currents through a thin piece of platinum wire.—BEETLE CRUSHERS.

[46882.]—**Dynamite.**—Query 46882 has evidently been answered on p. 246 by somebody who knows little or nothing about explosives. He talks of dynamite "burning fast." Dynamite is always detonated by means of fulminate of mercury, and, like gun-cotton, requires no tamping. If a small piece of dynamite be ignited (say, with a hot iron) it burns fiercely, leaving the kieselghur in the shape of fine powder; but nobody knowing anything about dynamite would attempt to use it that way.—TORPEDO.

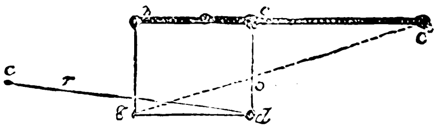
[46882.]—**Dynamite.**—The force of gunpowder explosion is not upwards, but equal on all sides from a centre—*i.e.*, the gases form from the solid substance quickly; but still they are slow enough for the pressure to find the weakest point, and thus find vent, in the case of a cannon at the mouth, in rock-blasting at the weakest side. *Re Dynamite.*—I have been an instructor in the use of nitro-compounds for years, and although authorities, makers, and miners will tell you at once the force is downwards, I do not think so, for the following reasons and examples:—Take the face of a tunnel and note the holes charged with dynamite, be they perpendicular in the roof, down in the bottom, or horizontal in the face, you will find the same crushing, pulverising effect at the bottom. Again, what I have often noted, a side horizontal hole half-way up the face—say, with a very weak bottom, you will find in many cases the mouth left intact and the bottom blown out, and that the crushing effect is not at the bottom of the holes in a line with it, but at the point of greatest resistance and opposite it. Again, find a cobble that three cartridges will break by putting them loose on the top, covered and packed airtight in clay, in the usual manner, to illustrate its downward force, but put at the side in the same manner and it will break it; now, sling it in a chain and put them underneath, packed as before, the charge against the stone, and it will break it, same as put on the top. Overburden a charge in granite or limestone, and explode it—then, blast it away with powder to get the débris lumpy, and you will find the space formed by the dynamite charges round; or bore a hole through a casting vertically, insert a charge sufficient to break it, half-way down the hole; fill up with clay at each end, set the casting about 6in. to 12in. above the ground and explode it; the iron is crushed and the sod scarcely broken through. Suspend a ball of dynamite in the centre of a hollow cast-iron ball, then suspend the ball and explode; it will break equally all round; explode one on the ground, and it breaks it at the point touching the ground with the greatest severity. From these facts I conclude the greatest effects are seen at the greatest resistance, be it up or down, which means that dynamite and powder explode on the same principle—*i.e.*, from a centre; but dynamite is so quick in its action, that wherever resistance offers it strikes with force; for instance, in a cannon it will not give time for the ball to travel, but bursts the gun. *Open Air v. a Cobble.*—The cobble offers the greatest resistance, hence showing the greatest effects. *Ordinary Blasting.*—The bottom of the hole gives the greatest resistance, as a rule, consequently shows the greatest effects.—MC.

[46893.]—**Speaking-Tubes.**—The distance to which sound can be carried depends very much on the method of fixing. Any sharp bends stop the sound to a great extent. All curves, therefore, should have as large radii as possible. I have no experience of such a distance as 150 yards.—ROSICRUCIAN.

[46897.]—**Powerful Bichromate Battery.**—To save valuable space, I send you a sketch and description of a battery consisting of two cells only, but you may easily increase their number according to requirements. I hope a few remarks will be sufficient to make the sketch intelligible. The carbon and zinc plates are fixed to the rectangular wooden lid *l l'*, so that always 4 carbon and 2 zinc plates are dipped into each of the vessels, *v v*, *v' v'*, &c. At each end the lid terminates in a round handle, *h*, *h'* with metallic ferrules, *m*, *m'*, which fit into *a a*, and *b b*, the former being lined with brass, which, when the battery is in action, *h h'* having been let into *a a*, form a connection between *m* and binding-screw *s*, and between *m' s'*; *m* is connected with the carbon, *m'* with the zinc-electrode. Carbon-plates $\overline{1, 3, 4, 6}$ and $\overline{7, 9, 10, 12}$, zinc-plates $\overline{2, 5}$ and $\overline{8, 11}$ are connected with one another, so as to form two large carbon and two large zinc plates; also 1 is connected with *m*, 5 with 7, 11 with *m'*. To make these connections, cut out strips of brass about 1-16in. thick, as shown in Fig. 3, to fit into the screws to be connected. The cells are charged up to a level of 8" from the bottom of the vessels with a solution of bichromate of potash in dilute sulphuric acid in the following proportion:—Bichromate of potash, 1lb. 1oz; sulphuric acid of spec. gravity, 1,836, 1 pint; water, 10·4 pints.—KAUTHACK.



[46901.]—**Watt's Parallel Motion.**—Neither Watt's motion nor any other in general use describes a mathematically straight line, though sufficient for practical purposes, and parts of the curves described by the levers are so nearly an approximation to the straight line that it is easy to employ proportions which shall not exceed the limit of such approximate line. The following diagram represents the



parallel motion, C' being the beam centre. To find the proper length of the radius bar *r* from *c* to *d* divide $C'h$ in c so that

$$C'c : cd :: do : oc$$

when o is the point of attachment to the air-pump rod.

$$gd : C'c :: do : oc$$

$$\text{Therefore } hc : C'c :: C'c : cd$$

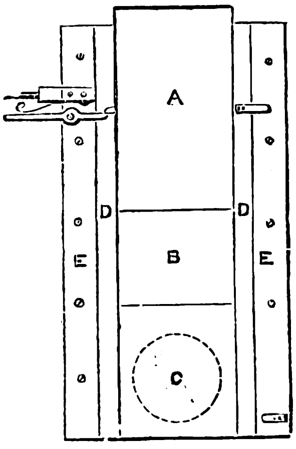
$$\text{Therefore } cd = \frac{C'c^2}{hc}$$

The length of link cd has an influence on the form of curve. It is generally made equal to the stroke of the air-pump rod, or half the length of the piston stroke.—FRED. WALKER.

[46902.]—**Maps.**—The best book on the subject is by W. Hughes, published by Longman, Green, and Co., 1864, third edition.—ROSICRUCIAN.

[46914.]—**Drop Shutter.**—The annexed sketch represents a very useful drop-shutter. The position of lens is shown by dotted lines at C. B is the exposing aperture; A is a piece of wood sliding in a groove in the frame D; by raising or lowering A, the exposure may be shortened or lengthened at pleasure; the frame D slides in the frame E; the back is one piece of wood with an aperture for lens to fit in; as described, it is ready for exposure.

By pressing the lever, which is kept in place by the spring, the frame D is released and drops by its own weight till it reaches the catch at the bottom. The exposure is made by B passing C. Make of thin mahogany: draw a sketch size required before commencing work. Describe diam. of lens, then you can easily calculate the other dimensions. The catches, &c., are made out of sheet-brass.—JAMES PARKINSON.



[46919.]—**American Organ.**—If any of your readers are the happy possessors of an American organ with a decent voice, I would beg of them *not* to follow the advice of Mr. Fryer, and clean the reeds once in six months, even with a piece of washleather. I am utterly at a loss to know who can have been Mr. Fryer's instructor, or the source whence he derives his inspiration. Probably, cleaning with bath-brick, or even emery, would not injure such American reeds as Mr. Fryer means, for they must be curiosities. Thus he says: "The reeds should be firmly secured to the blocks by two (not one, as in inferior organs) iron or steel rivets." That statement is most extraordinary—all the more extraordinary because Mr. Fryer need only refer to back volumes of his ENGLISH MECHANIC to find out his error. It must be well known to your readers (see No. 587, the "Munroe Reed") that one of the best makes of American reeds dispenses with rivets altogether; in another, equally well known, there is no rivet proper, but the metal of the block is punched through in the form of a rivet, and is closed over after being passed through the tongue. As a matter of fact, with the exception of the firm whose reeds have blocks with ⊳-shaped edges, the reeds with iron rivets are not only the worst in themselves, but they are placed in inferior instruments. And then with regard to the exceptions, unfortunately for your correspondent's statement, the smaller reeds never had more than one rivet; while those which do really require more, always have two, even in the inferior makes, which are known by their thin blocks. As to tuning, a new American organ requires, as a rule, "going over," after it has been well played for from six to twelve months, as the reeds then appear to have taken their permanent bearings, and to have settled down to their proper pitch; but after that it should last for years without being tuned. As to taking out once in six months to clean, I hope it will be sufficient to say that such a practice would be a good way to spoil the instrument, especially as it would involve frequent visits from the tuner. I have, for instance, an instrument which, for six years, has never had a reed drawn except to remove some particle which has got between the vibrator and block and muted a reed. Sometimes reeds corrode where the leather rests upon them, and they are thrown slightly out of tune. Cleaning is required then; but it is better to prevent the corrosion.—ORGANON.

[46925.]—**Water in Gravel-Pit.**—Supposing that there is no sub-stratum of very heavy clay, there will be no necessity to carry the shafts down to the spring. It will be necessary to make the shaft of sufficient capacity to hold all the water which now lies on the ground; when this is done, it will soon percolate the surrounding soil and disappear. —H. BARNABY.

[46930.]—**Hydraulics.**—I would venture to suggest that this querist has nothing to do but to put a glass tube into a cask of some coloured fluid to see for himself whether or not the orifice is filled. His friends must be peculiar mathematicians.—E. G. M.

[46930.]—**Hydraulics.**—If tank and pipe were in a vacuum the water would behave as your friends suggest. In practice, however, the pressure of the air on the water in tank assists the force of gravity to fill up the void which you assume to exist, while the same atmospheric pressure at bottom of pipe tends to arrest the outward flow, and keep back the outgoing water, as it were, while the inflowing water catches it up. In a large pipe the air might get in at the lower end, and to preserve a full bore the pipe should be tapered. Let a be the area of pipe at lower end, h = perpendicular height of level of water in tank above lower end of pipe, x = area of pipe at any point at a vertical distance, d, below surface of water in tank. Then $x = a \sqrt{h / d}$.—GLATTON.

[46930.]—**Hydraulics.**—It is quite certain that if it were a case of abstract hydraulics—that is, if there were neither friction nor capillarity, the water would not fill the lower part of the pipe; it would be "thinned down" by its acceleration from gravity, as shown by A. H. Mountain in his diagram (on p. 248). But friction being present, this will or will not happen, according to circumstances. For a certain slope and diameter of pipe the water in the pipe, if left to its own gravitation without any pressure from the head of water, would soon lose its acceleration from friction and acquire a constant velocity. If the pressure from the head of water gives the water in the pipe a greater velocity than this, the retarding friction will be greater than the gravity of the water, as resolved along the pipe, and the action of "thinning down" will not take place and the pipe will remain everywhere full. The tendency of capillarity would be to promote this result.—DUBLINIENSIS.

[46931.]—**Cuts and Bruises.**—At our works we keep a bottle of "Friar's balsam," some lint, and bits of rag. The balsam is simply poured over, and into the wound, a bit of rag saturated with the same preparation bound over it, and there you are. When working in the pattern-shop I have frequently used shellac varnish as a temporary dressing. Neither of them is sightly, but the first, I can say from experience, is most efficacious.—GLATTON.

[46931.]—**Cuts and Bruises.**—For small abrasions of the skin, rub a little drop of glue over them (glue is always handy). When your work is done wash well and dress with some good plaster. I use some of Seabury and Johnson's rubber plaster. Cuts from chisels, &c., are more troublesome because they *will* bleed. Hold under a tap; that will generally stop the bleeding, and then dress with plaster. Splinters must be extracted, the hands thoroughly washed, and a little piece of plaster put over to keep the dirt out.—TORTOISE.

[46931.]—**Cuts and Bruises.**—The most convenient and useful means of stopping bleeding from cuts through the cuticle, is a bottle of "French Polish," if a trifling wound, wrap in rag and then apply some polish, which instantly stops the flow and keeps out the air. If the cut be serious, apply the polish freely upon a lump of cotton wool. Whilst upon this subject, I may mention that for burns, nothing is so efficacious as the immediate sopping of the spot in ordinary "black ink," which being immediately applied, will prevent the formation of any blisters.—J. J. A., Liverpool.

[46934.]—**Jewelling Watches.**—Score off same as in other holes, place in mandrel; first cut a hole right through plate, half size of jewel; now cut hole to receive jewel, cut it sufficiently deep so that the jewel will go in level with the face of the plate. Now reverse the plate and chamfer, polish same, reverse plate again, press in jewel (which should fit tight) and with a pointed tool turn over. If you look at a jewel you will understand better. I shall give instructions for making a simple tool which can be fitted to any bench turns, for this purpose.—A FELLOW-WORKMAN.

[46935.]—**Electric Bells and Lightning.**—No extra risk is incurred by having two wires. The risk at all times is very slight. Resistance coils are not required. The object is to decrease the resistance of a line-wire as much as possible, not to increase it.—W. H. L. H.

[46937.]—**Oaths in Courts of Justice.**—The statutes which extend the privilege of making an affirmation to persons refusing or being unwilling, from alleged conscientious motives, to be sworn (Common Law Procedure Act, 1854, s. 20, and 24 and 25 Vict., c. 66, s. 1), make it lawful for the Court, judge, or other presiding officer, upon being satisfied of the sincerity of such objection, to permit such person, instead of being sworn, to make an affirmation. Such a person can scarcely, therefore, be said to be entitled to claim it as a right; but the words "it shall be lawful," are in practice in such a case very nearly equivalent to a direction to do the lawful thing. If the judge be satisfied that an oath would have no binding effect on the conscience of the witness, he is bound to administer an affirmation in a different form (32 and 33 Vict., c. 68, s. 4.).—SPERANS, Lincoln's Inn.

[46938.]—**Photography.**—The formula I use is as follows:—Stock Solutions: Pyro acid 1oz., glycerine 1oz., meth. spirits 6oz.; mix the glycerine and spirits, and add to the pyro bottle; label A stock solution. Bromide of potass 60gr., liq. ammonia (sp. gr. ·880) 1oz., glycerine 1oz., water 6oz.: mix, and label B stock solution. 1oz. of A to 15oz. of water, label A; 1oz. of B to 15oz. of water, label B. The stock solutions will keep for months; A, B a few days. Do not mix more than required for the day's use. If the plate has been correctly exposed, equal parts of A and B will be found to bring full detail and density. My method of developing is as follows. Before commencing, I see I have everything in their proper places (always observe the golden rule in photography—have a separate place for each article, and see you keep them there). Immerse the plate in water for a few seconds, say, till you have mixed the developer. For a plate 7¼in. by 4½in., I mix 1oz. of A and ½oz. of B; the developer must be kept in motion, to prevent any air-bells from settling; if the exposure has been correctly timed, add the remaining ½oz. of B. When fully developed, wash well, and immerse in the alum-bath for a few minutes: wash, and fix. If, after fixing, the plate should have a green or copper-coloured fog, immerse in a solution of alum and citric acid, strength not important. Are you sure your ruby glass is perfectly non-actinic? I should advise you to test it; or perhaps the dark slide, camera, dark room, admit light. If you will forward your address, I shall have pleasure in sending you a print from the negative I referred to. If you find any further difficulty, kindly write and state full particulars, and I for one will do my utmost to assist you.—JAMES PARKINSON.

[46944.]—**To Mr. Lancaster.**—Holes should be made in carbon plates, so that the lead runs through and insures a good connection, and the lead insulated with paraffin-wax. A brass terminal screwed into the lead for a connection.—TORPEDO.

[46945.]—**Leclanche Battery.**—I would recommend "W. J." to thoroughly wash the pot and its contents with water, to free the inside from crystallised sal-ammoniac. It is unnecessary to have new carbons, as these last indefinitely.—GEO. G. BLACKWELL.

[46945.]—**Leclanche Battery.**—Your porous pots are doubtless not so porous as they used to be. I should get some new pots and recharge them. The carbons will do again, well washed in warm (not hot) water. Commercial sal-ammoniac has always acted well with me, and it is cheaper than the pure salt. Reamalgamate the zincs.—TORTOISE.

[46945.]—**Leclanche Battery.**—The cells must be worn out after such a prolonged use. The MnO_2 has lost its power. The porous pots should be recharged, and would be better if entirely new. The carbon blocks ought to last for ever, but they should be cleaned. The sal-ammoniac need not be pure, but it is better for it to be so. I should think the zinc rods are nearly worn out also. It would be better to replace them also.—W. H. L. H.

[46946.]—**Goldfish.**—I would suggest that you construct a separate tank on a higher level than that you have at present. Let the rainfall accumulate in this, and when it is full, procure a bag of charcoal-dust, sprinkle the surface with some of this (the quantity to be found by trial). This, if done at eve, will leave the water pure, clear, and sparkling at early dawn. I have proved this on the Australian diggings, where drinking-water was "few and far between."—J. J. A., Liverpool.

[46948.]—**Resistance of Electro-Magnets.**—The total resistance should equal the internal resistance of the battery intended to use with it. Electro-magnets of large size are generally coupled up for quantity, forking off round each pole and back by a common return-wire, so that each pole of a horseshoe-magnet has a separate wire round it, forking into the same battery-leads.—TORPEDO.

[46948.]—**Resistance of Electro-Magnets.**—The best effect is produced when the amount of wire on the magnet is such that its resistance is equal to the internal resistance of the battery. In case of two magnets, their joint resistance should be equal to the internal resistance. This does not mean that you are to get this resistance by using very thin wire, because then the wire would be so short that there would not be sufficient convolutions. Nor should the wire be too thick, for the convolutions will be so numerous that the outer strands will have no perceptible effect on the core. —W. H. L. H.

[46949.]—**Sodium Salts.**—There are two sodium hydrogen tartrates, viz.:—$C_4H_4Na_2O_6$ + H_2O, neutral; $C_5H_5NaO_6$ + H_2O, acid. Both are crystalline, and very soluble in water. Any work on qualitative analysis will answer latter part of the query.—GEO. G. BLACKWELL.

[46949.]—**Sodium Salts.**—(*a*) Tartaric acid, being a dibasic acid containing two atoms of typical hydrogen, which can be replaced by metals, we have hydrogen sodium tartrate, NaH, $C_4H_4O_6$, as well as sodium tartrate, Na_2, $C_4H_4O_6$. I hardly think that there is another name for it, and there will be no other remedy but to use this hideous name. The best proof of the existence of hydrosodic tartrate is the circumstance that it is provided for the practical examinations in chemistry at the Prelim. Scientif. (London). (*b*) NaHO will do as a reagent as well as KHO, though caustic potash may be more powerful to a certain extent; the reactions, of course, will be correspondent. Thus caustic potash or soda throws down white zinc hydrate, $Zn(HO)_2$, soluble in excess of the precipitant.—A Medical Student.

[46951.]—**Papyrograph.**—I do not know if this process would act on the paper, but it seems tolerably obvious that "ordinary" paper would not do, as if the letters were eaten away to form a stencil, the centres of letters such as *a o b*, &c., would fall out.—Glatton.

[46951.]—**Papyrograph.**—If "Dabbler" will refer to Mr. Bolas's paper, on p. 477, No. 774, he will find a brief description of the process to which he refers. It is the ink that is the strong solution of caustic soda which acts on the previously-varnished paper. Over another signature I gave a full description of the process in No. 501, p. 177, which is known and extensively used as Zuccato's papyrograph. I may mention here that the paper is varnished on one side only, and is written upon on the uncoated side, the caustic ink thus attacking the varnish from the back. If those interested cannot procure the No., I will, if the Editor has space, copy the directions briefly.—Nun. Dor.

[46952.] — **Reaction.** — The brine probably contains magnesium chloride, which is a very common impurity, so that magnesium carbonate, which is only sparingly soluble in water, is precipitated by the potassium carbonate. The equation will be $MgCl_2 + K_2CO_3 = MgCO_3 + 2KCl$.—W. H. L. H.

[46952.]—**Reaction.**—One reason for the cloudy appearance of your mixture and for the precipitate is undoubtedly the impurity of the substances taken, for commercial salt contains, besides NaCl, calcium sulphate and magnesium chloride, and commerical potassium carbonate is mixed with alkaline sulphates, chlorides, silica, &c. And in all probability the mixing of these two solutions will have produced a double salt of KCl and $Na_2 CO_3$, and this, together with the crystals, separated from the impurities, must have effected the precipitate. Did you really see a fluorescence? Was it not an iridescence caused by refraction of the light? For as you perhaps know, Cl would tend to destroy any fluorescence. It is impossible to form the equation, unless to analyse quantitatively as accurately as possible.—A Medical Student.

[46953.] — **Pearl Ashes.** — For a very minute and accurate analysis of pearl ashes see "Quantitative Chemical Analysis," by Thorpe (Text-book of Science. Publishers: Longmans, Green, and Co., 4s. 6d.), pages 82 and 140. It would be impossible for any person to describe the process more plainly and accurately.—A Medical Student.

[46955.]—**Elementary Optics.**—The spherica aberration in a telescope objective cannot be corrected, but it may be reduced. One way is to cement the two lenses forming the objective together, leaving a very small space between them, which is done by means of a ring of paper, introduced between them, to the effect of keeping them apart. Another plan is, destroy the spherical surface of the convex lens by making the centre thicker. This is done on the principle that the refraction is greater at the ends of a lens than at its centre.—A Medical Student.

[46957.]—**Battery.**—What does "Amateur" want to plate with—copper, silver, or gold?—Geo. G. Blackwell.

[46957.]—**Bunsen Battery.**—You do not say what solution you want. To charge a Bunsen, put nitric acid in the porous cell, which contains the carbon, and in the outer cell, which has the zinc, sulphuric acid and water.—Caton.

[46957.]—**Battery.**—A Bunsen battery is not so well adapted for plating or gilding. I should not use it for that purpose. You had better have a Daniell's battery, or if you are an amateur to whom a little time is no object, use the new battery invented by Mr. Bennett. I have tried it for both gilding and silver plating, and it does the work well, but slowly. I used a solution of soda made as described by me a week or two since, and I intend shortly to give it a thorough testing, and shall make some larger batteries. The one I used was an old 2lb. meat tin (cost nil), and a flat porous cell 5 by 4. I only operated on one small article at once, but it was quite sufficient to show me what the battery is capable of.—Os.

[46958.] — **Half-Chronometer.** — I presume "Chronos" is acquainted with the lever escapement, so if I give him a description of a half-chronometer (generally called a lever chronometer, and stamped "Morton's Patent" on the plate), he will understand the difference. This escapement has the lever mode of unlocking, and chronometer mode of giving impulse. The balance staff is fitted with two rollers: the bottom one is a crank roller working the lever and pallets, same as in an ordinary lever, but the pallets have no impulse faces, and so made that the wheel has a long drop on the locking face of the inside pallet, and a short drop on the outside locking pallet. When the balance, by means of the lever, unlocks the outside pallet the wheel begins to perform the long drop, and in so doing gives impulse (by a tooth in advance of the pallets) to a small projecting jewel in the large roller on balance-staff, which is at that moment travelling in the same direction. It is an escapement not liked by watchmakers. You mention in your query an overcoil spring; this may be applied to almost any escapement, but is never put to a verge or horizontal; it would be as useless as a compensation balance to such escapements.—G. K. Stockton.

[46961.]—**Battery.**—Perhaps "Bell" has paraffined the carbons but too well, and, in consequence, has no metallic connection with the carbon. —Geo. G. Blackwell.

[46961.]—**Battery.**—It seems to me that you have used paraffin oil instead of paraffin, if so, you would of course spoil the carbons, and it would creep up all over the plates. If you cannot get paraffin, use pitch. This is commonly used, and seems to answer every purpose. You may perhaps clean your carbons by roasting them before a hot fire till the paraffin oil is driven off.—Os.

[46961.]—**Battery.**—Put your carbon plates on a clear fire till the paraffin has all burnt out of them. Let them cool, and then heat one end (about an inch and a half) over a Bunsen burner; then put a lump of paraffin wax on the end, and let it soak in, and continue putting the wax on the end till it shows a tendency to catch alight; now take your blowpipe, and direct the flame on the end of the plate, and you will notice the wax receding from the flame; continue using the blowpipe till you have driven the wax back far enough to make your connections. If you have done this carefully, you ought to have a line of wax all round the carbon, effectually preventing the solution creeping up to the connection.—Tortoise.

[46962.]—**Stereoscopic Camera.**—I would not advise "Stereo" to construct a camera solely for taking stereoscopic pictures. One may be made for the two following sizes: 6½ by 4¾, 7¼ by 4½. The latter is used in such cameras for stereoscopes; the dark slide is so constructed to carry the two sizes without the use of carriers. The first of a series of articles, fully described and illustrated by the writer on the construction of such a camera, will be found in the June number of "Amateur Work." It would take up too much valuable space in the queries of the "E. M." to give instructions, without of very simple construction. When I make apparatus, I like something ornamental as well as useful.—James Parkinson.

[46963.]—**Astronomical.**—(1) As the rotation of the earth is in the same direction as the orbital motion, the motion in space of an object on the equator at midnight is equal to the motion in orbit of the earth, plus the motion of rotation; at midday, the motion in orbit minus the motion of rotation. At midnight the motion in space is greater than a place 180° distant by twice the velocity of the earth's rotation. (2) Both the earth and moon revolve round their common centre of gravity, so it is equally correct to say that the earth revolves round the moon, as that the moon revolves round the earth. This is explained by the familiar experiment of fixing a heavy and a light ball on the ends of a stick, and revolving them on their common centre of gravity.—Mimas.

[46965.]—**Pianoforte.**—I might tell "W.H." that the best way to keep his wires from rusting would be to keep them in a dry place; but, as I am afraid this would be but stale information, I will recommend him to give them a smart rubbing with a leather and a little slaked lime. This will, at least, undo the mischief of the finger-marks that are usually left on after stringing. If, however, the rust has began to appear, he cannot do better than rub them with a rag that has been lightly touched with paraffin or sweet oil, though I should warn him that in so doing, he cannot be too careful not to let the oil touch the wrest-pins, for, if it does, it will inevitably creep between them and the wood, and cause them to slip back after tuning.—W. H. Davies.

[46966.]—**Balance-Springs.**—I do not know of anything better than to dip a small drill in your watch-oil and oil it; you must clean off the rust first; so long as the coils work free of each other, the oil will not interfere with the going of the watch.—A Fellow-Workman.

[46969.]—**Railway Curves.**—The formula is not correctly quoted; it should be $a = c / \pi r \times 90°$. Here *c* and *r* are supposed to be in feet, but as the radius is generally an exact number of chains, we may take one chain as the unit, in which case the *c* will disappear, and the formula becomes $a = 90° \div \pi r$, where *r* is the radius in chains of any length, either 66ft. or 100ft. The angle *a* will be the same for any length of chain, provided we use the same chain for all the measurements. If the radius is 40 chains, $r = 40$ in the above formula, $\pi = 3{\cdot}1416$, and it will be more convenient to reduce the 90° to minutes, which thus becomes 5,400′; we therefore have $a = 5{,}400' \div 3{\cdot}1416 \times 40$, from which it will be found that $a = 42{\cdot}97'$. If you have a table of natural sines, the angle can be found very easily. If the angle at centre, see page 287, Nov. 25th, be bisected by a perpendicular on A K, it will be seen that the sine of half the angle at centre, or angle $a = c / 2 \div r$; or taking *c* as the unit of measurement, sin. $a = 1 / 2r$; in this case $r = 40$, so that sin. $a = {\cdot}0125$, from which *a* will be found to be about 43′. The first method is the more accurate, as ordinary tables will not work to decimals of a minute, and these decimals are important in long curves.—M.I.C.E.

[46972.]—**Cheap form of Voltaic Cell.**—You might succeed in making the Leclanché cells work by soaking the porous cells (and contents just as they are) in water, and changing the water frequently, taking care to drain the cells after each soaking. If this will not do, you can take them to pieces and recharge. You could make a galvanometer for a couple of shillings, and I would advise you to do so. I cannot say why your new cell will not ring the bell, as I don't know much about bells; but I would not advise the use of the new battery for that purpose, as it requires more attention than Leclanché cells. If soda solution is used, the cells dry up. I have not tried potash, as the other is cheaper; but, any way, I think they will require at least daily attention, and sometimes more. On reading your query over again, it strikes me that perhaps you have omitted to fill the porous pot with solution.—Os.

[46972.]—**Cheap Form of Voltaic Cell.**—You do not say what you put in the porous pot with the zinc. I presume it was some of the potash solution. If the bell you speak of required four Leclanchés to work it, it is not likely that one battery such as you speak of would produce any effect. Fill the porous-pot with a strong solution of common brown potash, as it is commercially termed, cork it up after putting in the zinc; put the pot inside the tin and fill up with iron borings. You need not moisten the borings unless you want the battery to work at once. I expect you will want four or five to equal the original Leclanchés; I have not found this style of battery excel the Leclanché, though others seem to. 2. If there is no spark visible at the junction of the two connecting wires, put the extremity of one on your tongue, and then touch the tongue with the other, you will experience a slight metallic taste.—Tortoise.

[46974.]—**Horizontal Escapement.**—This is addressed to "J. P. W.," but I take the liberty to reply. The middle dot of the three on the plate of Geneve watch is for the purpose of putting watch in beat, the dot on the outside of the balance should come directly over the middle dot, when the watch stands idle. The word "draw" is often used by jobbers: it means "detent"; the detent side of the cylinder is nearest the dots. The verge watch is the only watch which has *not* got a "draw." A pointed peg would be preferable to tweezers, on account of its being lighter.—A Fellow-Workman.

[46976.]—**Canary.**—Your bird is probably being suffocated by being hung near the ceiling when candles, gas, &c., are being burnt. Even without this, the air near the top of room is by no means wholesome, as you may experience by standing on a table when windows are shut and there are several people in the room. Remedy: place the cage on table or on the ground.—Glatton.

[46976.]—**Canary.**—You should give your bird from 4 to 6 drops of canaradyne with egg food, or upon a small piece of soaked bread. You can procure a bottle of canaradyne from Mr. F. Tibbs, Wilfrid Works, 63, Chalk Farm-road, London, N.W. Continue to give the usual food, but no hempseed. I have found this an invaluable remedy for asthma in canaries; if the disease is of long standing it is not possible to entirely cure the bird; the bird should not be kept in a room where gas is burning: they lose their feathers in consequence.—Julia.

[46976.]—**Canary.**—Try the first prescription of "A Medical Student" given to a two-legged patient. No hemp-seed, but only rape, at the same time abundance of bread soaked in pure water and then pressed; continue with lettuce and watercress (twice a week). Use the following preparation:—Throw a piece of the crumb of white bread (about the size of a nut) into a cupful of milk, boiling and stirring it all the time (with a wooden spoon) until it is of the consistency of pap. Let this be perfectly cold before given to the patient, and always fresh, for as soon as it is sour it will do harm.

Give this paste only once in four days, as the asthma is but slight at present. You would do best to use homœopathic medicines besides, which, though I am an allopathist, I cannot but recommend very strongly for such particular cases. The following tinctures would be the most useful (add about five or six drops to the water, using, of course, one medicine at a time):—Ipecacuanha, aconitum, nux vomica, and if all these will not succeed, try sulphur, using the first dilution of each tincture.—A Medical Student.

[46978.]—**Canaries.**—It is a common thing for canaries to neglect to feed their young ones; I believe it to be the result of high breeding, I lost several young birds last year in the same way. The old birds were of the Norwich breed; the hen was a dark-crested bird.—Julia.

[46978.]—**Canaries.**—You are perfectly right in thinking that the cause of death is want of food. Similar cases happen very often. The mates should assist the hens in the fatiguing office of filling the little beaks, after the ladies have fulfilled their duty, consisting in sitting on the eggs and hatching the young. The hens become tired of their arduous task, and following their natural instinct, leave off the duties of a loving mother, and expect their husbands to take up the ceaseless task of feeding. But these gentlemen being too highly bred and cultivated, feel a great indisposition to work, being not accustomed to it, and so the poor things perish most miserably. The only remedy is to feed the little ones from the very first day of their life.—A Medical Student.

[46979.]—**Etching.**—I regret that I cannot give you any information about steel-plate etching. For copper-plates two preparations are required. (1) The mordant, composed of hydrochloric acid, 100 grammes; chlorate of potash, 20 grammes; water, 880 grammes. The water is to be warmed, and the chlorate of potash perfectly dissolved in it first; then the acid is added; the common muriatic acid of commerce must not be used; it gives off intolerable fumes, and is of a deep yellow colour. The proper form of the acid for etching does not fume, and has a very slight odour when mixed with water. (2) The ground for the copper-plate, consisting of a solution of yellow beeswax in turpentine, decanted until no sediment remains; the solution should be clear, and of a bright yellow colour; add one-sixth of its volume of Japan varnish. To prepare the plate, clean the surface with engraver's emery-paper; then pour a small quantity of the mordant into a shallow porcelain bath such as photographers use, and put the plate in the bath, leaving it until the surface darkens all over; if any spots remain bright, it is a sign that the plate is greasy, in which case the grease must be removed; then, when the plate is uniformly dark, wash and dry it, and pour on a little of the ground, so that it covers the surface all over, let it dry for twelve hours, then apply a second coat of ground, and without waiting for it to dry, smoke the surface with twisted tapers, holding the plate upside down—let it dry, and the plate will be ready for etching on. Etching needles can be made of ordinary sewing needles with points of different sharpness, set in wooden handles. A more satisfactory kind, however, consists of a bar of steel, about the thickness of one's little finger in the middle, tapering to a point at each end; these needles are more easy to work with, as the weight of the needle, or rather bar, is enough to penetrate the wax coating on the plate, and the hand is left at liberty to draw freely; the needle can be sharpened on a sharpening stone. Now proceed to draw on the plate, taking care that the needle goes through the wax and touches the plate; take care also that your nail does not remove the ground, or there will be a line where you do not want one. It is a good plan to have a piece of board with a hollow about ¼ of an inch deep sunk in it of slightly larger dimensions than the copper. Place the plate in this, and have a flat piece of wood like a drawing ruler, which you can place across the hollow, so that you can etch any part of the plate without fear of damaging the ground. Draw all the darkest lines first; then immerse the plate in the bath containing the mordant for three hours. Take it out, dry it with blotting-paper, taking care not to push the wax back into the lines you have drawn; draw the next darkest lines, put the plate in the bath for 1½ hour, dry it again, draw the lighter lines, put it in the bath for three-quarters of an hour, dry again and draw the lightest lines, and put in bath for three-quarters of an hour. The lines will then have bitten for 6 hours, 4½ hours, 1½ hour, and three-quarters of an hour, according to the darkness you wish to produce. Six hours is about the average time for this biting solution; but it requires a longer time in winter, and shorter in summer. The ground must now be removed with petroleum, and a proof of the plate must be taken, to see if there is anything further required. The etching is much improved by being touched up with a sharp point, filling up gaps you may have left, and making the shades blend better; this is done without acid, of course, and is more in the style of engraving; it is termed "dry point." Unless you have some experience in copper-plate printing, I should advise you to send the plate to a regular lithographer, as it will be a long time before you can print properly—the presses are expensive, £6 6s. or £8 8s.; a printer will do them for you at from 2s.6d. to 5s. or so per dozen; it depends on the style in which they are printed and the paper used. I may mention a few prices, as a guide to you: copper plates from 1s. each, etching ground 1s. per bottle, needles from 6d., double ends, all steel, 1s. 6d., porcelain baths from 1s. 6d.; the prices are probably very much the same everywhere. I get my materials from Roberson, 99, Long Acre. I forgot to say you must apply the ground to both sides of the plate, or the biting solution will attack the back when in the bath. I shall be glad to give you any further hints that you may need, if I can. I have quoted largely from Hamerton's "Etcher's Handbook," 5s., published by Roberson, Long Acre—a useful book.—R. B.

[46981.]—**Verge-Turning Collet.**—If you look at the beginning of my articles on the verge watch, you will see drawing of what you require; it will be necessary to protect bottom pallet. If you have not got the paper, write again.—A Fellow-Workman.

[46983.]—**Concrete Bed for Engine.**—To "Desoridi."—I should say use concrete in preference to either ashlar or brickwork, not only on account of its cheapness, but on account of its homogeneity; which permits the strain and jar, thrown on the bed, to be distributed throughout the whole of the foundation. I have known instances where foundations in ashlar, for large revolving chemical furnaces in North of England, have given most unsatisfactory results: the same parties have put down concrete foundations with the greatest benefit, and also at a much less cost. I do not propose to go into the matter, but simply to give "Desoridi" particulars of one large bed, about 38ft. by 14ft. by 5ft., that I have recently put down in our own works, and which appears to be a thoroughly satisfactory job. The cost may appear small, but it is the actual cost to us:—

Cost of Concrete Bed.

Broken slag (from blast furnace) 2s. 9d. and 3s. per ton, 94 tons 18 cwt. ……	14	0	0
Portland cement, £2 3s. per ton, 8 tons	17	4	0
	£31	4	0
Cost of slag per cubic yard …………		3	4
,, ,, cement per cubic yard ………		4	0
,, ,, excavating, tipping, and mixing		1	8
Total cost per cubic yard		9	0

Part of slag was 1½in. cube, and part small to fill up interstices. Engine bed was supported on rails, and the concrete mixed and tipped, and then levelled, and well packed into corners, and around holding-down bolts, &c. Ashlar would cost 2s. 6d. per c. foot, or £1 2s. 6d. per c. yard. Trusting this may be of use to "Desoridi" is the desire of—W. S.

[46984.]—**Hardening Copper.**—An addition of a small percentage of phosphorus to the copper when casting gives considerable hardness. Hammering hardens it to some degree.—Glatton.

[46984.]—**Hardening Copper.**—Certainly there is. If dipped into water when bright red it will be hardened; but when I used copper nails for a clincher-built boat, I always had to harden every nail by hammering upon a smooth anvil.—J. J. A., Liverpool.

[46985.]—**Gilding the Edges of Mounts.**—What you should use is strong size, which is equivalent to weak glue.—J. J. A., Liverpool.

[46985.]—**Gilding the Edges of Mounts.**—You will succeed better with your gum if, after putting it on the paper with a brush, you allow it to remain till half-dry; you will find it will then stick at once. Before gumming the paper, leave it for a few hours between damp blotting-paper, and don't use the gum too thin.—Os.

[46985.]—**Gilding the Edges of Mounts.**—The edges of cut mounts are gilt by very narrow strips of gold-paper stuck round them. The best way to do is to fasten the gold-paper, back up, on a pane of glass, and when dry give a coat of thin, clean glue. When dry cut into strips ⅛in. broad. Practice is necessary before you will use properly.—Belfast.

[46987.]—**Tinning or Bronzing Small Malleable Castings.**—I do not know of any method of bronzing iron without melting it; but perhaps the following may suit:—To render iron as white and beautiful as silver, take ammoniacal salt in powder, and mix it with an equal quantity of quicklime. Put them all together into cold water and mix well. When done, any piece of iron which you shall have made red-hot will, if you steep it in that prepared water, become as white as silver. You must not get the articles hot enough to burn them, and use a clean fire. A little practice would assist.—A Fellow-Workman.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, E. Devaux has replied to 46236; W. Robinson, jun., 46418.

46383.	H.P. of Locomotives, p. 43.
46385.	American Birch Stain, 43.
46394.	Timing French or Other Pendulums, 44.
46398.	L. and N.W. Engines, 44.
46403.	Cottage Building, 44.
46418.	Photography, 44.
46421.	Boat-Building, 44.
46612.	N.L.R. Engines, p. 138.
46623.	Numbers of Midland Coaches, 138.
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46635.	Imitation Marble, 138.
66648.	Chimney on Girder, 139.
46650.	Electrical, 139.

QUERIES.

[46995.]—**Sutton's Storage Battery.**—I have constructed a storage battery on Sutton's principle, and before using it I shall be glad if some electrical friend would answer the following questions:—In charging the cells, must they be put to the dynamo-machine to be charged one at a time, or can they be put on all at once, or can they be charged both ways? After charging the storage battery with the dynamo-machine, is there any danger in handling the connections of the battery when making the contacts to the lamp to be lighted with the naked hands? And if so, would indiarubber gloves do for insulators?—Electric Light.

[46996.]—**Italian and Spanish Locomotives.**—I would be much obliged to any correspondent who would give a description of any Spanish, also of any Italian, express passenger locomotives.—Tyke.

[46997.]—**Piano Warranty.**—To Mr. F. Wetherfield or Mr. W. H. Davies.—I have a trichord upright piano, without the check-action, catalogued at 44 guineas, and warranted for five years. Three years of the warranty term have expired, and two strings of the highest G have broken, thus affecting, also, the G-sharp above—one long string being adapted for two notes instead of two short strings. The touch has also become somewhat loose, which detracts much from the pleasure of playing the instrument. The wires have become rusty where pieces of flannel or some stuff underlie them only. As I am rather disappointed with my purchase, I should be glad to hear whether these defects should be made good by the makers?—J. Jones.

[46998.]—**Organ.**—I am intending to add two rows of pipes to my organ. It has at present four rows, as follows:—

Stopped Diapason… ..	56 pipes,	wood,	8ft. tone.
Principal …. …………	56 ,,	metal,	4ft. ,,
Wald Flute……………	56 ,,	wood,	4ft. ,,
Piccolo …………………	56 ,,	,,	2ft. ,,

The pipes I am thinking of adding are as follows:—

Open Diapason ……	56 pipes,	metal,	8ft. tone.
Dulciana ……………	44 ,,	,,	8ft. ,,
Bourdon ……………	32 ,,	wood,	16ft. ,,

I would like to place some of the pipes in a swell-box; but I am not sure which of the rows of pipes should be chosen for this. I should be greatly obliged if some of your numerous correspondents could assist me in this, and if they think a reed-stop would be advisable of 8ft. tone in the swell. I would like the swell-box to be as small as it is possible to have it. The room in which my organ is placed is not very large.—Cairn Hostie.

[46999.]—**Piano Repairs.**—Will any of the readers of the "E. M." kindly give me information on the following points?—1. To put new strings in an upright piano? The strings are not fastened at the bottom, but simply pass round a peg, the same string being used for two consecutive notes—e.g., G and G-sharp. 2. With what to clean rusty wires? How to remedy a somewhat loose touch? I know none of the names given to the different parts of the construction, but am a good hand at tuning, and tuning only—no repairing.—J. Jones.

[47000.]—**Model Steamboat.**—I have a boat which has, up to now, gone by clockwork; but I want it to go by steam. It is of the following dimensions:—Length 1ft. 11in., breadth 4½in., depth 3¼in. Would an engine ½in. bore, 1in. stroke, be sufficient to drive the boat at a moderate speed, with a screw 2½in. in depth? If so, what size boiler would it require? Would a boiler 6in. long, 4in. diam., with bottom ends flanged for a lamp, be sufficient to drive the engine? Any hints would oblige—Amateur.

[47001.]—**Miniature Electric Light.**—To Mr. Lancaster.—Would you oblige by telling me how to make a miniature electric light for a scarf-pin?—the battery, &c., to be carried in the pocket. I read about them at the Electric Exhibition in London. Please give full instructions about the making of it.—H. A. P.

[47002.]—**Black Paint for Window-sashes.**—Can any of your readers, from experience, recommend a black paint with a fair amount of gloss that will stand upon window-sashes in a direct southern aspect without blistering?—G. V. Ball.

[47003.]—**Storage Battery.**—Will any brother-reader kindly answer the following questions?—1. If the current of the storage cell would do to ring an electric bell through about 50 yards of wire? 2. If the current of a storage cell of dimensions below is any stronger than the battery which charges it, say two ½-pint Bunsens? 3.

How long a current from a storage cell in which lead plate was 72 sq. in. and copper 60in. would last if connected for 20 minutes each day?—Electrician.

[47004.]—**Bread.**—How is it that English bread is so inferior to foreign? My foreign friends when they first come over can't stomach your bread at all. They call it "semi-dried dough." How *is* English bread made? Does the fault lie in the material, manipulation, or in ignorance of the proper method of making?—Disgusted Foreigner.

[47005.]—**Bank of England.**—I should feel much obliged if anyone of "ours" would kindly inform me about the following?—I want to pay into the Bank of England a certain amount, say £500, in one sum or in instalments, such amount to be converted into a life annuity, payable to my heir after my death. What rate per annum does the Bank of England pay, if the £500 is non-returnable—*i.e.*, if the £500 remain in the Bank *in perpetuum*?—Canstall.

[47006.]—**Collodion Balloons.**—Will someone of "ours" kindly inform me how to make the above, of, say, 4 to 6in. diam.?—Paolo Ebimo.

[47007.]—**Photographic.**—I use Swan's dry plates, but my negatives are frequently disfigured by small round spots of clear glass, which I would like to get rid of. The negatives seem all right till nearly dry, when small pieces of the film burst up and detach themselves. Would somebody kindly inform me of the cause and remedy? If I cannot prevent the spots, how should I touch them out?—Perthshire Farmer.

[47008.]—**Ferrous Oxalate Development.**—Can negatives developed by ferrous oxalate be intensified? I can get abundance of detail in my negatives, but they are not dense enough to insure a good tone to the prints. —J. B. S.

[47009.]—**Naval Architecture Govt. Sc. and Arts Exam.**—Will some reader kindly say what are the best books to study for the elementary stage of this subject?—Volvox.

[47010.]—**Magneto-electro Machine.**—Can I magnetise 7in. horseshoe magnet of steel 1in. by ⅜in. by current from Smee's battery of 60 cells, plates 2½in. by ¾in.? What amount and sized wire required, and how wound on horseshoe? Would same current passed through wire on bobbins of machine answer purpose as electro-magnet with which to magnetise the horshoe? And lastly, how should wire be wound on bobbins of ordinary magnets—both same or reverse ways?—G. H.

[47011.]—**The Voice.**—A few practical hints from any of your readers as to the best means to pursue for self-cultivation of the voice, and to strengthen, preserve, and improve its quality and clearness for singing in public? Further, to avoid huskiness? Also, dryness of the mouth and throat just previous to and during singing, will be received with best thanks by—An Amateur.

[47012.]—**Transmitter.**—I should be glad if any reader would kindly give a description of, and information how to make, the best and simplest transmitter in connection with the Bell receiver? I want the telephone for use between house and stable—a distance of about 100 yards.—A. Reel.

[47013.]—**Steam-launch.**—I should like to keep a small steam-launch, but do not live on the waterside. I have made inquiries of several watermen, and they tell me that I could lay a small launch off any stairs, provided I did not anchor in what is termed the watermen's way. Now in front of our stairs at Deptford, there is plenty of room and shelter, as the cattle-market jetty runs out a good way. The boat I propose would be about the size of a waterman's boat.—Steam-Launch.

[47014.]—**Steam-power.**—I am a wood-turner, and I wish to drive my lathe by steam-power. Is there any official to interfere (Board of Trade, for instance), or have I to register my engine and boiler, or the fact that I am a user of steam power? In short, is there anyone to prevent, excepting, of course, the Insurance Co., who insure the house? Also, will the water company charge for use of water for 1 h.p. boiler?—Steam-power.

[47015.]—**Portable Greenhouse.**—The glass panes slide in grooves, the edges of any two adjacent panes making (or rather being intended to make) a butt joint with one another. As a matter of fact, very many panes are not cut square, and some are as much as ¼in. apart. I have thought of applying strips of tape covered with indiarubber solution as plasters to cover these gaps, but doubt if the sun would not cause them to peel off. What cement would be the best?—Glatton.

[47016.]—**Repairing Ebonite Dish.**—I have broken an expensive ebonite dish. One large piece with clean edges that exactly fits the hole is out of one side. How can I mend this to withstand photographic chemical solutions—all used cold? The ebonite is no thicker than cardboard, and the dish must not be patched with anything that will much reduce the size of the dish.—W. T. B.

[47017.]—**Tricycle-making.**—Will any correspondent give sketch (dimensioned), from which parts might be purchased and fitted up at home? I should like it be a convertible, that is, by detaching a smaller wheel at side, and inserting the treadle and a second driver, or as the Coventry tricycle, which, I think, would be easier to make. But is it (that is the design) patented, or is it only some particular part, as I know if the general design is patented, I should not be allowed to make. I prefer the open front machine, by what I can see of the advertisements in your paper, if I cannot make the Coventry tricycle.—J. O. E.

[47018.]—**Marine Screw-propeller.**—I shall be glad if any kind reader can inform what advantage I shall obtain by having two screws on same shaft in lieu of one I already have 2½in. dia., with three blades, and pitch 5in., as I want to increase the speed of my boat, as I have plenty of engine-power, and oblige—Thrust Disc.

[47019.]—**Disinfection.**—I am most anxious to become acquainted with the most recent and approved scientific principles involved in, and methods of, disinfection. I mean especially with reference to large quantities of clothing, bedding, furniture, rooms, &c., and the apparatus necessary for carrying out the same on a large scale. Perhaps our valued correspondent, Dr. Edmunds, or some other gentleman practically acquainted with the subject, will kindly inform me where I can obtain such information, or refer me to some work from which I can gather the required knowledge?—T. R. S.

[47020.]—**Mus. Bac. Degree.**—I should be very glad of any information about this degree. Is it possible for any but students at the Universities to compete for those at Oxford and Cambridge? Where can I obtain particulars of the examinations, and of those for the London degree? When are they held, and which is considered the easiest exam.?—L. R. D.

[47021.]—**Telescopes at the Crystal Palace.**—It is with great pleasure that I inform you that your excellent journal is making great progress amongst the students of the Wigan Mining and Mechanical School. Nearly two-thirds of the students are weekly subscribers, and as new scholars keep coming in every session, your circulation will keep increasing, as when once they commence to be readers, they look with pleasure for its appearance. Since last year I have myself introduced it to three improvement societies, and they, too, are now taking it in weekly. I should be very much obliged if any of your London readers could inform me who is the maker of the telescopes in the tower at the Crystal Palace? Also, the dia. of the object-glasses? As I have been told they are wonderful telescopes.—A Student.

[47022.]—**Shafting.**—I have a short piece of upright shafting, and the top bearing at times makes a screaming noise. It never gets hot; all the oil I can pour on it makes it no better, and there seems nothing wrong with it or the foot-step.—J. A.

[47023.]—**Seasick.**—To Dr. Edmunds.—Will you kindly tell me what to take when sick at sea, as I am an abstainer?—A Rechabite.

[47024.]—**To "Sigma."**—I wish to use a Swan's lamp of 20-candle power occasionally, and to have power always available. It appears to me from what I have read in the "E. M." that this could be readily accomplished by means of a Sutton secondary battery of copper and amalgamated lead plates. Will you please say the simplest way of constructing one of sufficient size in the most compact form, and the best battery to use for charging the same in the most economical manner? Also, how to charge the secondary from the ordinary cells? The secondary must be large enough to work for 10 hours at a time if required. I think the information will be acceptable to many readers besides—Incandescent Light.

[47025.]—**Medical Coil.**—To Mr. Fred. Walker.—I shall be very grateful for the promised directions (with sketch) as soon as possible, having plenty of time to spare at present, which may not occur again. Only please bear in mind my purse is not very long. I should like to know the price of wire per lb.; and if you think silk-covered is preferable, I will use it instead of cotton-covered.—G. D G.

[47026.]—**Melting Brass Dust.**—I have a quantity of brass turnings and filings which I wish to melt up and cast myself. Which is the simplest way to do the same? I have a large fire-place in my cellar where a range has been taken away; the flue runs three stories high. Myself and friend thought of building a furnace with bricks and lining with fireclay, coke fire.—Brass Dust.

[47027.]—**Electric Current.**—Does the current in a Gramme armature arise from the influence of the field-magnet on the coils, independently of the iron of the ring? Or is it solely caused by the iron of the armature? Or if both contribute, in what proportion each? In taking current off commutator, do all the coils yield, or only the two coils at the neutral points? Is there a better ring armature than the Gramme, or any other form that would not give alternating currents?—David.

[47028.]—**Slow Motion for Lathes.**—To "F. W. G."—I beg to tender my most sincere thanks to "F. W. G." for his able reply to my query, *re* Four-jaw Chuck. The illustration is all that could be wished. Should I find any technical difficulties in the construction of same, I will apply to him again. I should like to know if any reader or correspondent of "E. M." has tried the slow motion described by Mr. Young a short time ago (working with a chain from crank to pulley), and whether it gives satisfaction?—Chuck.

[47029.]—**Difficulty with Coil.**—To Mr. Lancaster.—I have made a coil of the following dimensions: Length of reel 7in., the tube made of cartridge paper, thoroughly glued and well dried, with ebonite ends 4in. square and ¼in. thick; the tube is ⅞in. interior dia.; the ends are glued on; core of about No. 18 iron wire 7¼in. long, sufficiently soft to show but little polarity; primary two layers of No. 16 cotton, weighing about ¼lb.; last layer paraffined, so as to soak through to the other layer; between primary and secondary a layer of paraffin, sufficient to fill up the interstices of primary, while allowing the rows to be seen through it. Secondary, which is wound direct on to this layer of paraffin, consists of 1lb. of No. 35, averaging 1,400 yards to the lb. There are a good many soldered joins in this, on account of its being a job lot. It is insulated with paraffin, first brushed on to each row, and then ironed in, and between each row are two or three layers of guttapercha tissue, fastened by paraffin and a hot iron. There are 18 rows of secondary condenser, 66 pieces of tin foil 5¼in. by 4¾in., separated by paraffined note-paper, neither thick nor highly glazed. Tin foils project about 1in. After having made the condenser, I heated it and pressed it very tightly, so that the paraffined paper stuck together. This coil, with a battery of six bichromates, plates 6in. by 3in., arranged for intensity, gives a spark barely ¼in. long, when used with a contact-breaker. Without the condenser the spark is just visible. I may mention that the breaker is one of the vertical form. This result puzzles me, for, when I had only 12 rows on and used it with only one bichromate, I got a spark ⅜in., and occasionally a forked one ½in. long. I noticed, as I proceeded winding the wire beyond 12 rows, that the spark slightly decreased, but attributed it to the declining power of my battery; but when I came to use six cells I found that it had decreased still more. I do not think I have used too much battery power, as I lowered the plates gradually and tried the coil with them at different degrees of immersion. I have now taken off the ebonite ends, thinking that there might be a leak there, but can discover none. Can you suggest the cause of this decrease in strength?—B. B.

[47030.]—**Repairing Watch.**—To "Alfojoe."—My best thanks are due to you for your reply to my last query, and through your instructions I have put the stopwork in perfect order; but with regard to my second query I riveted on the 'scape-wheel of the verge watch as you directed, but cannot now get the watch in beat. The pallets are too far from the 'scape-wheel, as no matter what angle I place them at, the watch runs down when wound. I have the pallets broken of two other verge watches, and would be glad to know how to put new ones in and to remedy the above? Also, the necessary tools required, and the price of them? Hoping I am not troubling you too much.—Country.

[47031.]—**Blocking Brass Musical Instruments.**—Could any reader kindly inform me how to do the above?—Mundamental Bass.

[47032.]—**Stonehenge and Sun Worship.**—I am much obliged to "F. R. A. S." for kindly answering my query (46888). As the subject is a really interesting one, perhaps someone acquainted with Stonehenge would say what is the evidence connecting that mysterious old relic with the worship of the sun? Does it possess angles, avenues, or isolated standing stones pointing in the direction of earliest or latest sun-rising?—Neo.

[47033.]—**Mining Questions.**—Would some kind reader answer the following questions?—1. How would you rebar an oblong shaft 6ft. by 14ft.?—the wood being very much decayed. 2. What is the rule for putting column pipes for pumping into a shaft with regard to plumbing and staying? 3. What is the rule for putting wood guides into a new shaft?—Miner.

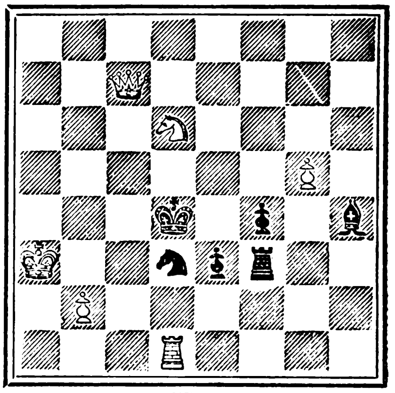
[47034.]—**Dog-chuck for Lathe.**—Will any of "ours" kindly give description (with sketch if possible) of a dog-chuck for lathe? and oblige—E. D.

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCXLIX.—By Dr. Gold.

Black.

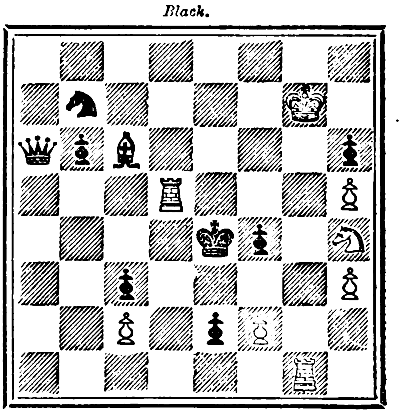


White.

White to play and mate in three moves.

PROBLEM DCCL.—By W. Grimshaw.
From "The Complete Guide to Chess,"
by H. F. L. Meyer.

Black.



White.

White to play and mate in three moves.

Solution to 745.

White.	*Black.*
1. B to Q 6	1. B takes B (a)
2. Q to Kt 2 (ch)	2. K moves
3. P mates	
	(a) 1. Kt takes B
2. Q to Kt 7 (ch)	2. K moves
3. Mates	

Solution to 746.

White.	*Black.*
1. Q to K Kt sq	1. P takes P (dis. ch)
2. Q to Q 4	2. Anything
3. Q or P mates	

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, JUNE 2, 1882.

A CROWN-GLASS ACHROMATIC TELESCOPE.

THE instrument to which I propose to give this name, and to introduce to the notice of our readers, is so called because crown-glass is the only kind of glass which is used in its construction; and the lenses used are a convex one to receive the rays, and a concave one to correct the aberrations, both of the lenses being of crown-glass.

I had at first supposed that the only advantage would be a diminution of expense; but, on further examination, it would seem that there is so much advantage in the use of only one kind of glass, that a well-constructed telescope of this kind will bear very favourable comparison with any that can be made with two sorts of glass. I propose to show what reason there is for such a hope.

Achromatism of the Instrument.—Now, as it is obvious that the lenses will have to be at a certain distance apart, the instrument will be a sort of *dialyte;* and, therefore, the most natural thing to do first is to compare it with a dialyte of the common construction having a flint correcting-glass.

To do this with regard to achromatism, surely all that we have to do is to write down, side by side, the conditions necessary for it in the two cases severally. For the ordinary dialyte, then, the condition is:

$$\frac{b-d}{f_2}\,\frac{\mu_2-\mu'_2}{\mu_2-1}+\frac{b\,(\mu_1-\mu'_1)}{f_1\,(\mu_1-1)}-\frac{d\;b}{f_1f_2}\left(\frac{\mu_1-\mu'_1}{\mu_1-1}+\frac{\mu_2-\mu'_2}{\mu_2-1}\right)=0\ldots\ldots\text{A.}$$

And for the other it is:

$$d=\frac{f_1+f_2}{2+\frac{f_1}{b}}=0\ \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\text{B.}$$

It needs no argument to show which of these will practically be most liable to error in the application of it. But, in addition to this, the formula B, for glasses of the same kind, has this great advantage—that, as Dr. Parkinson observes, "irrationality" has no place, and therefore we are *free from the inconvenience of the secondary spectrum arising from it.* And this is one of the main advantages which the proposed instrument will have, not only over a common dialyte, but over every other kind of telescope in which two sorts of glass are used; and which, if there were no other advantage, would seem to be sufficient to deserve attention.

The equations given above are those commonly used for making rays of different colours *emerge parallel,* and this is what is commonly meant by "achromatism." But there is another sense in which the term may be quite as properly used, and which would seem to give better results. It is when the rays are made to converge to the same point. Let a ray falling upon the first lens at P, Fig. 1, be resolved into a red and a blue ray, which meet the second lens in R and B, and after refraction emerge parallel, so as to meet the axis in r and b. Then, in this case, the chromatic aberration—that is, the distance between b and r—will, though much reduced, be not destroyed, as they would be if they met in some common point f, and where the chromatic aberration is consequently destroyed. Moreover, when the rays meet the axis in b and r, these points cannot simultaneously be in focus, so that when viewed by the eyepiece, there will be more or less indistinctness, which should not exist, if they met in a point.

Let us, therefore, investigate the conditions under which they may come to a common point, and first suppose that the rays which fall upon the first lens are parallel to each other and to the common axis. Then, after refraction through the first lens, they meet the axis at a point whose distance from it is f, and whose distance from the second lens is therefore $d - f_1$. Call this u, then if v be the distance from the second lens of the point where the ray meets the axis after second refraction, we have $1 / v - 1 / u = 1 / f_2$, or $v = uf_2 / (u + f_2)$.

FIG. 1.

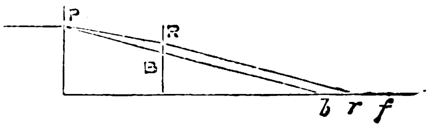
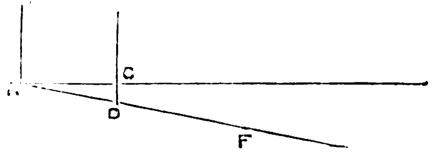


FIG. 2.



Suppose now that for another ray f_2 becomes $f_2 + \delta f_2$, and u becomes $u + \delta u$, and v becomes $v + \delta v$, then, since these are to meet in a point, $v = v + \delta v$ or $\delta v = 0$.

Taking, therefore, the variation of v in the above equation, and putting the result $= o$, we have $(u + f_2)\ (u\delta f_2 + f_2\delta u) - uf_2\ (\delta u + \delta f_2) = 0$, which is easily reduced to

$$u^2\delta f_2 + f_2^2\delta u = 0\ \ldots\ldots\ldots\ldots\ldots\ \text{C.}$$

Now, if f_1^1 and f_2^1 are corresponding values of f_1 and f_2 for the other ray, $\delta f_2 = f_2 - f_2^1$, and since $u = f_1 - d$, $\delta u = f_1 - f_1^1$, and eq. C. becomes $(f_1 - d)^2\ (f_2 - f_2^1) + f_2^2(f_1 - f_1^1) = 0$. or $(f_1 - d)^3\ f_2(1 - f_2^1 / f_2) + f_2^2 f_1(1 - f_1^1 / f_1) = 0$; but since the lenses are of the same material, $f_2^1 / f_2 = f_1 / f_1 = \alpha$, say, then the last equation is divisible by $f_2(1 - a)$, and gives finally

$$(f_1 - d)^2 + f_1f_2 = 0\ \ldots\ldots\ldots\ \text{D.}$$

This, then, is the condition required, and whenever it is satisfied rays of different colours and parallel to the axis will meet it in the same point. And it is evident that for the values of d to be possible, f_1 and f_2 must have opposite signs, that is to say, one lens must be convex, and the other concave.

Suppose, now, that the parallel rays make a small angle α with the axis of the lenses, then, equation C is the same for both cases. But in the latter the value of u is D F, Fig. 2, or A F — A D or $f_1 - d \sec \alpha$. So that all we have to do in this, or in similar cases, is to write $d \sec \alpha$ for d. This, of course, will not give absolutely the same value of d for all values of α; but as we are only concerned with rays which enter the eye, it will suffice to examine what can be the extreme value of α for such cases. Its value will be angle which the telescope moves through, as the star apparently moves from the centre to the circumference of the field of view. Suppose that, in doing so, the instrument moves through 10′, this will be the value of α for that case, and its secant is so very nearly equal to unity that we may suppose it actually so without the least sensible error. And thus, what is true for the axial point of the image, or field, will be sensibly true of every other point also.

If we had attempted to form the equation of condition for meeting in a point where the lenses are of different material, we should get an equation involving μ', &c., which will be about as far from being simultaneously satisfied for all rays as is the equation for rays being made parallel.

These two methods, therefore, of producing achromatism by a crown-glass correcting lens may both of them be proposed:—That which makes the rays emerge parallel, and that which brings them all to a point; and of these the latter would seem to be the best, inasmuch as it would be possible to focus the instrument more accurately than it could be otherwise, which, of course, is in every way a gain, especially, perhaps, for close double stars. For, when an instrument does not admit of being focussed very exactly from uncorrected aberrations of whatever kind, the general effect will be the same as in a perfect instrument thrown slightly out of focus—that is, would give a slightly larger and worse defined image, and, therefore, the images would have a greater tendency to overlap.

It may here be asked, "Is there not a *third* way of correcting aberration, which would have an advantage over either of the former—namely, by slightly *over*-correcting, so as to make the blue end of the spectrum fall farther from the o. g. than the red end, in order to adapt it better for viewing through a Huyghenian eyepiece?" This kind of correction has often been used, but, I believe, without much success; and as it is altogether a haphazard one, it is needless to say more about it, further than this—that I have prepared the plan of an eyepiece adapted to the second method of correction, which I hope to give an account of after having, in the next number, described the correction of spherical aberration in the proposed instrument, which I hope to be able to show, is capable of being corrected to any amount of exactness.

W. G. Penny, M.A.

(*To be continued.*)

REVIEWS.

The Marine Steam Engine. By Richard Sennett. London: Longmans.

THE author of this treatise is a chief engineer in the Royal Navy, and holds the position of first assistant to the chief engineer at Devonport Dockyard. His object in writing the work was to provide a textbook for students of marine engineering, which might also be found useful by those Naval officers who desire to obtain a knowledge of the machinery in the vessels they may be appointed to command. For these purposes the work is well adapted, being neither too theoretical nor too general, but eminently practical in character, especially from the point of view of the marine engineer in the Royal Navy. Mr. Sennett has not hesitated to utilise the material he found ready to his hand, but in preparing his book has availed himself of anything that could render it as complete as possible within its own lines. Thus in the chapters on the properties of steam, the author derived much assistance from the writings of Prof. Cotterill, and in other parts he has utilised the teachings of Prof. Rankine, making all suitable acknowledgment. The historical portion of the subject is wisely reduced to a mere outline, which is quite sufficient for modern students; but in practical details, as well as in theoretical explanations, the author has spared no pains to make the work complete. After a brief introductory, Mr. Sennett proceeds to treat of the prime mover of the marine engine—the boiler and furnace—and having explained the nature of combustion, and the reason why a certain quantity of air is required to burn a given weight of coal to the best advantage, he gives Rankine's formula for finding the weight of air theoretically necessary, and then proceeds to show under what conditions the result found by the formula may be modified. The author's remarks are the outcome of practical training, and render his work of more value than the usual run of text-books, written by men who have had no personal experience of the actual working of the apparatus and machines upon which they write. The various forms of boilers and their numerous accessories are fully described, and the Admiralty rules and tables are given where desirable. The chapter on the corrosion and preservation of boilers is as important as it is interesting. From it we learn that the plan of filling boilers with solution of lime to preserve them when not in use has been abandoned, and that carbonate of soda solution is preferred. New boilers in store are first carefully dried, and are then hermetically sealed after pans of quicklime have been placed in them. Another plan is to put burning charcoal or coked coal into the boiler, and then close up all cocks and valves. By this means an atmosphere heavily charged with carbonic acid is produced, and there is little risk of oxidation. The steam, the mechanism, and the propeller are treated in the same manner, illustrations being freely used where they serve to elucidate the subject. The book contains chapters on the indicator and the diagrams produced by it, on pumping, water-tight and fire arrangements, also one on the materials used in the construction of the marine engine and its accessories. Amongst the appendices is a fairly exhaustive list of examination questions, and an index renders the volume complete and well adapted to serve its purpose.

Lectures on the Science and Art of Sanitary Plumbing. By J. Stevens Hellyer. London: B. T. Batsford.

These lectures were delivered at the request of the National Health Society to working plumbers and others in the hall of the Society of Arts. It will be remembered that they attracted so much attention and gave rise to so much lively criticism that the subject of plumbing obtained more than the usual amount of notice from sanitarians, and even found a spare corner in the daily papers. The book before us presents the subject in six lectures, the first being introductory, treating of the trade and its members, of the public attitude with regard to the trade, and of the importance of plumbing being properly performed in order to secure healthy houses. The other lectures deal mainly with technical details, which, of importance to the plumber, are in some cases not without interest to the householder, who can, from a perusal of this book, learn the difference between good and bad arrangements and how to detect bad work—not an easy matter with plumbing. The necessity of traps, of trap ventilation, and of the other sanitary arrangements now adopted in well-appointed houses, are dealt with in four of the lectures, the second being devoted to a technical description of the art of joint-making and pipe-bending. The work is freely illustrated with woodcuts and plates, some of the latter being very valuable, as they show clearly the evils of the arrangements depicted. Many of those who have heard the lectures delivered will, no doubt, be glad of the opportunity of possessing a permanent record neatly printed, with such extracts from the discussion as the author has thought it advisable to append.

William Hedley, the Inventor of Railway Locomotion on the Present Principle. Newcastle: J. M. Carr.

The author of the little work before us believes that William Hedley is entitled to stand at the head of the list of inventors who have helped to make the locomotive what it is, and he has endeavoured to bring forward evidence establishing Hedley's claim to be the inventor of the locomotive. It may be conceded that justice has not been done by the majority of writers to the part played by William Hedley in the development of the locomotive, mainly because he was frequently hidden under the name of Blackett, the gentleman who appears to have done no more than find the funds; but the author of this work goes too far when he asserts that "without William Hedley, George Stephenson might have lived in vain. It was William Hedley who gave the locomotive its life and power, and made the work of other men possible." Hedley claimed the "principle of locomotion by the friction or adhesion of the wheels upon the rails"; but Mr. Zerah Colburn probably puts the claim on its proper ground when he says that Hedley was the first to work up the adhesion of the driving-wheels upon a commercial scale, for there can be no doubt that Trevithick had demonstrated the sufficiency of the adhesion of the wheels before the experiment was made which satisfied Hedley. The author is quite right in complaining of statements, still often made, that Stephenson was the inventor of the locomotive, when it is clear that Hedley made the first locomotive which was a practical success, by continuing in work for a period of half a century; but his little book can scarcely be accepted as more than the case from the advocate's point of view.

Progress. By James Platt. London: Simpkin, Marshall, and Co.

This is the concluding volume of a series of cheap and readable works, which have met with considerable success. The titles of these are thus introduced by the author in his concluding words:—Reader, make all you can from "Business," remember "Morality," use "Money" wisely, after studying the true principles of "Economy," and believe that "Life" rationally and wisely led must end in national and individual "Progress." The contents of the last-named can be imagined when we say that, amongst the subjects are capital, free labour, employés, technical education, production and distribution, and though the ideas are not altogether original, the author quotes Montaigne as a defence of his method of writing a book:—"I make others say for me what, either for want of language or want of sense, I cannot myself express." In his chapter on technical education Mr. Platt has taken a full grasp of the subject, and has enforced the absolute necessity of training in every branch of life, for the national existence depends on the utmost economy in production and distribution; but "technical education," he says, "will be deprived of half its benefit, unless we encourage inventive genius at the same time, by a complete alteration of the Patent Laws. At present, we stifle inventive knowledge, or, rather, deprive the nation of its benefit, by a tax that discourages rather than opens out the minds of those who might be benefactors to mankind." Those who have read the previous volumes of Mr. Pratt's series will not need advice to procure the concluding volume.

Electric-Lighting. By Le Comte Th. du Moncel. Translated by Robert Routledge, B.Sc. (London: Geo. Routledge & Sons.)

This is a translation of the second edition of Du Moncel's popular treatise "L'Eclairage Electrique"; and though considerable advances have been made since its original issue in 1880, the translator has preferred to leave the matter unrevised. So far as its omissions are concerned, the author will have little cause to complain, but we suspect that he would have altered some of the statements contained in the notes. As a popular treatise, the work will give just that information which the public so much need just now, the illustrations of machines and lamps being numerous, though necessarily not including the more recent inventions. Descriptions of these the translator has endeavoured to supply in an appendix; but as, speaking of incandescent lamps, he tells us that the "subdivision of the electric light presents no difficulties," and that "Fox-Lane" uses a string of flax from which to prepare the carbon filament, we can only regard it as a pity that he did not obtain the assistance of some electrician in writing the appendix. Much of the text has already appeared in English dress in various periodicals; but the work will, no doubt, be widely read by those who wish to know something about electric-lighting.

We have also received *Hot-Water Heating*, by F. A. Fawkes (B. T. Batsford), a useful and handy guide to all wishing to know how to arrange and put up heating arrangements for hot-water. —— *Mechanical Dentistry*, by Chas. Hunter (Crosby Lockwood and Co.) is the second edition of a manual that has been received with considerable favour. The most considerable alteration is the re-writing of the chapter on celluloid, a material which has recently been more extensively used in dentistry.——*A Treatise on Mathematics as Applied to the Constructive Arts*, by F. Campin, C.E., is the second edition, revised and enlarged, of a well-known volume of Weale's series. The work is especially adapted to the wants of those who have not received a mathematical education; and this, the second edition, includes a second part dealing with the higher mathematics.——*Hints for Investors*, by Walter M. Playford (Crosby Lockwood and Co.), is an explanation of the mode of transacting business on the Stock Exchange. which will be very useful to small capitalists.——*An Elementary Treatise on Conic Sections*, by Charles Smith, M.A. (Macmillan and Co.), and a *Treatise on Elementary Trigonometry*, by Rev. J. B. Lock, M.A. (Macmillan and Co.), are books which may be recommended to students, who must have some difficulty in choosing works of the kind.—*Picture-frame Making for Amateurs*, by James Lukin, B.A. (L. Upcott Gill), is a handy guide to the art of making-up picture-frames of various kinds, and will be found interesting by those who can handle such tools as are required. It is freely illustrated.

THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURAL, AND LODGMENT.*

By John Watson Warman,

Associate of the College of Organists, London.

u. (8) *Passing Through of Key-Action.*—Whenever an Organ possesses more Manuals than One, and at the same time Two or more of them are to admit of being independently Coupled to the Pedals, it is inevitable that either the Key or the Coupling-Actions will have to *Cross;* that is to say, one Set of such Action will be compelled, at some one point, to pass *through* some other such Set. It has already been seen (at *g*, ante) that it is in some respects best for the Tails of an upper Manual to overhang the Tails of the one beneath it: it is now to be noted that whenever such overhang is secured, any necessity for the Crossing of the Actions from such Manuals to the *Pedals* is avoided; but that at the same time a Crossing in the Actions leading from these Manuals to the *Palletts* is thereby rendered almost inevitable. It is hardly required to remark that a Crossing in the latter Actions is of the more import, because of the greater number of the notes on the Manual than on the Pedals.

The most usual way of effecting such

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Crossing of the movement to the Palletts is to Skew or Crank, on *plan*, one—we will here assume the Upper—of the two Sets of Keys, so that its Tails come exactly opposite the *spaces* between the Tails of the Lower Set; and therefore the set of Stickers rising vertically from such lower Tails pass exactly between the said upper Tails, —each of the latter being so Notched on both its side-faces as to furnish a Mortise or Slot between each pair of Tails, for the said Sticker to move freely through: see further at *d*, next. And provided that the Notching-out be sufficiently large for the Sticker to have a little clear space all around it, and the Sticker-foot be wired into its Key-tail in the usual way—to prevent any chance of the Sticker's rubbing against the Notch—, this Treatment will answer very well. Whenever the Sticker is super-broadened (see *m*, next, 2nd parag.) the Notching must of course be elongated accordingly.

v. But there exist at least Five objections to such a method of Crossing. These are:—(*a*) sometimes additional work involved in sawing out the Keys: (*b*) extra wear sometimes thrown on to one side of the Mid-Pin mortise: (*c*) interference with the placing of a Coupler between two Sets of Keys (see *s*, ante): (*d*) the "throwing out" of the Action Points of one Set of Keys with respect to the same Points in the other such Set, and consequent frequent necessity for a *second* Skew or Slant somewhere, —to restore the coincidence; thus, for instance, if both of the Manuals possess a Coupler to the Pedals, it will be here impossible to make *one* set of Backfalls [beneath Manuals] serve for *both* of such Couplers (see *g*, ante), and not only is this so, but one of the two sets of Backfalls will have to be placed slightly *Slanting* in order to bring its front Noses into coincidence with the Noses of the Backfalls to the remaining Manuel: (*e*) an *End-gap* or *Key-gap*, will in some cases become unavoidable (see 93 *q*; also *z*, next, 3rd parag.)

For the best directions and treatment in the cutting of the Key Slant or Skew see under Head of SCALE (at 93, *r*).

w. With the object of obtaining the upper Manual Tail Overhang, without having either to dispense with the Sticker just spoken of, or to Skew or to Crank the Key, several methods have been devised, only one of which, however, needs mention here. It consists merely in passing the lower-Key Sticker through a suitable *Mortise* cut in the Tail of the upper Key. This Treatment does away with all the Five preceding objections, but it introduces in their place Two fresh ones, viz., (1), interference with Removal of the upper Manual, and (2), liability to Cyphering in both of the Manuals. The second of these objections can, however, be got over, provided the Lay-out admits of the Stickers' being made long enough in proportion to the vertical distance-apart of the two Sets of Key-tails (see at this point with *Contracted Levels*, at 92, *q*), by simply *omitting* the Foot-Wire of the said Sticker,—the said Foot thus merely resting on the [lower] Key-tail, and so being free to follow any lateral casting or crooking of the upper Key-tail. The Mortise through which Key passes must of course be then made very accurate in form and size, as it has to furnish the sole *guide* for the lower end of the Sticker.

x. An *Instance* of the foregoing Treatment may be seen in the Organ, of 2 Manuals and the Equivalents of about 10 Sounding-Stops, Rebuilt (see 22, *s*; and 60, *v*) for Mr. Martin Bradley, of Leominster, Herefordshire, in 1867,—at which time this particular Device first occurred to the present writer. The plan here answers very well; but of course the difficulty of removing the Swell-Org. Keys remains. (The employment of any preferable arrangement was here rendered impracticable by reason of the necessity for the new work's being grafted into the existing old.)

y. In another Rebuild—also of 2 Manuals—, in 1876, by Gern, of London (see 28, *j*), for St. James's, Addison-road, London (W.), the preceding arrangement has been adopted along with the *retention* of the Foot-Wire of the Sticker. This is, as just implied, always a really objectionable Treatment, for the Mortise must, obviously, be then made large, in order to ensure freedom for the Sticker within it, and this as manifestly tends to improperly reduce the substance of the Key; and even notwithstanding such increased freedom in the Mortise, a *Cyphering* is still liable unless the Keys be made of thoroughly seasoned material, for the corresponding Tails of the two Manuals may quite possibly cast or warp in *opposite* lateral directions. It is right to add that the Keys used by this particular Builder appear to be generally so "dry" as to materially lessen the chance of any unbidden sounding from such a cause as the foregoing.

z. After a considerable amount of thought and attention, I have come to the conclusion that in many cases (see here at *p*, next, 8th parag.) the really best method of Crossing two Key Actions will be found in an exact *Cranking*, by means of a suitable *Wire*, of the proper portion of such *Action* itself,—whether such portion be a Sticker or a Tracker.

In order to explain this Treatment, we will suppose it to be desired to apply it to such a pair of Manuals as those last named (at *y*, ante), and in which pair the upper Keys are, so far as the direction to right and left is concerned, exactly vertically *over* the lower Keys at every point. The lower part of the Sticker had here better be made entirely of Wire,—of the ordinary *Button* kind (see *Department* KEY-ACTION): this Wire will rise in the usual way from the lower Key, but, a little before reaching the under-face of the upper Key, it (the Wire) will take a sharp square turn or bend sideward for a distance exactly equal to half the plan-distance apart—centre to centre—of the Key-tails semitonally; the Wire will then ascend vertically till it is a sufficient distance above the upper face of the Swell Key, and then turn sharply sideward—precisely as before, except in the contrary direction—so as to return vertically over its first starting point; it will then be continued vertically for a short distance, so as to form a *tang* for insertion into a suitable Sticker,—continued and finished in the ordinary manner. In all cases where any Action Noses which rest on the Tails of the Upper Manual (see *d*, next, 4th parag.) do carry Regulating Buttons, it will be desirable to form the upper elbow of the Cranked Wire at a point *high* enough to favour the access necessary for such Regulation. And whenever such Noses, whether Regulating ones or not, do extend actually *between* the Cranked Wires, the said upper elbows are obviously *compelled* to be made sufficiently high to keep properly clear of the said Noses, even when the latter are risen with their Key Tails.

It will thus be understood that the Wire or Cranked part of the Sticker passes between two Keys in each case. It will manifestly be necessary to cut a little segmental or semicircular shaped *Notch* into the side faces of the Keys,—for the Wire to work freely through; and this Notch will be lined with *Cloth*, if required. A similar Clothed Notch will sometimes be required on the inner face of one of the two Cheeks of the Key-Frame (see 86, *t*).

Where the Sticker is short enough, it should be composed *entirely* of the Wire; and, where there is a sufficient amount of length on both sides of the Cranking, a Wood portion should be applied at *both* of such sides.

The treatment for a *Tracker* will be adequately understood by what has now been said.

When the Cranking passes between Backfalls, Squares, or Levers, the treatment will naturally be even more simple than as aforesaid with the Keys; for even *Thick* Backfalls will contain enough space between them to accommodate the Wire without any Cutting-away whatever. A small patch of Cloth may be attached, at the proper point, to *one* side of each of the Backfalls, Squares, or Levers.

zz. The slight increase which this *Crank-Wire* Treatment involves in labour and material, as compared with the simple Skewing of the Key, is hardly worth naming; the whole of the previously mentioned difficulties are avoided; and there remain, in addition, the following palpable advantages:—(*a*) the amount of substance at the Crossing being so small, much more freedom can be insured at such point, and this obviously diminishes the chance of an unbidden sounding through a "sticking" of the action; also in cases where the Noses of two Backfalls, Squares, or Levers are actuated by a single Key-tail (see *f*, next), or where the Backfalls are required to be thick enough for a Wire Tracker to pass through a Piercing in each of them (see *Department* KEY-ACTION), the Cranked Wire will often afford the only means possible for passing a Sticker between such Backfalls, Squares, or Levers: (*b*) the Removal or Replacing of the Key is facilitated,—its Tail being readily drawn out or pushed in between the two Wires: (*c*) Regulation of the Action is made easier, because the Cranked part of the Sticker or Tracker acts as a stopper to prevent it from turning round, and so there is usually no necessity for grasping the Thread-Wire with a Pliers: such Regulation is also rendered easier when it has to be performed by means of a Tool inserted between each two of a set of Stickers, because such Stickers are made of wire—so widening the opening—at the point of such insertion,—as when the Swell-Organ Key-tails do carry a set of Regulating Noses in rear of the Great-Organ Sticker line (see here the No. 4 *Treatment*, commencing at *p*, next): (*d*) the same causes act to render the entire removal of the Regulating Buttons (when taking Action to pieces) easier: (*e*) there is no possibility of the Great-Org. Sticker's becoming jammed through getting askew; and this advantage is obtained *without* either the additional work of super-broadening such Sticker and elongating the Notching (see at end of *u*, ante), or of passing the Sticker through a Key-tail: (*f*) it becomes quite practicable to allow the Noses of Squares, Backfalls, or Levers—especially if they be of Non-Regulating kind—to enter and lie actually between the [Cranked] Stickers: (*g*) it is now possible (and is not so by any other method) to let Stickers or Trackers pass through a Fanned or otherwise irregularly distanced Action,—because the plan-amount of the Crank elbow can be varied in every note, or in as many of them as is required: (*h*) the cranked part can be altered, by bending the Wire, so as to *follow* and accommodate a lateral casting or warping in the Keys or other portions through which such Cranking passes: (*i*) there is less liability of a Sticker's or Tracker's dropping away between Backfalls, &c., or slipping through a piercing in a single one of latter, immediately upon its Button being removed; and yet the Cranked portion of such Sticker or Tracker can be made to admit of being drawn out at pleasure through such piercing: (*j*) more space is left for a possibly desired Button-Clip for Participation (see descrip. at *j*, next, 1st parag.), if the Button itself be *not* in advance of the Great-Org. Stickers (see at *h*, next, 9th parag.) For any other advantages of the *Crank-Wire* method of Crossing, see *Departments* COUPLING-ACTION and KEY-ACTION.

zzz. No *Instance* of the *Crank-Wire* Treatment is as yet known to the present author,—it being his own Device.

(*To be continued.*)

PRACTICAL NOTES ON PLUMBING.—XXXIV.[*]

By P. J. Davies, H.M.A.S.P., &c.

Lavatory-Basins.

In fitting up lavatories great care should be taken in the selection of suitable fittings for the class of work that has to be executed, not forgetting simplicity of arrangement, cleanliness, and substantiality of the fittings. Such being the case, I propose to commence this branch of the trade by first describing the most simple, and gradually leading my readers, as it were step by step, to the most elaborate and intricate patterns and systems at present in use. The general height for lavatory-basins is 2ft. 6in., and in schools from 2ft. upwards.

By referring back to Fig. 120 in the BUILDING NEWS for Oct. 28, 1881, at 19 and 20, the reader will see a simple lavatory-basin suitable for its situation and work. All that is required is a round basin 13in. or 14in. in diameter, having a washer and plug fixed in the bottom, and an overflow-arm for the overflow-pipe 23, which may be branched into the waste-pipe, as shown at 22; below the basin should be fixed some kind of trap having a cleansing cap and screw, as shown at 22; from the top of the trap should be taken an air-pipe, as shown at 24, and carried up as shown at 25; to prevent siphonage and corrosion, or the outgo of the trap L W may discharge into a properly constructed open trap-head or otherwise; but in this case it is branched into W (waste) pipe, as shown at 37. Should the expense of carrying up an extra vent-pipe be too great, it is possible that this pipe may be taken back and branched into the main waste-pipe at about 33, and if this is too much trouble, use a thoroughly well constructed open-top trap on the inlet end of the waste-pipe, or a proper ▭ trap, as shown at the lavatory-basin (Fig. 121.) It should be remembered that I am not always in favour of the ▭ trap, but ever prefer to have them properly ventilated. I mention this to prevent any quibbling, and to show that I am quite aware that in certain situations an ∽ trap will answer every purpose. It is under such circumstances that the plumber must exercise his own judgment or discretion. By again referring to Fig. 121, published in this journal Nov. 11, 1881, it may be seen that this basin has an additional fitting: instead of the simple washer and plug as fitted in the basin (Fig. 120) it has a pull-up quick-waste, as exemplified at L W (Figs. 50, 52, 53, and 54, in issues for August 12 and 19, 1881.) It will also be noticed that to the waste-pipe from the trap there is no vent-pipe, but the end of this waste-pipe is taken right away to the gully-trap, shown in the left hand corner of Fig. 122, or if circumstances will allow, it may be taken to the fresh-air inlet, part of the main in the right-hand corner of the fig., as the sink-pipe does; but under these circumstances do not branch the lavatory or other waste-pipes into the waste-pipe of the bath, simply because by so doing you are very likely to interfere with the draught of the bath-waste, and so cause it to run sluggishly and noisily; and further, it is a matter of very common occurrence for the bath-pipe water, by its induced action, to empty the other traps, more especially if the trap is not of the ▭ pattern or kind, having an exceedingly small inlet or dip-pipe in proportion to the body.

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In order to prevent siphonage I have fitted a full-sized 9in. deep by 6in. wide ▭ trap with an only 1½in. dip-pipe, and found it effectually prevent siphonage under the most trying circumstances. Having settled about the basin waste-pipe and class of trap, the next thing for consideration will be the outlet. The washer and plug is known to all plumbers, therefore let us next examine Fig. 196. Quick-waste A is a bracket to be fixed to a wooden block to the brickwork or otherwise; B the union for fixing with a leathern washer on the *inside* of the basin; this union has a fly-nut C for holding the union firmly to the basin; the union may with white-lead be bedded to the basin; F is a lining for soldering or connecting to a short length of leaden pipe, so as to connect it with the lining G of the valve; H the outlet valve; E the lining leading to the trap; J the pull-up knob, fixed by the fly-nut K to the slab or top; L the deep nut or lining for connecting the stand-pipe M, or valve, with the pull, which may be done with copper-wire-chain or otherwise. It will readily be seen that with such valve arrangement as this there is not any provision for overflow, and therefore an overflow arm must be fixed on the side of the basin, as shown in the dotted lines X (Figs. 197 and 200), or a branch inserted into the pipe, fixed between the valve and washer in basin as at N (Fig. 197) and in such a manner that the pipe O may be taken or bent up to the water-level of the basin, as shown at overflow, and having an outlet to discharge either into the open air or otherwise, as discretion or circumstances may dictate, taking care at the same time that this pipe does not siphon out the basin. If the outlet of this pipe has to be taken down below the top or water-level, an air pipe should be branched into the top at P, which will of course stop siphonage. Within the last few years the standing waste-pipe, so well known in connection with cistern-work, has been introduced for the outlet valve, which will be easily understood on examination of the diagram (Fig. 198).

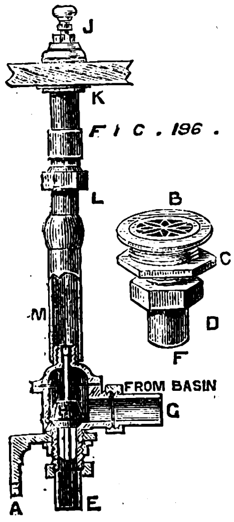
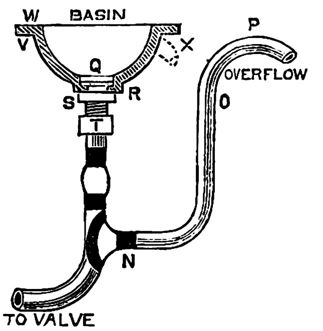


FIG. 196.

FIG. 197.



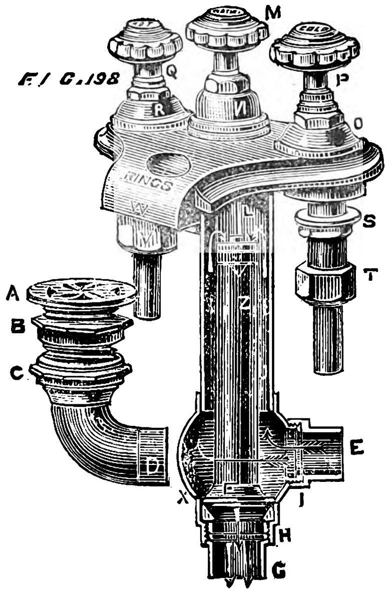
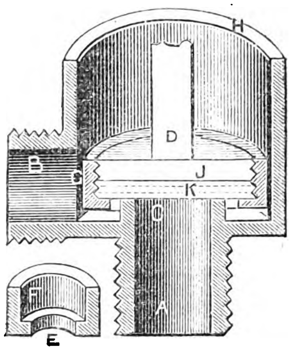


FIG. 198.

Suppose the washer A to be fixed to the bottom of the basin, and the union bend D to be attached to the body X, water from within the basin can run down through the union and charge the body up to the top of the stand-pipe Z, and overflow, as shown by the arrows at K, so that it would be impossible for the basin to overflow, assuming always that the overflow is large enough. Next, by the knob M and rod L, pull up the stand-pipe Z; by so doing the valve F must also be opened, which allows the contents of the basin to run full-pipe bore away; but suppose you let go the knob before the basin is emptied (say when half empty) unless you have a good air-pipe or a properly constucted ▭ trap to allow plenty of fresh air, the seal of your trap will be instantly destroyed, and the stink arise through the standing waste. There is, however, a remedy which only to-day I have invented, and put into practice. It is as follows:—Fix an inverted cup on the rod L, so that its mouth or lip shall cover the standing waste-pipe when the knob is let go in a similar way that the bell-trap does, but let it dip to about the bottom of the basin. More will be said about this diagram in Water Supply, as also in chapters on Bath Work.

It frequently occurs that the wastes of lavatories are fitted to work with a kind of stool valve, as shown at Fig. 148, with levers and chain connected to the ordinary pull; when such valves as these are fitted, make the ordinary outlet B (Fig. 148) the inlet from the basin, so that all the water from the basin may drain entirely away, and see also that the rubber on the valve is properly fixed, with a pillbox lid nut G (Fig. 199), which will prevent the rush of water having any effect upon the edges of the rubber, which otherwise will have a tendency to pass into the seating; as a matter of course, when the rubber is fixed to the valve in this manner, the seating must be a raised one, as shown at C (Fig. 199) and D (Fig. 152) &c. This raised seating is to allow for the bottom part of the pill-box nut, which otherwise would prevent the valve from closing, unless a washer were fixed round the seating.

FIG. 199.



Water Supply to Lavatories (Fig. 200).

There are many different methods whereby the water supply can be accomplished, some of which are of the most intricate nature. I shall, however, be content to describe some of the more simple ones that I have fitted up myself. Fig. 200 is a very good lavatory, similar to one that I fitted up in Portman-square 18 years ago, and, moreover, one not likely to get out of order. A is an 18in. white and gold basin, with inlet pan B from hot and cold supply

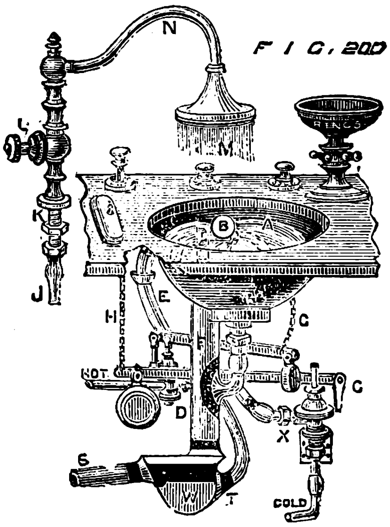


FIG. 200.

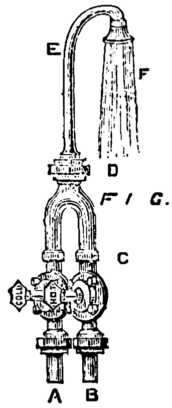


FIG. 201.

valves; E is the overflow pipe, brought from the arm of the basin into the heel of the ⊂⊃ trap; F is the quick-waste, constructed in the dip of the D trap, the valve being a 2in., ground in long pump spindle valve, worked by the use of a rod and sling attached to the pull-up knob "WASTE"; the levers of the hot and cold supply are attached to the knobs by the use of the chain G H. Of course the pulls are made in such a manner that by giving them a quarter turn they will hang up. To this basin is fixed the swing pillar-bracket L, which is used for shampooing, &c. The pillar is fixed to the marble slab by means of a fly-nut, as shown. The swan-neck may be fitted with universal-joint, or sometimes only made to swing in a side-direction, or it may be fitted with india-rubber tubing; the valve L may be dispensed with, and a double valve, one for hot, the other for cold; or it may be supplied through a breeching-piece, as shown in Fig. 201.

WATCH-CLEANING AND REPAIRING.

By "A FELLOW-WORKMAN."

(*Continued from page* 255.)

IT does not matter what job you do, you must have a foundation to work upon, and also a rule; we will, therefore, find the foundation of a barrel; Fig. 57, therefore, shows the foundation and also the rule. The line B to C should be a true surface of the outside of the teeth; B to A, D to E, and C to A should be at right angles; A to F would be the centre through the barrel.

FIG. 55.

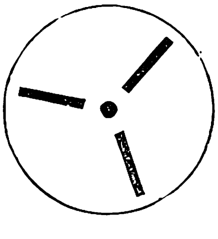


FIG. 56.

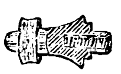


FIG. 57.

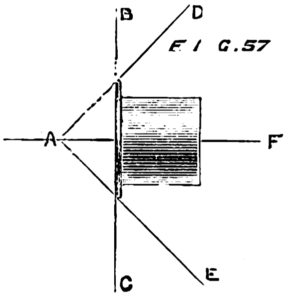
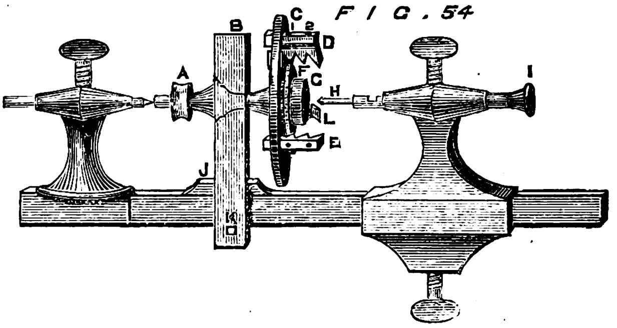


FIG. 54.



We will, therefore, say that you have filed up the holes in lid and barrel, and you wish to cut a dead centre from F to A without loosing the other angles; to do this you must fit your barrel, as shown Fig. 54, on a true surface, and the outside of the teeth must run true; then the point of your drill must enter at a dead centre, and when you have drilled a hole right through the barrel, you will find, on trying it, that the teeth run perfect. You must be careful to put lid on in its right place.

Fig. 54: A is rose for drill-bow, and also Fig. 56, which runs through B, as shown by dotted lines. J is foot for B, to hold it more firm, and K is a square wedge, which goes right B and holds it down firm. C is chuck, D double clamp, with screws at back, as shown at E. The jaws are screwed on to the chuck by means of a nut at the back. You put up E and L in position, and then D; then you tighten D by means of screws 1 and 2. F is a washer or ring, which holds barrel, and H is the drill. Fig. 55 is face of chuck with jaws removed the black lines are slots for jaws to run in, and the dot in the middle is for a male centre to be screwed in, which I will speak about another time. Fig. 56 is A in Fig. 54; the section shows a hole with a thread; the chuck C (Fig. 54) is screwed into this hole.

(*To be continued.*)

SPRAGUE'S ELECTRIC METER.

THE specification is just published of a patent taken out for improvements upon the electric meter, invented by Mr. Sprague in 1878, which greatly simplify the construction and action of the instrument, while extending its applications. This new patent contains also several additions made to the meter to increase its utility, and appears to cover every mode by which electrolytic actions can be practically used to register the quantity of electricity passed into a circuit.

The original idea of plates of metal acting alternately as anode and cathode, reversing the direction of the current by the weight of the metal transferred, and registering the number of reversals, is still the basis of the instrument; but all the mechanical modes of supporting the plates by springs or balance-beam are done away with. A single moving plate is used, which floats in the liquid like a hydrometer, and which sinks or rises in the liquid exactly in proportion to the weight of metal added to or taken from it. As the quantity of metal which serves as the measure of the electric quantity is added to the electrode, it sinks till the limit is reached, when a contact is made, which sends a current into a reverser, whereupon the relations of the electrodes being changed, the metal dissolves, and the plate rises to its upper limit, and again actuates the reverser.

Several forms of reverser are shown, which are intended to permit the whole of a large current to pass, and in which all sparks are prevented in a very simple manner, as both ends of the wires are connected together, by the motion of the reverser, before the contact at which the spark would appear is opened, so that the extra current has a closed circuit in which it passes without sparking. The register is actuated in a very simple manner by the reverser. The moving part of this carries a small wheel, upon which lies a lever also carrying a small wheel, and when the reverser is at rest these two wheels are in close contact. The motion of the reverser, therefore, lifts the lever by the action of the two wheels passing each other, and each such raising of the lever moves the indicating-train one tooth.

An automatic heating arrangement, which may be applied to various other uses, is employed to prevent the solution from being frozen. This consists of a coil of fine wire inclosed in the space between two glass tubes placed vertically in the liquid. When this wire is heated by the current, a stream of warmed liquid will run up these tubes, and thus warm the liquid generally, and the same appliance is of use to prevent stratification in the liquid. The current is sent into the heater by an automatic thermo-regulator, consisting of an air-thermometer fitted with wires, which close the circuit whenever the temperature falls to a fixed degree.

The influence of change of temperature upon shunt ratios is guarded against by balancing the liquid and metal of the meter circuit by a shunt composed of graphite and German silver, so adjusted that the variation is equalised in both circuits; but the care taken in the various designs shown in the specifications, appears to indicate that the intention is rather to do away with the complication of shunts by sending the whole current into the meter—a plan which will no doubt give less scope to the suspicions of consumers.

There is another mode of action shown which is based on a new idea, which may, however, be seen foreshadowed in the 1878 patent. In this construction two metal plates are employed, which would require exchanging for each other periodically as the metal is transferred from one to the other without reversal; but these plates and this metal, though they do the work, have nothing to do with the measuring, and therefore do not require weighing. The current passes from them to a cylinder floating between them on bearings. As one side of the cylinder receives metal while the other dissolves, the centre of gravity is displaced, and the cylinder rotates on its axis, and by its motion records the electricity passing. The idea is no doubt promising; but how it will perform in practice, would probably require to be determined by action in use.

But another modification appears to offer considerable promise of utility in connection with electro-metallurgy. The motion of the electrode is transferred to an index which traverses a scale showing the subdivisions of the interval between reversals. This scale may be made to show ounces of silver or gold, and a shifting contact is placed over any desired quantity: thus, if a silvering vat contains articles on which it is desired to deposit five ounces of silver, the stop would be adjusted at that point. When the indicator reached this spot it would touch the stop, and send a current into a connected apparatus, which would either disconnect the work, or ring a bell to call attention. If found to work in practice, this would evidently save a great deal of work, and also loss of valuable metals, or deficiency of metal deposited.

If electric-lighting advances with the rapidity its advocates look for, the question of measuring the current will become of very great importance, and it will remain to be seen whether electrolytic action will furnish the best means of measurement practically, as it does theoretically. If so, it is obvious that self-registering instruments must be preferred, to any mode of merely weighing a deposit at intervals.

EDISON'S CURRENT METER AND OTHER IMPROVEMENTS.

A MEANS of measuring the quantity of current passed along a given wire is as much a necessity of the general system of lighting by electricity as the gas-meter is to the existing system. It may be remembered that Mr. J. T. Sprague patented a simple device for calculating the quantity of current by the amount of copper deposited in a shunt circuit, and it so happened that Mr. Edison patented, or applied for a patent, for an invention which is practically identical. He has recently obtained a patent for a modified form of the invention, and according to the specification (4576, 1881) the new meter indicates a correct result with a smaller current than was required by the copper cell. The invention has been on view at the Crystal Palace, and was briefly described by us some time ago. It consists of amalgamated zinc electrodes in a solution of sulphate of zinc, and the sum to be charged to the consumer of current is ascertained by the increase in weight of the receiving plate—zinc, being deposited on one electrode, and dissolved off the other. According to the specification, a heavy coat of zinc is deposited on the plates, which zinc is thoroughly amalgamated while being deposited; but according to the descriptions of the process given by those connected with the invention, the plates are coated with chemically pure zinc, so as to reduce local action to a minimum, and they are then amalgamated. The plates are about the size of microscope slides, 3in. by 1in.; they are a quarter of an inch thick, and are kept apart by little strips of ebonite about a quarter of an inch thick, and clamped together by ebonite screws passing through the centre of their length. The depositing cell is arranged in a shunt from the leading conductor of the house or other circuit in which it is desired to measure the amount of current consumed,—a resistance being placed in the line to shunt a small definite portion of the current through the meter. In the wire leading to the latter is another resistance to compensate for the effects of change of temperature. This resistance is formed of copper wire, the electrical resistance of which increases with a rise in temperature, while that of the solution in the cell diminishes. A sufficient length of copper wire is, therefore, put in the circuit to equal the loss of resistance in the cell, and the arrangement is then permanently compensated for temperature. Arrangements are, however, made to prevent the temperature of the apparatus falling below a certain minimum; for when that is reached an Edison lamp is thrown into circuit, the heat from which quickly raises the air temperature of the box in which the meter is contained. When no current is being supplied, an electro-magnet breaks the shunt, thus preventing the establishment of a counter-current and the recomposition of the solution. In practice it is proposed to use two meter-cells placed in a cast-iron box so connected that one registers at a greater rate than the other, but in strict proportion. One of the cells would be examined monthly by the ordinary officers of the company; the other would be in the sole custody of superior officers, and would be examined quarterly. It is proposed that the inspectors, on coming to "take the meter," should remove the cells and replace them with fresh ones, the cells so removed being taken to the head office, and the plates carefully weighed after being separated. The difference in weight will be calculated in webers, ampères, coulombs, or whatever term may be used to designate the amount of current consumed, and the bill will be made out accordingly. Whether it will be paid ungrudgingly remains to be seen, for it is difficult to see what check the householder will have on the Electric Light Company, and remembering the perennial outcry about gas bills in face of the tell-tales, which every consumer can read if he will try, we are afraid grave charges will be made when consumers have no check at all. The copper cell, with the tipping beam, which registers the current consumed on dials similar to those of a gas-meter, is considered too delicate for use in the houses of customers, but will be employed at stations.

Another of Mr. Edison's improvements is a method of regulating the generative force of a dynamo-electric machine. In this invention (4552, 1881) a device is adopted for diminishing the mass of the yoke uniting the cores of the field-magnets. The electromotive force of the generator is kept constant by means of an electro-magnet, which acts upon a conical block, fitting a conical opening in the centre of the yoke. In Edison's well-known vertical machine, this method of a conical block drawn into the hole in the yoke by an electro-magnet and forced out by a spring and its own weight, can be easily adopted, but for other forms he provides means for partially shunting the magnetic currents or lines of force away from the field in which the armature is revolving, by adjusting levers to connect the pole pieces with the yoke, or to connect the brushes together.

Another invention recently patented relates to means for maintaining the electromotive force of a current from secondary batteries by reinforcing the primary current from time to time, so as to keep up the electromotive force in the consumption circuit; but as the arrangement cannot be explained without diagrams, we must refer those interested to the specification, No. 4553, of 1881.

WILLOUGHBY SMITH'S INDUCTOPHONE.

We mentioned in the "Scientific News" last week that Mr. Willoughby Smith had, in the course of some investigations into the phenomena of telephony, made a remarkable discovery—viz., that an iron plate, so held that the magnetic lines of force from a flat coil of insulated wire could impinge upon it, would produce the same musical note as that given by a tuning-fork used as a make-and-break contact in the circuit with the coil, although there is no visible connection between the iron plate and the coil. The apparatus, which has scarcely yet taken a definite form, has been called the inductophone, a name which sufficiently expresses the nature of the phenomena. It consists of a board, on which is mounted horizontally a tuning-fork, one arm of which carries a light contact piece normally bearing against the point of a binding screw placed on one side of the fork. Between the arms is a small electro-magnet, which, when the current is passed, maintains the vibrations of the fork indefinitely. The connections are so arranged that the current alternates, when the fork is vibrating, between the main line and a short circuit, and in the main circuit is placed the flat disc or coil, made up of insulated wire, rather fine, held between two pieces of cardboard in a frame so as to resemble in shape an ordinary bedroom looking-glass. One end of this coil is connected to the battery—Mr. Smith used a number of Leclanché elements—and the other is connected through the tuning-fork with the other pole of the battery—that is, when the contact is made. The fork being set in motion, the current passes through the coil of the magnet, and a rapid make-and-break arrangement is set in full swing, corresponding in number of contacts to the normal pitch of the fork. Thus, if the latter is an ordinary fork giving staff C, the number of vibrations per second is 512, and it follows that exactly the same number of magnetic changes take place in the coil or disc of insulated wire—consequently, also in the magnetic field which it creates. If, then, a telephone, a telephone-plate, or any suitable piece of iron is held in such a position as regards the looking-glass-shaped coil-frame, that the lines of force can impinge upon it, a sound is produced which is identical with that due to the tuning-fork, although there is no mechanical connection between the receiver and the flat coil. It must be confessed that this is a remarkable discovery, for the action is perfect, even when the transmitter and receiver are separated by a brick wall and several feet of air, the actual distance being limited only by the delicacy of the apparatus. It is obvious that the greatest effect will be found in that position in which the largest number of lines of force can impinge upon the receiving plate, and this will be found in the centre line of the flat coil or transmitter, the intensity varying as the square of the distance. The greater the number of lines of force, and the greater the intensity of the field, the greater will be the effect produced upon the receiving diaphragm. As to the distance through which the effect is produced, we believe that experiments are being made to determine it with some degree of accuracy; but as it obviously depends, to a certain extent, upon the apparatus employed, endeavours will, no doubt, be made to perfect that first. Meantime we have given sufficient particulars to enable experimenters to take up the study of a very interesting phenomenon.

ELECTRICAL ACCUMULATORS, OR SECONDARY BATTERIES.*

By Prof. Oliver J. Lodge, D.Sc.

(*Continued from page 256.*)

A PLANTE and a Faure cell, though the process, and more especially the time, of formation is different, are, when formed, pretty much the same thing; and consists of two plates of lead, one coated with black peroxide of lead (PbO_2), the other with a spongy material consisting of metallic lead in a fine state of division and more or less alloyed with hydrogen; both plates immersed in dilute sulphuric acid of about ordinary battery strength. Two plates in this condition must, as explained last week, give a current when connected by a wire, the positive current flowing along the wire from the peroxide coated plate—the + plate—to the spongy metallic — plate, and back through the liquid in the other direction; the spongy lead becoming gradually oxidised, and the peroxide reduced to some lower oxide, all the time the current lasts—*i.e.*, until the condition of the surfaces has become either temporararily or permanently the same. In order to bring the plates into the active condition they are first coated with oxide of lead, either electrically — by Plante — or mechanically — by Faure, which is then acted on by an electric current passed through the cell for some considerable time, the current being made to enter the liquid at the plate which is to be peroxidised, and to leave it at the plate which is to be reduced. Hence the former of these plates may be permanently labelled +; for when charging the cell the current enters at it, and when discharging the cell the current sets out from it. The other plate is similarly always —. There need, therefore, be no ambiguity about these terms. The + plate is always to be connected with the positive pole of the dynamo, whether the latter is supplying the current to the battery and charging it, or whether the dynamo is receiving the current from the battery and being driven by it.

Theory of Electro-chemical Decomposition.—It was stated last week that electricity was conducted through a liquid by means of two opposite processions of the constituent—dissociated—radicles of whatever substance in the liquid is undergoing decomposition, and that every such radicle possesses a certain definite charge of electricity which it carries with it and delivers up to the electrode, either when it is set free by combination with its fellows, or else when it is made to combine with something in metallic communication with the electrode. It was also stated that the charge of electricity possessed by a dissociated monad radicle is constant; and that diads have twice this charge, triads thrice, and so on. From these considerations it follows—as was proved by Faraday—that for a given weight of substance decomposed, a definite quantity of electricity is required; a quantity which will be known as soon as we know the number of atoms liberated, the electrical charge of each, and the weight of each. Let q be the dissociation charge of a free hydrogen or other monad atom or radicle. We do not know the value of q yet, we only know that it is perfectly definite and unchangeable. Let μ be the weight of any atom or compound radicle released from a combination in which it acted as a k-ad; in other words, let its active atomicity have been reduced by k, or let k be the number of bonds which have been broken in the act of making it a free radicle—whichever way of expressing it is preferred—then it is necessarily possessed of an electrical charge kq.

Let N be the number of such atoms delivered up to an electrode in any time, then in the same time a quantity of electricity $Q = N k q$ must have passed through the cell; and the weight of the substance liberated at the same time is $N \mu$—call this M. Then

$$\frac{M}{Q} = \frac{\mu}{k q}$$

Now, in the right-hand side of this equation k is the only thing we know; we only know the relative weight of different atoms, not the absolute weight of any. Let h be the absolute weight of a hydrogen atom, and m the number ordinarily known in chemistry as "atomic weight"—viz., the number which expresses the weight of any atom relatively to hydrogen, so that $\mu = m h$; then the above equation may be written

$$\frac{M}{Q} = \frac{m}{k} \cdot \frac{h}{q}$$

Now, though neither h nor q are yet known, their ration has been determined by careful measurement, and it is 1·9505 in C. G. S. units; in other words, the electrical charge of a free hydrogen atom is 9505 times its weight in grammes. And the charge of any other radicle of atomic weight m and with k free bonds is $\frac{9505\,k}{m}$ times its weight in grammes.

If the weight of the substance be expressed in pounds, and the quantity of electricity concerned in its liberation or decomposition in Ampere-hours—as for practical purposes is rather convenient—the above number 9505 becomes 12,020, or, with sufficient accuracy in ordinary cases, 12,000. So we will now repeat the above equation in an easy and practically useful form:—

$$\frac{\text{Weight of substance acted on in a single cell, in pounds}}{\text{Quantity of electricity passed through it, in Ampere-hours}} = \frac{\text{ordinary ``atomic weight'' of the substance}}{\text{12,000 times the number of bonds released per atom of the substance}}$$

Whether the "substance" is the constituent which is liberated at the positive or at the negative pole, or whether it is the original compound, which is not "liberated" at all but decomposed, matters nothing. The above statement is perfectly general and universally applicable. It applies also when it is recomposition that is going on instead of decomposition.

The expression "number of bonds released or joined per molecule" is not a happy one, but the phrase "change of valency" is no better, and the very simple meaning intended to be expressed is best conveyed by an example. Suppose $CuSO_4$ is being decomposed; two bonds are released when Cu separates from SO_4, hence

$$\frac{\text{Weight of sulphate of copper decomposed}}{\text{Quantity of electricity passing through it}} = \frac{63{\cdot}5 + 32 + 64}{24\ 000}$$

But we might equally well write—

$$\frac{\text{Weight of copper deposited}}{\text{Quantity of E required}} = \frac{63{\cdot}5}{24{,}000}$$

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* From the *Engineer*.

Take as another example the decomposition of common dilute sulphuric acid, with copper electrodes, say,

$$\frac{\text{Weight of hydrogen set free}}{\text{Quantity of E passed through cell}} = \frac{1}{12,000}$$

$$\frac{\text{Weight of sulphuric acid decomposed}}{\text{Quantity of E}} = \frac{98}{24,000}$$

$$\frac{\text{Weight of sulphate of copper formed at the expense of the oxygen electrode}}{\text{Quantity of E}} = \frac{159\cdot5}{24,000}$$

Suppose nitrate of silver is the substance acted on. Here only one bond is released per molecule, so

$$\frac{\text{Weight of silver deposited}}{\text{Quantity of E}} = \frac{108}{12,000}$$

$$\frac{\text{Weight of nitrate of silver decomposed}}{\text{Quantity of electricity}} = \frac{170}{12,000}$$

Finally, suppose the substance acted on is Pb O, the protoxide of lead, then

$$\frac{\text{Weight of litharge oxidised to peroxide}}{\text{Quantity of E required}} = \frac{223}{24,000}$$

Weight of litharge reduced to metallic lead, the same.

Thus a current of one ampère is able to oxidise on one side of a Faure cell $\frac{223}{24,000}$ lb. of litharge per hour, provided there is no waste, nor any gas given off, and to reduce the same amount on the other side. Or, every pound of litharge on either side of a Faure cell requires 108 ampère-hours for its reduction and oxidation.

If, instead of one cell, a number *n* are taken and arranged in series, and the current sent through them all, the above action goes on in each cell, so of course the total decomposition will be *n* times as great.

SCREW-CUTTING BY EAST INDIAN NATIVES.[*]

ONE of the engineers of the great India and Peninsular Railroad in India, told me that he quitted work and loafed a month to watch the natives build some heavy press screws without machinery of any kind whatever. There were eight screws five inches in diameter, twelve feet long, threads about one and a half inch pitches. The natives worked out-doors in the sand; far away from anything suggestive of art or industry. They secured bars of native iron, excellent in quality, but neither round, straight, nor of uniform diameters along their length. They filed these bars bright and wrapped around them, spirally, a ribbon of some fibre, the space, &c., being regulated entirely by accurate native eyes. They then made mud-lined trenches which they filled with some kind of home-made acid. They soaked the screws over night in this acid, and in the morning had a well-developed corrosion in the way of a thread. They then neutralised the acid by bathing the screws in water, after which they stripped off the fibre and set to work with chisels and files and cut the threads to proper depth. Here were screws, but they were not round, nor of uniform pitch, nor with uniform thickness and depth of thread. They then made a mould in the earth and stood a screw upright in it for a core. A long nut of native brass was then cast upon the screw. The nut was then worked loose, and the screw chipped at and filed at till the nut would run from end to end. This was one step towards uniform accuracy. The nut was then melted and cast again upon the screw. The screw was re-dressed till this nut run all right. This kind of business was kept up till about twenty nuts had been used for each screw. My friend said that the final work was as perfect a job of nut-and-screw fitting as he ever saw in his life. There was no perceptible difference to be felt in running a nut from end to end on a screw.

It is not uncommon in our Southern States to see old sugar-cane presses built entirely of wood, with a wooden screw about five feet long, 14 inches in diameter, and with a thread, as near as I can remember now, about three inches wide, which would be six inches pitch.

The nut is formed in two immense wooden blocks firmly keyed together. These screws and nuts are cut out with a mortising chisel, mallet and saw. The work is all accurately marked off geometrically, before the cutting is commenced. Many of the southern millwrights particularly pride themselves on their ability to lay off these nuts and screws. The student in mechanical drawing who has advanced to the projection of a section of threaded nuts, would probably find himself stumped if he attempted to put his knowledge into practice by laying off the lines in the hollow cylindrical surface of a half nut.

Few lathesmen ever lose faith in the accuracy of the lead screw of a lathe. If they will take a walk along the length of a lathe they will be able to see the difference between one part and another. The actual number of threads to the inch make but little difference because they can do whatever they wish to do with the aid of the change gears. But it is very important to know that the number of threads to the inch is regular throughout the length of the screw. A ten-thread screw should have a hundred threads in ten inches; but measure one and see about it. One inch will be found to have ten threads; the next, ten and one-hundredth, perhaps; the next some other trifling variation; and so on throughout the length. Not only will every inch vary from the other inches, but one thread is likely to be a different pitch from the thread right along side of it. It will be at once seen that the screws made by the natives in India were probably much more accurate than they would have been, if they had been cut in a lathe with the lead screw in the ordinary condition.

Lathe makers throughout the world follow the plan of cutting their lead screws from a master screw, procured from the shop of Sir Joseph Whitworth & Co., in Manchester, England. Whitworth early discovered that screws were not accurate enough, even for ordinary shop-work, and at once commenced to produce a reasonable standard. As near as I can understand the matter, Whitworth's work stood unquestioned just so long as it stood untested. Every one who has gone into any class of work which was to be based on the accuracy of a screw, such as measuring machines, graduating machines, &c., &c., has quickly found that the best screw to be had was a Whitworth screw, and that a Whitworth screw was not good enough for the work. These parties have generally contented themselves by using a Whitworth screw in connection with a device for correcting the errors discovered. Some of them have gone into the matter of constructing an original screw, by methods which will in themselves insure the accuracy of the work. I understand that The Pratt and Whitney Company, in the construction of their gauges, have determined to go to the bottom of the thing, and that they are now in the midst of a laborious research after an accurate inch and a screw of uniform pitch.

One of the Whitworth devices to overcome errors was as follows: He cut ten screws a foot in length, taking great care in the operation to use the same part of his lathe screw all the time. When these short screws were done, they were, of course, copies of a single foot of his old lathe screw. They had the errors of that foot, but had not the errors of any other foot. He then bored a hole through these screws and faced them accurately to a length, testing them in his measuring machine which measured to the millionth part of an inch. He then strung them on a bolt and thus made a long screw of them, of which every foot was bound to be the same. There might be twelve different kinds of inches in each foot, but the feet were uniform. He then made a nut of great length, so that it could not be said to be governed by any one particular inch of a foot, and thus became operated on by at least two of the sections at once. With this built-up screw he cut a long screw, and it looked as if he had certainly eliminated all sources of errors. But still the first close tests made of them showed that no one thread was like any other thread, and that no one thread maintained a uniformity of spiral during its complete, single convolution.

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[*] Extracted from a paper by "CHORDAL," in *American Machinist.*

EFFECT OF HEAT ON A BATTERY.

AMONG sundry recent attempts to improve the galvanic battery, we note one by an Italian engineer, Signor Gaudini, who describes in *Natura* the results of experiments in heating batteries. He considers that this application of heat is of much interest, both from a theoretical and a practical point of view.

Of the various types of batteries tried, that which yielded the best results was as follows:—A cast-iron vessel containing a porous vessel of terra-cotta, surrounded by a hollow cylinder of zinc, which acted as the positive electrode. A prism of carbon within the porous pot served as negative electrode. The exciting liquid was a solution of chloride of sodium, and the depolariser a supersaturated solution of bichromate of potash and sulphuric acid.

In the cold state, this couple gives an intense but inconstant current. When placed, however, on a small gas-heater, its current increases considerably in intensity, and continues constant, with closed circuit, as long as desired if properly managed. The flame should be regulated so as to keep the temperature of the various parts at about 100° C.; and one should add, from time to time, to the porous vessel a few crystals of potassic bichromate, with sulphuric acid, and to the outer vessel some salt water.

With such care the battery will furnish a current much more intense than that produced in the cold state. The increase of intensity arises from a diminution of the internal resistance, and a notable increase of the electromotive force, as will be seen from the following:—

	E	R
Battery used cold	2·10	0·82
„ „ hot	2·44	0·71

Here the values of E are expressed in Volt units equal to 100 millions, or to 10^8 absolute units of electromotive force, corresponding nearly to that of a Daniell element; and the values of R are expressed in ohm units equal to a billion, or 10^9 absolute units of resistance, nearly corresponding to that of a column of mercury at 0°, one metre long and 1 sq. mm. in section.

The fact of diminution of the internal resistance is in perfect harmony with known properties relative to conductivity of liquids, and need not cause any surprise. The increase of electromotive force deserves more consideration: it may, perhaps, be explained by supposing that the heat promotes the chemical action, and the osmotic current through the porous diaphragm. As to the constancy of the current, it is certainly a consequence of the lessened polarisation of the electrodes; because, with increase of temperature, the development of gaseous bubbles is facilitated.

In fine, the advantages claimed for this heated battery are as follows:—

1. A great and constant electromotive force.
2. A small and invariable resistance.
3. No noxious emanations.
4. Easy composition, always presenting the same conditions.
5. Facility of adding new materials.
6. Cost comparatively slight, since the unproductive consumption being small, the saving in that part quite compensates the greater expense of heating.
7. Lastly, a battery of six elements, formed each of an iron vessel about 6in. high, and 3½in. diameter, with all the rest in proportion, may cost about sixty lire (say, £2 5s.), and, used with heat, will give a current comparable to the maximum obtainable from a Paciuotti dynamo-electric machine, modified by Gramme, which, with supports, will cost about 900 lire (say, £40). It may be added that this battery in the cold state will give a ready current of brief duration, as it remains a long time unaltered with open circuit.

UTILISING THE MOTIONS OF THE SEA.

SEVERAL methods of utilising tidal motion and the action of sea-waves for obtaining a store of motive-power have been proposed, and some of them have been patented, but have not at present been brought into use, the expense of erecting the necessary works being probably out of all proportion to the power to be gained. In *La Nature*, a method of utilising wave-motion is described as the invention of M. V. Gauchez, who would suspend a large float by ropes from a pulley outside of a stone inclosure built a short way from the beach. Within the inclosure is a bell-shaped iron vessel, suspended from a central-pulley system, connected with the float pulley. This moves up and down in correspondence with the float, on a block of masonry, which has passages communicating with the air-space above and with a pipe below, extending to a reservoir on shore. The bell, in rising, sucks in air through valves in its upper surface, and, in falling, forces the air along the passages to the reservoir. The ropes are kept always taut by means of a weight hung in air from a pulley connected with the central system, and the bell has at its lower part a caoutchouc membrane connected with the block of masonry. M. Gauchez specifies the dimensions which, he thinks, would insure a rapid flow into the reservoir and involve no excessive heating. Another scheme, by Prof. Wellner, of Brünn, is described in *Dingler's Journal.* Fixed along a sea wall is a sort of air-trap—a metallic case, open below, now in air, now in water, as the waves beat on it. At the top this communicates through valves and pipes with a reservoir, in which the air is compressed, and the force thus supplied may be directly utilised for some purposes. Prof. Wellner brings a pipe from the reservoir to the lower part of an air-wheel, which is like an overshot water-wheel, immersed in water. The air displaces the water from the cells, and drives the wheel round, while expanding and rising to the surface. The system works with different degrees of compression, if the air-conducting tube be provided with several valves, so that the air may be admitted to the wheel at different depths, according to the pressure. With small waves and compression it is admitted higher. This arraratus Prof. Wellner proposes to use for supplying cooled air to beer-cellars, larders, &c., in hot climates.

SCIENTIFIC NEWS.

BY the end of this week comet Wells will cease to be above the horizon at night, and it is now considered to be scarcely bright enough to be seen during the day, even when it reaches its brightest. The position on June 10, according to Dr. Oppenheim's ephemeris, will be R.A. 5h. 6m. 37s., N. Dec. 21° 38·7′, Berlin midnight. After that date we may possibly hear of some good observations being made in the southern hemisphere.

According to the *Dun Echt Circular*, No. 52, the spectrum of the nucleus of Comet Wells deserves the closest attention, as it shows a sharp, bright line coincident with D, as well as strong traces of other bright lines, resembling in appearance these seen in the spectra of γ Cassiopeiæ and allied stars.

Mr. O. Stone has published, in the sixth number of the publications of the Cincinnati Observatory, the results of a series of micrometrical measurements of 455 double stars made with the 11in. refractor. The stars selected are in two classes—those which are to form part of a general catalogue of double stars between the equator and 30° S. Dec., and those in either hemisphere which Mr. Burnham noted as requiring further observation.

On June 1 Mr. Clement L. Wragge expected to have all his apparatus in working order, and to renew his observations at Ben Nevis and Fort William. A new fixed station is being established near the Lake at an elevation of more than 1,800ft. above the sea, and Mr. Wragge will make observations during the ascent and descent by means of travelling instruments, so as to localise disturbances in the atmosphere between the summit and Fort William. On the summit itself he will make five observations at intervals of half an hour between 9 and 11 a.m. Self-recording instruments will take the temperature at 9 p.m., and the apparatus supplied by Dr. Angus Smith will measure the actinism of the sun's rays and of daylight. Mr. Browning has also sent a rain-band spectroscope.

Lord Rayleigh, professor of experimental physics, at Cambridge, has been awarded the Hopkins Prize for his papers connected with the theory of vibrations, and especially for that on the theory of resonance.

The 49th annual report of the Royal Cornwall Polytechnic Society, as usual, contains some interesting papers, with notes on new inventions, and the meteorological tables. This society does a large amount of good, and we are pleased to see that it is progressing in every way satisfactorily.

Mr. Stretton has issued a third edition of his brochure on Railway Accidents, which can be had of Simpkin, Marshall, and Co., or of Messrs. Spencer, Leicester. There are four plates—viz., a diagram showing the arrangement of Sykes's electrical signal apparatus, the diagram for calculating the efficiency of brakes, and two plates showing the details and general arrangement of the Westinghouse automatic brake. The text has been revised, and several additional paragraphs inserted.

The 68th annual report of the Council of the Royal Geological Society of Cornwall contains the president's address, the reports of the officers, and several useful papers. The accounts show that the financial condition of the society is satisfactory.

The society of Telegraph Engineers and Electricians have appointed a committee to report upon the fire-risks of the electric light. The committee consists of Professor W. G. Adams, Sir C. T. Bright, Messrs. R. Crampton, R. E. Crompton, W. Crookes, Warren De La Rue, Professors G. C. Foster and D. E. Hughes; Messrs. E. Graves, W. H. Preece, Alexander Siemens, Spagnoletti, A. Stroh, and Sir William Thomson.

A peculiar effect upon workers in a bichromate of potash factory in Russia has been noted: a hole being made in the septum of the nose, the partition after a time disappearing entirely. Some of the men have been employed for ten years without being affected, while others are attacked in the first month; but that the disease is somewhat more than an individual peculiarity is evident from the fact that an inspection of all the hands proved that more than 50 per cent. of the men had diseased noses. The early symptoms are a slight tickling of the part affected, followed by bleeding, but with no uncomfortable feelings, and, in fact, the destructive process is painless.

Mr. J. L. E. Dreyer has been appointed successor to the late Dr. T. R. Robinson as director of the Armagh Observatory.

The ultimate effects of a *régime* in which small doses of arsenic are given from time to time are in striking contrast with the earlier ones. According to MM. de Poncy and Livon, cats so treated seem improved at first; they eat more, and fatten, and have all the signs of very good health. But by-and-by they begin to grow lean, are subject to diarrhœa, loose appetite, and seem languid; and at length they die in a state of poverty of blood (anæmia) and leanness. On examination, one finds the muscles (the heart included), extremely pale; the liver, lungs, kidneys, and mesenteric ganglions all have the characters of fatty degeneration.

A valuable report by a French Government Commission, on the rupture of cables in mines, appears in a recent number of the *Annales des Mines*. Among other points, we note the affirmation that metallic cables, both steel and iron, may be used with as much security as cables of textile material, proper care being taken in providing and maintaining them (and more is needed). In very moist pits, especially with acid water, aloe cables are preferable; in pits, with return of air, and somewhat high temperature, metallic cables. Where flat cables are used, the textile allow of better equilibrating the motion of the engine than the metallic. Round metallic cables are more easy to make well than flat ones, and with conical or spiraloid drums, admit of regulating the engine's motion very conveniently. (French managers, it is stated, do not, in ordering cables, specify details and conditions of working sufficiently.) The resistance to rupture of hempen or aloe cables varies largely with choice of material and mode of manufacture, and careful experiments should be made with the yarn or cable (the cable should not contain more than 20 per cent. of tar). The wires of a metallic cable should likewise be tested, both for flexure and torsion. Marks of fatigue of a cable generally appear outside; but with metallic cables, long used, it is well to make direct experiments on isolated wires, or on the ends. The importance of diameters of winding being as large as possible is greater for metallic than for textile cables, and for steel than for iron cables. The minimum diameter for iron cables should be 1,300 to 1,400 times that of the wire, and 2,000 for steel. It should be 80 to 100 times that of the cable diameter in metallic cables, and 50 times in textile. Thick metallic cables should not be worked beyond a tenth of the force required to break them; small round cables a sixth; good aloe cables a seventh, or an eighth. Cutting off the ends of a cable (too much neglected in France) should be done every two or three months. Once a week, at least, a cable should be passed for examination slowly up and down before the eyes of a competent agent. (Directions as to conveyance of personnel and various other topics are also given by the Commission.)

Mellogen, the new substance obtained by Signors Bartogli and Papasogli in their recent remarkable experiments of electrolysing distilled water about six weeks—first with strong, then with weaker batteries, and carbon electrodes—is a solid, dark, very shiny matter, soluble in hot water and in alkalies, insoluble in most mineral acids, and in ordinary solvents such as alcohols or benzine. It does not fuse, is not crystallisable, burns difficultly, and has strong colouring power. Its most salient property is its combining easily with oxygen, and giving rise to acids of the benzocarbonic series. The best oxidant is hypochlorite of soda. The formula of mellogen is $C_{11}H_2O_4$. If alkaline solutions be used as electrolytes in place of distilled water, mellic acid and its congeners are largely formed, but very little mellogen; on the other hand, with an acid electrolyte, the mellogen is abundant, and the former products are almost wholly wanting.

A new aperiodic galvanometer, described lately to the Paris Academy by MM. Deprez and D'Arsonval, consists of a rectangular frame with fine wire wound round it, supported between the two branches of a horseshoe magnet, placed vertically. The support consists of two silver or copper wires; one above, with mirror, proceeding to the end of a bent stand, having two movements by which the frame can be either displaced vertically or turned round; the other connecting the frame with an elastic strip below. These wires serve both as an axis to the frame, and in conveyance of the current. Within the frame an iron tube is supported, to intensify the magnetic field. The instrument is very sensitive, distinctly indicating a current, *e.g.*, whose intensity is a ten-thousandth of an ampere.

With regard to the operation of the will on the muscles of the eyes, Helmholtz says we are limited to efforts for the attainment of single and distinct vision. Mr. Le Conte Stevens (New York), finds this incorrect. Though never troubled with involuntary double vision (through paralysis or other weakness), he is able at any time to converge or diverge the visual lines without using any external points of fixation, thus securing two separate images of a given object (*e.g.*, a door-knob), keeping these apparently separated at any desired angle within certain limits, and fixing the attention alternately on either image, separately, at pleasure. This power was not suspected till revealed by special experiment; but there is no reason to suppose it is not possessed by most others whose eyes are healthy.

A blowpipe has been patented in Germany by Schlag and Berend, of Berlin, in which the air blown into the mouthpiece passes through a valve into a caoutchouc bag, which is inclosed in the tube, and serves as regulator of the issuing air, in the case of intermittent blowing. (The valve prevents return of the air forced in.)

A Brazilian exhibition is being organised in Berlin for October to December this year, by the Central Society of Commercial Geography. Prominence will be given to the raw materials which Germany does not, or not sufficiently, produce, and for which Brazil is so eminently adapted, *e.g.*, ores, cotton, coffee, cocoa, tobacco, hides, silks, tanning materials Opportunity will be given German merchants of finding how their share in importation from Brazil may be advantageously increased. By means of books, maps, pictures, models, photographs, &c., a full representation of the country and its population will be aimed at. In Antwerp, an international exhibition of all objects connected with gymnastics takes places in August.

La Lumière Electrique gives illustrations of three small pieces of apparatus lately exhibited in Belgium. The first is a telegraphic sounder in which, by way of strengthening the sound, the armature, is terminated by a small hammer which strikes on a brass drum. Next a harmonica, devised by M. Somzée, for indicating the presence of fire-damp, consists of a flame burning in a glass chimney, the draught being so regulated that the flame is silent in pure air, but begins to sing when a certain proportion of fire-damp is present The third apparatus, also by M. Somzée, is an electric regulator, in which inclined passages conduct fine carbon power into the arc, increasing the number of solid particles raised to incandescence (an idea M. du Moncel does not think practical.)

In the neighbourhood of Rheims, recently, M. De Lemoinne found sufficient remains of a remarkable bird (of new species), belonging to the Eocene epoch, to give a fair idea of its structure. A thigh bone of the same animal had before been discovered by M. Planté, the well-known physicist, at Meudon; it was about 18in. long. The bird was of gigantic size, having a height, when erect, of at least 10ft. The skull was comparatively large, and less disproportionate than that of the ostrich. In the opinion of M. Alph. Milne-Edwards, judging by the skeleton, the bird had affinities to the duck, but it has peculiarities which forbid the ranking of it in any of the present natural groups. It has been called *Gastornis Edwardsii*. (Various anatomical details, with a representation of the skeleton, are given by M. Meunier in *La Nature*, 466.)

The revival of industry in Italy is witnessed in various ways at present. According to *Les Mondes*, Baron Cantoni, impressed with the fact of Indian cotton going past Italy to England to be spun and returned as thread, has formed in Venice a cotton spinning company under the name of "Cotonificio Veneziano," with a capital of ten million francs. The first factory has been built, and will receive 80,000 spindles. At Venice, too, a company for river-navigation has been formed. By means of barges, towed by steam-power, to Cavanella, Pavia, and Magadino, it will transport merchandise to the foot of the Gothard, saving a third of the cost of railway-carriage from Genoa. Lately, for the first time, railway-carriages of national make were exhibited at Milan; but the axles and wheels, it was stated, came from France. The last financial statement in the Chambers, by Signor Magliani, showed that the floating debt had diminished about 100 million francs in three years; that the exportation and importation balanced each other for the first time, and that the receipt of imposts exceeded the ordinary expenditure by 49 million francs.

The early French beans in Algeria have been extensively affected this year by a disease unknown before, at least in these crops. It attacks stems, branches, leaf-stalks, and fruits; which acquire a white covering, in some parts like tufts of wadding; this being the mycelium of a parasite fungus, which also deeply invades the bark, and sometimes penetrates to the pith. M. Prillieux finds some evidence that the same disease attacks other plants of very different nature—as clover and hemp.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

⁂ *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

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ABERRATION AND PARALLAX—COMET α 1882 (WELLS)—SPHERICAL ABERRATION—RELATIVE MOTIONS OF THE EARTH AND MOON—POINTS OF SUNRISE ON THE LONGEST AND SHORTEST DAYS.

[20088.]—I WAS rather interested in your précis on p. 234, of the paper read by Mr. Downing at the Royal Astronomical Society on the 12th, on his discussion of the observations of γ Draconis made with the Reflex Zenith Tube at Greenwich. That the parallax should be a minus quantity, in other words that measurement should show that this star is farther than infinitely far off (!) does introduce an element of uncertainty which somewhat vitiates the result; but, at the same time, they cannot fail to possess value for the physical astronomer. As is known to a large number of those who will read these lines, the Constant of Aberration, as determined by Struve, = 20·4451″. Combining this with Michelsen's beautiful determination of the velocity of light, we obtain a solar parallax of 8·810″; while employing Michelsen's light-velocity with Downing's Constant of Aberration, the solar parallax rises to 8·838″. Inasmuch as recent researches (with the exception of the Ascension Observations of Mars) all point in the direction of the larger parallax; this, pro tanto, would afford an argument for the superior correctness of Mr. Downing's results.

The drawing of Comet Wells, given by Mr. Mills in his letter (20037) on p. 237, certainly seems to me curiously to exaggerate the visible breadth of the Coma in proportion to its length. In saying this, however, I so far speak under correction that I have had no experience of the aspect of this body as viewed in a 12¼in. reflector. But as seen in a smaller instrument, the tail is both longer and straighter than it appears to be in the engraving. It does travel very quickly. The rapidity of its motion must strike the least practised observer. By the bye, it is by no means increasing in brilliancy in the predicted ratio.

"E. P" (query 46955, p. 249) heads his question "Elementary Optics," the fact being that the destruction of spherical aberration in an achromatic object-glass is a difficult problem in analytical optics, quite incapable of explanation within the limits of such a paragraph as this. Spherical aberration is quite curable. For some practical details "E. P." may consult the *Philosophical Transactions* for 1821.

A few elementary considerations may suffice to remove the difficulties which beset "Gimel" (query 46963, p. 249). The first passage in Sir Edmund Beckett's masterly book which has puzzled your correspondent has reference not to the earth as a whole, but to any given point on it. A figure will make this clear at once. Here we see the earth describing her orbit round the sun in the direction indicated by the big arrow; while she rotates at the same time on her own axis, as pointed out by the smaller ones. Does not "Gimel" see that any place, say, at *a*, on the night side of the earth, is travelling in precisely the same direction as the earth herself; whereas when her rotation brings that point into daylight, say at *a′*, it is, as it were, moving backwards with reference to the direction of the earth's orbital movement? The second stumbling-block which "Gimel" has met with may be surmounted quite as easily. If he will fasten two unequal weights to the end of a stick and whirl it up into the air, he will note that the centre of motion approaches the heavier weight in proportion as it is heavier. Now, in our figure, E represents the earth and M the moon, and as it must be abundantly evident that the common centre of gravity of the system cannot coincide with *e*, the earth's centre, let it be at *c*; then will your querist see that it is round *c*, and not *e* at all, that the moon must revolve, and that as she must, so to speak, always carry the line joining her centre and that of the earth, with her, the earth's centre must describe the little orbit *o o* round *c*; and this is what Sir Edmund Beckett means. If "Gimel" will rigidly connect a card earth and moon by a wire, and pinning his card earth near its periphery down to a board, cause the moon to describe a circle round the pin as a centre; he will note at once how the earth, ex-necessitate, describes a little orbit round it, and hence, in a sense, round the moon, too.

FIG. 1.

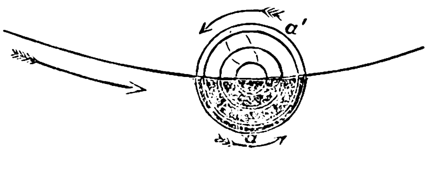
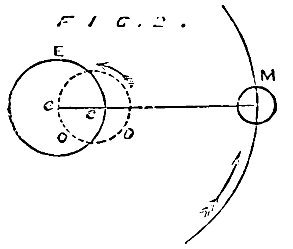


FIG. 2.



From what "Neo" says in query 47032 (p. 272), it is evident that it was *not* Stonehenge to which his original question (46888) referred. I only wish to say here that if your correspondent should not be familiar with trigonometrical computation, and will tell me whereabouts his "circle of large stones, now buried and planted with trees," is situated, I will give him the point of the horizon at which the sun rises on the longest day in that locality, as also the approximate variation of the magnetic needle; so that, armed with a common pocket-compass, he can stand in the middle of the stone circle and see whether a line passing through it and the monolith is, or is not, in the direction of the point of sunrise at the Solstice.

A Fellow of the Royal Astronomical Society.

ONE MORE PUFF—NEWSPAPER SCIENCE—WELLS' COMET—VISIBILITY OF NEBULÆ—ASTRONOMICAL EYEPIECES—MICROSCOPE POWER.

[20089.]—THE political newspapers are always ahead in matters of science, telling us what we could have known in no other way. The *Leeds Mercury* says: "We may fairly expect that the heroes of the next meeting of the British Association will be Mr. Lockyer and his colleagues of the eclipse expedition. There seems every reason to anticipate that they will be able before long to make known very important and interesting conclusions with regard to the nature of the sun and his marvellous appendages." (N.B.—Blessed is he that expecteth nothing, &c.)

To us readers, thinkers and workers in astronomy, the words "important conclusions," "successful results," and others of the *Leeds Mercury*, have a familiar kind of ring which we understand perfectly. Of course, there is no reference to Mr. Ranyard; but, considering the origin of the inspiration, we could not "fairly expect" that. My excuse for wasting so much valuable space with the above quotation, must be that if it is not noticed in some such journal as this, it would be allowed to pass, and if we care anything for astronomy, or for truth, we ought to show up these things.

What can "F.R.A.S." mean where he says (letter 20035, p. 236), speaking of the comet,—"It will not become a daylight object until it has passed too far to the south to be visible in the British Islands at all" [at night?] Did he intend to add the words I have placed in brackets? Or will the declination of the comet be more than 45° S. during the first half of June?

It is certainly true, as "Mizar" says (query 46279, p. 626), that a greater quantity of light is gathered up by a large object-glass or mirror than by the unaided eye; but (in the case of nebulæ) if the sky is not perfectly dark, it also is made correspondingly brighter. A nebulosity of appreciable extent ought to be more easily visible to the naked eye; but as a large telescope gathers more light than a small one, and there is nearly the same proportion of light lost in each, a large one should show more. There are, however, some curious anomalies in the visibility of nebulæ.

Stopping out bright stars to prevent their glare interfering with faint nebulæ only mitigates the evil, some of which is done in the telescope, by reflection from the glass surfaces before the rays reach the eye. A low power acts as a stop, because the eye is not large enough to take in rays from all parts of the object-glass or mirror. By the way, Mr. Mattieu Williams' remark, on p. 467 of last Vol., just after Mr. Ranyard referred to a common hand telescope, is too irrelevant to be of any value.

"Aldebaran's" letter (20069, p. 289), tends to show, what I have not hitherto seen, where his fundamental misconception lies. The replies he has given to query 46396, have made it abundantly clear that he has made some central mistake, vitiating all his results, but he gave us no hint of its nature. Now we have it. "Aldebaran" says: "In all telescopes there are two sets of rays to be dealt with. 1st. The cone of direct rays from the object-glass, which is the only one represented in text-book diagrams. 2nd. The rays diverging from the image, and which alone can be utilised for vision." Apologising again for a long quotation, I would ask "Aldebaran" how the 2nd set of rays got into the telescope at all, if they are not part of the "cone from the o.g."? In the next paragraph he tells us that the position of the apex of the cone of rays, relatively to the e.p., is "not of the slightest importance." Why, "Aldebaran" does not even know what "focus" means; he has not learnt that "focus" is equivalent to "apex of cone," and that the image is formed there. And yet he wants me to go and hunt up a tutor to explain to me matters which I am accustomed to teach, and which any first-stage science student (in optics) would regard as simple. Can "Aldebaran" say where Mr. Proctor says the determination of ray-paths is difficult? Does it astonish "Aldebaran" to learn that there is but one set of rays in a telescope; just those that come down from the o.g., and neither more nor less?

Just remarking (in connection with letter 20074, p. 261) that a 1½in. does not magnify nearly 7·5, $l = 12$, I would say that it would be quite as correct to divide by 15 as by 7·5, near the end of paragraph 2. The o.g. magnifies (assumed) 6·8, and o.g. and e.p. magnify 34; therefore the e.p. magnifies 34 / 6·8 = 5 times. The amplification the o.g. gives on 12in. has no more connection with it than its amplification on 24in., because neither of these lengths is being used.

Paugul.

COMET-SEEKING.

[20090.]—THE announcement that "Mr. H. H. Warner, of Rochester, New York, has offered a prize of two hundred dollars for each discovery of a new comet made in North America or the United Kingdom" will, it is hoped, prove an incentive to observers for increased diligence in this department. It is true that amateurs have no mercenary motives whatever in astronomical work, but indulge in it because it is congenial to their tastes, and productive of more genuine pleasure than is afforded by any other line of research. To them it is a "labour of love," and a source of continued and varied gratification. But Mr. Warner's munificence will none the less be appreciated by them as a practical encouragement to an original branch of observation which, certainly in this country, has been languishing only too long.

As to the systematic search for comets, which I referred to in the English Mechanic, No. 888 (19859), several additional observers have lately volunteered assistance, and I trust that arrangements will soon be made to insure the complete and rigorous examination of the most promising regions of the sky at short intervals. My own share in the work has been necessarily very limited during the past few months, owing to ill-health; but I now trust that the direction and better organisation of the observers will emanate from Lord Crawford's observatory at Dun Echt, where so much effective aid has already been given to cometary astronomy. It would be a matter for congratulation should Lord Crawford decide to take in hand the further organisation of comet-seeking in this country, where so much observing strength is capable of being utilised to this end.

Bristol, May 29. **W. F. Denning.**

QUADRANT OF ALTITUDE.

[20091.]—A short time ago, in working some problems upon the celestial globe with the quadrant of altitude, the idea struck me that if a more flexible substance than brass could be used, a greater facility in working would be obtained. As I determined upon a method by means of which I was enabled to make a quadrant of altitude, combining in itself a minimum of cost and a maximum of facility, I now venture to submit the idea to the appreciation or condemnation of your readers. In the first place, a slip of stout drawing-paper was procured, about $\frac{5}{8}$ of an inch in breadth.

This was laid along the equinoctial line from 0 to 90°. Next, it was divided into spaces, which corresponded to 10° each; then these spaces were divided again into 5°, afterwards into 1°, and the ultimate process of division was that each 1° was divided into thirds or spaces of 20′ each.

After this somewhat tedious operation was completed, the paper was pinned on the drawing-board, and all the divisions carefully ruled.

The next desideratum was to give the paper a coat of white varnish (as this prevented its being easily torn) and the whole was finished.

I am in perfect ignorance as to whether the idea is original or otherwise; but, certainly, it claims a position in the scale of economy.

Referring to the list, I find that the price of quadrants of altitude for 20in. globes (which is the size mine was made for), is 6s. 6d. each. The one which I made cost nothing but simply one hour's time. **A. Manock.**

High-street, Doncaster, May 27th.

WENHAM'S NEW MICROSCOPE.

[20092.]—The statement is reiterated by "Another F.R.M.S." that I was led to devise my new microscope in consequence of some remarks by Dr. Edmunds on Wale's microscope, published in the *Journal* of the R. M. S. in Dec., 1880.

I trust that this allegation will fall to the ground when I state positively that my microscope was designed before the date of Dr. Edmunds' remarks.

As to the modification proposed in Wale's microscope on 10th November, 1880, by Dr. Edmunds, I can corroborate your correspondent, "Akakia," that I worked at that idea, as he states, some two years before, and gave it up as impracticable. I agree also with this correspondent that "no single individual" has any right to claim the *principle* of radial illumination as centralised on the object and I have been careful to avoid any such claim in my patent, confining myself simply to a particular method of carrying out the *principle*.

The delay in registering the patent is easily explained: Messrs. Ross preferred that a patent should not be applied for until the microscope could be submitted to the test of practical work, and two or more of these instruments were actually completed before the specification was filed at the Patent Office.

This is all that I need say concerning the claim set up for Dr. Edmunds, and it must suffice that I entirely repudiate the statement that I have appropriated his non-practical suggestion.

F. H. Wenham.

[20093.]—In your current number I see a further letter (No. 20071) from "Another F.R.M.S.," to which I am compelled to ask space for a few words in reply.

Passing over the attempt of your correspondent to distort the meaning of certain words which he finds in the description of my microscope into something which they were never meant to convey, their intended signification being perfectly plain, and I may add perfectly true. I find the sum and substance of his letter to be simply a reiteration of the charge previously made against me—viz., that I had stolen (there is no other word for it) the principle of construction embodied in my new microscope from Dr. Edmunds.

In the endeavour to make good this charge (which of course is well known by all having any cognisance of the matter to be without the slightest foundation), he tells a very circumstantial story of my being present in person at the eventful meeting of the Royal Microscopical Society on Nov. 10, 1880. That I sat by and heard Dr. Edmunds make the great "enunciation"; that my silence on the occasion goes to prove that I could question neither its value nor originality; and further, that I stood by and listened with interest to the instructions which Dr. Edmunds was giving to Mr. Swift to enable him to carry out the great principle of construction then for the first time "enunciated."

Your readers, too, will be able to appraise at its full value not only this claim of Dr. Edmunds, but also the character of the means taken to uphold it, when I say that there is not one word of truth in this story. It is from beginning to end a—well—pure fabrication.

So far from being present at that meeting, I was not even in London, but some two hundred miles away in my quiet home in Lancashire, totally unconscious of the great "enunciation" which at that moment Dr. Edmunds was—*pro bono publico*—giving forth to the world. **John M. Moss.**

[20094.]—I must ask permission to say a few words upon the new stands patented by Mr. Moss and Mr. Wenham.

1. On Nov. 10, 1880, at the Royal Microscopical Society, I fully explained the principle of a concentric microscope, which I had been constructing, and I pointed out the applicability of that principle to the Wale stand for rough purposes.

2. Mr. Swift informs me that Mr. Moss stood by after the meeting, listening to further explanations which, at Mr. Swift's request, I then gave; but I am not able, of my own knowledge, to endorse the statement that Mr. Moss was one of these gentlemen, as I have not the advantage of knowing him.

3. The principle of my concentric microscope was in no way suggested to me by the sight of Mr. Wale's stand, and it was entirely new so far as I am acquainted with microscopical literature. My concentric microscope was completely planned and in hand during the year 1878, and on Dec. 15, 1878, I made a communication to that effect to Mr. Frank Crisp, the honorary secretary of the Royal Microscopical Society—a communication in accordance with the remarks which at the moment I rose and made at the Microscopical Society nearly two years later. Mr. Crisp has given me permission to say that he was then (Dec., 1878) perfectly aware of the object that my new stand had in view, and that he will state as much if requisite.

4. I have nothing to do with any abortive diagrams which Mr. Wale or Mr. Wenham may have made upon a drawing-board years before. There is no suggestion that I could have known anything of such sketches or drawings, and they are now suggested only on the faith of anonymous writers. Such rights of priority are decided by well-known law—*i.e.*, that of priority in publication in a scientific journal, or in communication to a learned society in public meeting assembled. Under this law my position is unassailable; the dates of the patents of Mr. Moss and Mr. Wenham follow directly upon my publication of the principle, and their specifications were mere attempts to expropriate my principle by monopolising various mechanical contrivances for applying it. On those contrivances I do not comment; what I claim is to have originated and published the general principle of "the Concentric Microscope," a microscope concentred round the intersection of the two axes of reference which I specified and evolved by means of a purely geometrical conception in which the optic axis is regarded as the polar axis; the optic plane as a meridian plane; the stage plane as the equatorial plane; and the centres of the object and the lamp plane as two points in the plane of an ecliptic. On the other hand, the principle of my microscope is not deducible from that of the telescope to which Mr. Wenham now refers back as having suggested it to him. The fact that an experimenter twenty years ago stuck a hemispherical lens over a diatom by means of balsam, and saw it very clearly, does not make him the inventor of the principle on which our homogeneous immersion lenses are constructed, simply because he had neither the mathematical knowledge nor the brains which were needed in order to perceive the principle of what he saw. Just so, random diagrams, such as those now furtively suggested, would not give a title to having anticipated this important principle, and it is repugnant to common sense to ask us to believe that astute commercial men like Mr. Wale, Mr. Moss, and Mr. Wenham, if they had really conceived this principle and realised its far-reaching consequences, would have let it sleep for years, and then, directly upon my publishing it, that Mr. Moss and Mr. Wenham should run against each other at the Patent Office in their attempts to appropriate it.

5. The statements made by Mr. Wenham, and repeated and amplified by "Akakia," as to my having "deliberately undertaken an alteration of Wale's microscope" and failed, are absolutely without foundation. I did nothing but give to Mr. Swift the permission for which he asked with regard to his students' microscopes, and his not going fully on with the matter was due, I understand, to his discovering that Mr. Moss and Mr. Wenham had forestalled him by lodging specifications for patents on the subject. Having in my own study seven stands, including a large Powell and Lealand stand, with every accessory made by them for me, I was little in need of another stand, and having no sort of commercial object to serve, it is not wonderful that, with my engagements, the completion of a stand with my own hands has been delayed. But I shall shortly hope to have the privilege of submitting my "concentric microscope" to the Fellows of the Royal Microscopical Society, and to their judgment I now leave this question. **James Edmunds, M.D.**

WHAT SHALL I DO WITH THE MICROSCOPE?

[20095.]—This question has been often asked and often answered; but, as I wish to suggest a subject not previously mentioned, perhaps the Editor will courteously insert the following: it is on the intestinal teeth of insects, and as it can be worked out with simple means, and an object-glass of 1in. focus, I hope it will prove of interest to many beside myself:—

The directions given to me were, to pull off the head of a cricket, drag with it the stomach, and attached to it the gizzard or organ containing the pyloric teeth, skin off the muscular coat with your thumbnail, cut off any portion of intestine; then mount. It is a small conical organ 1-20th of an inch or more long, and contains six vertical rows of toothed plates, slightly overlapping each other; on each side is a row of tooth-like processes, outside these another row; then comes a plain column giving rigidity to the whole. It may be slit up, mounted whole, point downwards, or cut transversely into rings. The mole cricket, the field, and, I believe, the house-cricket, have it, with slight differences in the form of the plates, and some have brushes of hairs covering or attached to the teeth. This plan I was content with till I found I missed many interesting points in the stomach and gullet; but even in this simple way you can produce most beautiful objects. I now kill with a drop of benzine, cut off the extreme tail, pull off the head, cut off the whole intestine, and put it in a 1oz. phial with 5 or 10 drops of liquid potash. After it has stood about half an hour, I partly fill with water and shake it well to detach the muscular coat and tracheæ; then slit it up, wash and adjust on a slide. Drain away any moisture, apply a drop of carbolic acid, and place on the thin glass. After a few minutes this will absorb all moisture, and render it quite transparent. If it does not, put a drop of acid at the edge and tilt the slide to drive off the first acid; then put a little balsam on the edge, tilt the slide, warming it to render the balsam more limpid, and it will gradually take the place of the acid, the lines of demarcation between the two being distinctly visible.

If you can obtain a cockroach, begin with that; the teeth are like small anvils. Then crickets, grasshoppers, beetle-grubs from the garden, beetles, gadflies—in fact, everything. I have found spiny teeth in the parasite of an albatross; the flea has a multitude of concentric hairs. Some stomachs are covered with fine spikes, arranged on a tesselated pavement; scarcely any are identical, but all are most beautiful.

We have a large yellow and black flying grasshopper in Australia; its stomach is about $\frac{3}{4}$in. long, with several rows of hairs at the upper part, then small teeth or spines scattered, then in larger numbers arranged obliquely in rows, then scattered, then arranged in groups of three or four in vertical rows, then more scattered; the stomach terminates in six prominent conical folds, studded with transparent prominences, which, on an irregular fold, show themselves as minute teeth; between these are minor folds, similarly studded.

This part, although continuous with the stomach, I consider to be the representative of the cricket's gizzard, and a similar arrangement is seen in many insects. The true intestine of about the same length has no teeth, but its middle portion is corrugated to give greater surface for absorption. I have said nothing about examining the tracheæ and muscles, but probably some microscopists will be led on to dissect in a more scientific manner, and in all cases it would be much better to have the names and the order to which they belong, as the differences in structure may then be found to indicate the nature of the food and the habits of the insect.

Brelli, N.S.W. **T. J. Sturt, M.D.**

MICROSCOPIC.

[20096.]—I see that your invaluable correspondent, Mr. Lancaster, accidentally found that a concave lens increased the magnifying power of the object-glass when used with the lantern. I have occasionally used, for several years, a bi-concave spectacle lens fitted to the draw-tube for table purposes, and find that a 2·3in. can be used to magnify to the same extent as a $\frac{1}{4}$in. Of course, the errors, if any, of the o.g. will be also magnified; but still, I find it handy, as the focus of the o.g. has to be but very slightly altered, and it saves the bother of using another lens. I would sooner use this arrangement with a good $\frac{1}{8}$in. than have an inferior $\frac{1}{4}$in.

T. J. Sturt, M.D.

MICROSCOPY—WIDE-ANGLE OBJECTIVES.

[20097.]—At the last meeting of the Royal Microscopical Society, a paper, by Prof. E. Abbe, "On the Relation of Aperture and Power in the Microscope," was read, in which many very interesting and knotty questions in scientific microscopy were discussed in their most intimate practical bearings. The summary of the first part of the paper, published in your report of the meeting ("E. M.," May 26, p. 275), briefly touches upon the main points; and I trust, sir, that you will find space for the paper *in extenso*, for it is rare indeed that we meet with anything on the theory of the microscope that is not a *réchauffé* of elementary platitudes such as do duty as "introductions" to our textbooks of the microscope. Prof. Abbe is well known to have done more towards elucidating the theory of the microscope than all the "authors" of textbooks put together of our generation. It is said that an elaborate exposition of his theory exists in MSS., which is only waiting a final revision by the Professor before being published in the *Journal* of the R.M.S.

There was one point in the paper, which is only lightly indicated in your summary, but which appeared to me not reasoned out with Professor Abbe's usual clearness and precision; and I would most respectfully invite his attention to it.

Referring to the application of diaphragms behind wide-angle objectives to cut down the aperture, and so add to the "penetration," Professor Abbe condemned the suggestion *in toto*, on the ground (as I understood him) that in all wide-angle objectives the aberrations of the marginal zone can only be corrected *practically* by leaving the central portion of the aperture more or less defective. In other words, the Professor's opinion appears to be—that the correction of the marginal aberrations necessarily entails imperfection in the central portion of the aperture—an incurable imperfection inherent to all wide-angle systems.

The question whether or not we can obtain "penetration," in any useful degree, by diaphragms to reduce the aperture, is not what interests me for the moment, but whether the cutting off marginal zones from an originally wide-angle system forces us to use a badly-corrected portion of the aperture, the central portion, which Professor Abbe says is designedly left defective in the constructions adopted by all practical opticians?

If this opinion of Professor Abbe's holds good, it would follow that no wide-angle objective can be of service, unless the conditions of the object and the illumination be such that the action of the extreme marginal aperture largely preponderates in the production of the microscopical image. Is this supported by experience? Let us experiment with the objective of largest aperture hitherto constructed, and see how far the results agree with his opinion.

The new homogeneous immersion $\frac{1}{8}$ of Powell and Lealand has a numerical aperture of 1·47 = 150° in crown glass). Assuming the marginal 10°, or probably even 30°, of aperture are in excess of what can be fully utilised with that initial magnifying power; then, in order to develop the utmost resolving power, the direct illuminating beam must make an angle of 60° to 70° with the optic axis in the focal medium of index 1·5. There can be no doubt the marginal aberrations of this lens are well corrected, for with this obliquity of illumination on suitable immersed objects the definition is excellent. In this instance the object is in a refracting medium of sufficiently high index and illuminated by proper immersion means; we are thus utilising principally the marginal aperture, and the good definition proves that the aberrations are well corrected.

But we find this lens also gives a fine image of dry *Podura* illuminated by a small axial pencil. What part of the aperture are we now utilising? Every expert will doubtless admit that in viewing with this lens a *Podura* scale mounted on the slide, having an infinitesimally thin film of air between the scale and the cover-glass, the effective aperture is cut down to less than 1·0 N.A., for the *maximum* aperture from such a medium as air is represented by 1·0 N.A. The aperture is reduced from 1·47 to 1·0, through the object being in air, and this reduction appears to me precisely equivalent to the use of a diaphragm behind the objective, limiting the pencil at exit to 1·0. In this instance the extreme marginal aperture of our lens cannot preponderate in the production of the microscopical image, for it is cut off. The image, then, is produced by the central portion only of the aperture—the part which Prof. Abbe says is designedly—nay, necessarily—left defective in all wide-angle systems!

It would be quite erroneous to suppose the central portion of the aperture incurably defective. The image seen of dry *Podura* entirely negatives that supposition; the clearness and sharpness unmistakably prove that the aberrations of the centre are quite successfully corrected by means of the "collar-adjustment," which Messrs. Powell and Lealand were the first to recognise as an essential addition to homogeneous immersion objectives for this very purpose.

In all cases within my experience, if the images are to be judged critically, the "correction-collar" must be brought into play. In the opinion of some of the best object-glass makers—such as Tolles, Spencer, and Powell and Lealand—the "correction" cannot be dispensed with if we desire to obtain the finest defining power of our wide-angle objectives with every class of object.

Prof. Abbe's experience is said to have been principally confined to the homogeneous systems with "fixed" mounting, in which assuredly the reduction of aperture from 1·47 to 1·0 would exhibit errors in the central corrections. But, surely, a defective centre that can be remedied by the application of a correction-adjustment must not be regarded as incurably defective—defective from the exigencies of the construction, but should be a strong practical reason for applying the "correction" to *all* wide-angle objectives? The additional difficulties of centring, &c., involved in the mounting are mere workshop difficulties that should not weigh for a moment against the production of a more perfect instrument. A few careful experiments with the correction-adjustment applied to such a lens as the $\frac{1}{8}$ I have alluded to, would probably convince him that at any rate between the apertures 1·47 and 1·0, the aberrations can be dealt with successfully. That being so, his opinion that the construction of wide-angled objectives necessarily involves a badly-corrected central aperture would need to be qualified.

In the above remarks I have limited myself to the case of the highest aperture on record. It is obvious that if Prof. Abbe's opinion of the necessity of bad central corrections in all wide-angle objectives can be shaken on that one example, we shall convert him into advocating the "correction" for *all* high powers, homogeneous, immersion, and others. I would have it understood, however, that my special advocacy of the correction-adjustment for homogeneous immersion is based on a series of careful trials with a number of objectives both with fixed mounting and "movable" adjustment. For severely critical tests, I consider the "fixed" mounting a mistake. Beyond the difficulty I have mentioned, of obtaining the finest definition, on both immersed and dry objects, with the objective lenses mounted in a fixed setting, there is the further difficulty that no fluid-medium has yet been found strictly identical with the front lens in refractive and dispersive power. The mounting fluids, too, vary from the low refraction of water to the high refraction of phosphorus in bisulphide of carbon, with a still larger range of variation in dispersive power. The correction-adjustment will certainly not enable us to cope successfully with all these difficulties, but it enables us to do so more effectively than the fixed mounting.

Akakia.

DYNAMO MACHINES.

[20098.]—Your correspondent is likely to remain "Faint Hearted" if he expects to obtain a current equal to 14 or 18 Bunsen cells from his machine. If his armature had been 7in. by 4in. (I presume it is of the I form), it would have been much better. With the gauge wire he has on it would produce a current equal to so many Leclanché cells, instead of Bunsens, the 18 wire would still add Leclanchés.

Wind the armature with 10 wire; join the F.M. in multiple arc. He will then get all it is possible from that size armature. Also try it as a shunt dynamo with the 10 wire; but join F.M. in ordinary manner.

George Tolman.

NOTES ON DYNAMO MACHINES.

[20099.]—In the very useful, practical, and interesting "Notes on Dynamo-machines," No. 20081, by your correspondent "E.," I notice two statements which I find it difficult to reconcile, viz.:—

26. "If the speed of a magneto be increased, we know that E.M.F. is increased in the same proportion." And

29. "With large currents we approach the condition of things in a magneto-machine, the E.M.F. remaining constant."

Now, the latter statement agrees with my preconceived ideas on the subject. The former does not. Does not the E.M.F. depend upon the strength of the magnetic field? This in a "magneto" is constant, and the increase of speed should augment the *intensity* of the current. In the case of a "dynamo," before the point of saturation of the field-magnets is reached, I can understand—armature, brushes, field-magnets, and lamps forming one continuous circuit—that as the speed increases, the *intensity of the current increases*, and this increases the strength of the magnetic field, which in its turn increases E.M.F. And when the point of saturation of the field-magnets is reached, increase of speed increases *intensity* (or quantity of current in a given time) without further increasing the E.M.F. Is this not so?

Ligurian.

ELECTRO-MAGNETIC MOTORS.

[20100.]—The conversion of current energy into mechanical energy being to me one of the most attractive problems, I read Mr. Huxley's letter (19997) with interest; but after examining the factors given by this gentleman, I obtained results which made me rather doubtful as to the possibility of utilising the motion of the particles of an iron bar, while under the varying influence of an electric current, and I cannot find much encouragement in Mr. Ponton's letter (20046), with whom I seem to share two or three ideas. However, we have not got so far yet that we could give up this subject, and "nil desperandum," I think, is as applicable to electro-motors as anything else. Trying to act in accordance with this, I shall briefly enumerate the most important data with which I am furnished at present.

I share Mr. Huxley's idea that we lose power by utilising armature-attraction; but as to the seat of the power, which by Mr. Huxley was considered to be the magnet itself, I attempt to go further, taking the current itself as such.

According to my knowledge, a bar increases in length when magnetised, and does not decrease, as stated by Mr. Huxley. This, of course, does not interfere with the principle of the motor, but still has a mechanical importance—*e.g.*, if my statement, which is based upon authority, is correct, Mr. Huxley's as well as Mr. Ponton's devices would have to undergo certain mechanical alterations; but an instrument constructed on Mr. Ponton's principle would easily settle this question, if necessary.

The bar, if magnetised to saturation, increases in length to the amount of 1-270,000th of its length, a result which could be obtained by a pulling-force of 25,300,000 / 270 000 = 91lb., 25,300,000 being the modulus of elasticity for wrought iron; and 91lb., I think, could hardly be called an "enormous" force.

The next statement of Mr. Huxley I had to quarrel with was, that magnetising and demagnetising could be done with the "utmost rapidity." It is true, a circuit can be made and broken with the utmost rapidity, as far as I can see, only limited by existing mechanical means; but the rapidity with which an iron bar can be magnetised and demagnetised is very limited indeed, according to the law that "an electro-magnet requires time to attain its maximum power."

Having obtained these results, I was pretty well convinced that any attempt to multiply that minute motion by leverage would be fruitless. On the other hand, I have reasons to believe that the path opened by Mr. Huxley is well worth being followed up, only in a different direction.

The only contrivance in which, as far as I know, this principle has been made use of is the Reis's telephone (1861), in which the making and breaking of a current passing round a small bar of iron was effected by a diaphragm, caused to vibrate by speech, &c., so that the bar was rapidly lengthened or shortened, the total effect of those changes being a reproduction of the vibrations of the diaphragm.

Finally, I should like to remark that, although hitherto I have done more to keep Mr. Huxley's ideas back than to advance towards a perfect machine, I have as strong hopes as he that something in this direction will be found yet.

R. Kanthack.

NEW ELECTRO-MAGNETIC CLOCK.

[20101.]—I may inform J. H. Huxley (letter 20077) that his idea of applying the magnetic force to the top of the pendulum is not altogether new, as I have made one or two clocks actuated in this way, so far with success. I venture to think, however, that if Mr. Huxley had put his plan into practice, he would find it rather unsatisfactory, in more ways than one. His compensated pendulum is an abortion: he appears to ignore the fact that the weight of the ball should be equally distributed on each side of the plane of vibration, and not (as appears from his sketch) some inches in front of it.

J. E. Floyd.

CUTTING CARBONS.

[20102.]—To cut carbons for galvanic batteries is what electricians call "a very tough job"; but, recently, I was in the atelier of a clever scientist, and I saw him cut them with ease and facility. He used for the purpose a machine called a "paper-cutter's knife," such as the reader, doubtless, will see at any bookbinder's establishment. With this instrument the block or shingle of rough carbon was held firm, whilst a cutter passed backwards and forwards above it quickly, making a groove. When this groove was about half-way through the operator struck the carbon with a mallet, causing its severance.

The cutter was not that ordinarily used for cutting paper-edges, but a highly-tempered tool like the parting tool employed for turning cast iron. **E. B. Fennessy.**

LECLANCHE BATTERY CONNECTIONS.

[20103.]—"W. J.," in letter 20078, page 263, describes a method of making a connection to the carbon in the Leclanche cell without the trouble of melting lead. In my opinion, his method is more trouble than melting the lead; and, after all, he gets a connection which, to say the least, is doubtful.

Now, what can be more simple than the method given in back numbers by, I think, our friend "Sigma"?—to electrotype the carbon-ends, and solder the wire or binding-screw, then cover with paraffin?

The way I do them is as follows: I get a jam-pot, about half-full of a saturated solution of copper sulphate, and hang a small bag of crystals in it; place a porous cell, containing diluted sulphuric acid (1 to 10) in the jar. Let the solutions be about the same level. Place a strip of zinc in the porous cell, and wrap a copper wire round the carbon, and connect to the zinc strip; then hang the carbon in the copper solution, so as to dip about ¾in. in it, and leave all night. Now wash well, and solder your connections to the copper head; now melt some paraffin (not lamp-oil) in a jam-pot in the oven, and dry and warm the carbon and place in the melted paraffin, so that the copper is well covered, and leave a short time for the paraffin to soak in. Then you have a connection which can be depended on.

A correspondent in a back number advises amateurs never to use a binding-screw where a drop of solder will do. I think that if amateurs would keep this in view, we should hear less of batteries failing without apparent cause.

J. Henshall.

THE ELECTRIC LIGHT FROM A CONSUMER'S POINT OF VIEW.

[20104.]—It has been often questioned whether the electric light produced by any system now exhibited will prove to be cheaper than gas. I have not met with reliable data wherefrom to compute the cost of the electric light accurately; but, after reading Mr. Hepworth's little history (Routledge and Son), I took such data as I found therein, notably those referring to Siemens' machine, p. 65, and endeavoured to arrive at an approximate result. Thinking that it may interest your readers, I send the accompanying table of comparisons between the system of Siemens and of ordinary gas lighting. I may have exaggerated some of the items against the electric light system; but, on the large scale, over, say, 2,500 candles, it proves equal or superior in cheapness to gas, as the table shows. I have allowed fully for contingencies; I have assumed the cost of the fittings to be the same for electric and gas lighting, and I have computed capital to be redeemed in about fourteen years, which may be taken as the probable life of a machine and its engine. The electric light approaches to 2s. 6d. and gas to 4s. per candle per annum. Perhaps some of your readers may throw further light on the matter, making it, possibly, still more favourable to electric lighting than I have shown. **M. Jonson, C.E.**

89, O-street, Kensal Green, 26th May.

A Comparison between Gaslight and Electric Light (Siemens' System).

Description.	Electric	Gas.	Electric.	Gas.	Electric.	Gas.	Electric.	Gas.
Power of engine	2 h.n.	—	3 h.n.	—	4 h.n.	—	8 h.n.	—
Number of hours of lighting daily	9	9	9	9	9	9	9	9
Number of burners	1	86*	1	215	1	430	1 or +	1000
Number of candles	1200	1200	3000	3000	6000	6000	14000	14000
Dynamo machine, with gearing complete	£ 75	£ —	£ 100	£ —	£ 115	£ —	£ 250	£ —
Ditto fixing	15	—	20	—	25	—	50	—
Engine-motor and gearing	120	—	160	—	200	—	360	—
Ditto fixing	24	—	32	—	40	—	72	—
Fittings to and on premises	95	95	227	227	452	452	1050	1050
Contingencies, 10 per cent.	33	10	54	23	83	45	178	105
Capital outlay	£362	£105	£593	£250	£915	£497	£1960	£1155
Coal, or gas, oil, &c.	£ 25	£ —	£ 38	£ —	£ 50	£ —	£ 100	£ —
Engineer and repairs	140	—	140	—	140	—	140	—
Carbons and waste	82	—	205	—	410	—	957	—
Contingencies, 10 per cent.	25	—	38	—	60	—	120	—
(Gas at 3s. 4d. per 1,000 cubic feet)	£272	236	£421	588	£660	1177	£1317	2737
Interest at 5 per cent., and redemption of capital	£ 36	10	£ 59	£ 25	£ 92	£ 50	£ 196	116
Yearly cost	£303	£246	£480	£613	£752	£1227	£1513	£2853
1 candle per annum	5s. 1d.	4s. 1d.	3s. 2d.	4s. 1d.	2s. 6d.	4s. 1d.	2s. 2d.	4s. 1d.

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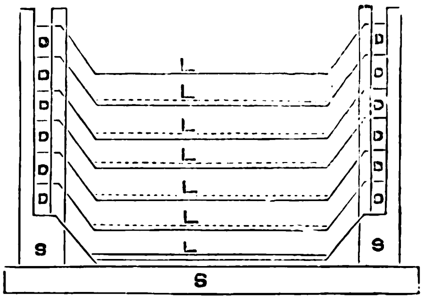
* The gas-burners are supposed to consume 5 cubic feet per hour, having an illuminating average power of 14 candles. Fittings have been taken at £1 1s. per burner for capital outlay, and electric patent rights and gearing at the same figure.

A SIMPLE FORM OF STORAGE OR SECONDARY BATTERY.

[20105.]—Having constructed a small secondary battery, on, I believe, a new and simple plan, I have thought a description of it may be suitable for your columns.

It consists of a series of shallow thin lead trays, L, about one-fortieth of an inch thick, pressed and hammered into shape in a wooden mould. These trays are arranged one over another in a wooden frame S. The trays are kept at an equal distance from each other, by pieces of wood which slide up and down in the stand, the ends of the slides being shown at D. The dotted lines in the bottom of the tray represent layers of red-lead, or oxide or reduced lead. On this is poured an acid solution of sulphate of copper, just deep enough to immerse the bottom of the tray above. The trays should be varnished all round the edges with Brunswick black or some other acid-resisting varnish. Wires for poles are soldered to the bottom of the bottom tray and to the top of the top tray. The battery may, of course, consist of a greater number of trays, and a series of batteries may be connected together.

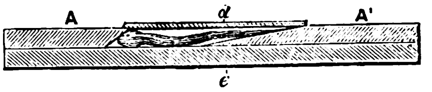


The advantages of this form of battery are, the oxide of lead can always be kept at the most advantageous thickness. The plates or trays can also be arranged at the most advantageous distance from each other. No diaphragm of any kind is required, and therefore, however long in action, no reduced lead can weaken its action. The only disadvantage I can see is that the battery must always be kept level; but in the majority of instances this would not matter. Of course, it could not be used in tramcars, &c.

In making batteries on a large scale, it would be well, perhaps, to cast the trays in an iron mould, and then it would be well to have one corner of each cell cut off; and let this be done on alternate sides to facilitate the inspection and supply of liquid. It would be well then to mix antimony with the lead to harden it. Possibly the trays may be made of carbon. **W. Symons, F.C.S.**

TADPOLE SLIDES.

[20106.]—As your readers seem fond of elaborate arrangements, I send sketch and description of "Schultze Tadpole Slide;" which I think they will find an improvement on that of Mr. Stokes, but I cannot help thinking the simpler the arrangement the better, and so I send you the following:—Form a groove or cell on an ordinary slip of glass with folded blotting-paper saturated with water; lay the tadpole in between on the glass, tail flat, cover the body over with saturated blotting-paper, the tail (if necessary) with thin glass. Keep the whole well saturated and the tadpole will live for many exhibitions.



Schultze tadpole slide is made as follows:—

To one side of a thick slide is fastened by means of Canada balsam a piece of another slide cut as represented at A, and to the other side a second piece of the shape seen at A', so that there is a small cell in the centre of the slide of the form shown in the section in the figure, a cover glass "*d*" closes the cell.

To place the larva *e* in the cell the cover-glass is taken off and the larva fished out of the water in a small watch glass and poured with the water into the cell. By manipulating with a brush its head is brought into the hollow of the glass at A, and the tail placed on the sloping surface at A'. The cover is then quickly replaced, care being taken that the cell is full of water. The animal is excluded from air and water, which, when it evaporates, can be replaced with the brush. In this way the circulation of the blood in the tail may be observed for hours at a time.

John Alex. Ollard, F.R.M.S.

Enfield.

AMERICAN ORGAN.

[20107.]—If "Joiner" likes to advertise his address, I will avail myself of his offer to see his instrument at first opportunity. I have been in the harmonium and American organ line nearly 17 years, and think his sketches a credit to him. I am sorry to say I have only taken in the "E. M." this last four months, but I mean to recommend it to all I know, as I think it may be taken in with advantage by practical workmen as well as amateurs. I will endeavour to give information, and shall be glad to receive the same, as I am not one of those men who profess to know all, and there is always something to be learnt about harmoniums and American organs. I think "Joiner" has not enough spring in his reservoir. I always put 24lb. in a one row; 30lb. in a 1½ row; 36lb. in a 2 row; 48lb. in a 2½ row, with sub-bass and octave coupler. I mean coupled through, not only one octave as in some instruments. I should put in the same class of instrument as he has constructed at least 60lb. I see Mr. Fryer, in No. 895, conveys the idea that all those instruments whose reeds have only one rivet in are inferior. I must certainly differ with him, as some tongues are not riveted to the box, or block, as he calls it, but slide in a groove or dovetail, and when properly done never shift. Then, again, in Ramsden's melody instrument (Dawe's patent) only one screw is used, and where are there better, both in tone and work? Then, again, he says in 99 cases out of 100, by merely wiping dust off the tongues of reeds, the instrument will be in proper tune again. Surely he must mean instruments that have had very little use. He is the first I have heard say such a thing; I admit it is a help, but he is a lucky man if he has come across anything like the quantity he says that did not want anything more done to them than dusting.

I will, at some future time, send the proper names of things used in American organs, as I find some things are called by very peculiar names. I am now finishing an American organ with 15 stops; it would be better for any who intend to make or finish an organ to put a ½in. wood button on the top of the plunger (see Fig. 1), and a regulating screw in the keys. It is much better than filing plunger to regulate; also, for convenience, I put an arm at each end of the key-frame. (See Fig. 2.) Let it run as long as the width of case. I put a screw in slot A into the end of case, so that the key-frame can be lifted up and down, not taken off as in most organs. I also put a dowel in the end blocks on soundboard for key-frame to drop on, as you are sure then of key-frame being in position; and some persons, in replacing frame, are not careful in getting screws into the same hole again. I inclose a sketch for "Beta" (Fig. 3), who, with patience, will get a good sub-bass if he does it properly. A, reeds; B, ¾-frame and partitions between each note glued on; C, box of pine over sub-bass notes; D, pallet covering holes to let wind in; E, pallets letting wind out into bellows; the holes in soundboard above pallet E I make 1½ long, ⅜ wide; F, stems pinned; G, rail to carry stems; H, rail to carry tracker I; tracker is grooved for wire staple ⌐¬ to go across the tracker into rail H; J J, two springs of light wire. My sub-basses done this way always come out well. K, regulating screw.

H. Hanks.

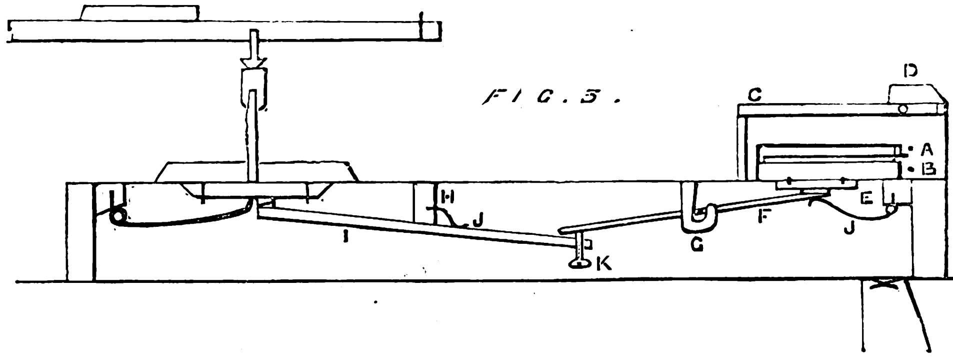
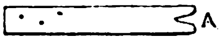


FIG. 3.

FIG. 1.

FIG. 2.



TWO-MANUAL AMERICAN ORGAN.

[20108.]—I was very pleased to see "Joiner's" description of his organ a few weeks back, and hope that by this time he has got it into satisfactory working order. When he has a little leisure, I am sure he would earn the thanks of amateur reed organ-builders if he would kindly give us some account of the various contortions of that "scratch set" of reeds. I feel sure he knows a thing or two about reed-voicing, which would be very acceptable to some of us.

Also, as to size and length of tubes. I have always understood that for a given reed, a tube of a certain size was essential. If this is not so, and the tubes can be varied at pleasure, it must afford a valuable means of altering the tone of the reeds, and thus gaining variety. Perhaps "Joiner" could indicate the limits between which such variation is of any advantage. I presume that in all cases, the scale of the tubes must correspond with that of the reeds, however much their absolute size may be altered.

Having been successful in making one fair-sized instrument, I intend, when circumstances permit, to start on a double manual, most likely with pedals; in fact, I have an idea of making it as much like a pipe-organ as possible. With this in view, I propose to confine the swell action to the upper manual, providing, however, shutters to the lower, which will be normally open, but capable of being closed by a stop. I should also arrange the stop knobs upon upright jambs on each side of keyboard. Would "Joiner" or "Organon" (who has kindly given me his assistance before) pass his opinion on this scheme, which would include an independent pedal stop of 16ft. pitch, and side-blown bellows, weighted so as to give uniform pressure; also coupler, manuals to pedals.

It appears to me that a reed organ is a very suitable thing for an amateur to make: it brings out his skill in wood and metal working, exercises his designing capabilities, and when finished, can be appreciated by almost everybody, which latter advantage does not always attend his attempts in other directions.

J. E. Floyd.

CHANGING-BOX FOR USE WITH DRY PLATES.

[20109.]—Since writing let. 20054, I have found that the plates did not enter and withdraw from the boxes freely by means of the tape, so the following alteration has been effected:—In place of the plain wooden partitions between the boxes, A, B, &c. (vide Fig. 1, p. 240 of present Vol.) have been substituted partitions of grooved wood, placed back to back, so as to hold the plates lengthwise, thus making the box capable of holding three dozen plates, viz., one dozen in each box. The centre box is covered by a panel, which lifts out, the fillet above the groove in longitudinal partition being cut away to admit of this. I find the whole to work well, even in the full glare of the sun, it being perfectly light-tight.

S. G. Horton.

TO MR. WASSELL.

[20110.]—It is extremely gratifying to me to find that my letters have been useful. I was rather afraid that trade methods would not hit the mark required by amateurs. I am glad this is not so. With regard to zone testings, the short reply of Mr. Calver to "Orderic Vital," is pretty much what all opticians would reply. The artificial star, or real one, for the telescope either refractor or reflector; the minute globule of mercury for the microscope; and the monochromatic sodium flame for the spectroscope, are the infallible tests for the optician. Each is a test for every error that can possibly exist. Every error is depicted in the first-named two, to the eye at once by a little motion of the eyepiece. Definition, adjustment, and achromatism are seen with unerring certainty, as well as the position of error, if any. This is only got off by practice, I know. So the mode described by Mr. Wassell will stand the amateur in good stead, if the ratios are once perfectly known. I am sorry I cannot help in that way. It will at once be seen that the flat, some sort of trial body, and eyepieces, are the first necessity in the trade mode. I should advise the amateur to get these first. In his case the body he means to use finally would be best. Make or procure flat and eyepiece. It is quite possible to test a mirror on artificial star without silvering it. The flat should be silvered. I will give a method for making flats in my next to the Editor. I shall be glad to answer any questions regarding the working of the mirror that may crop up.

Sir John Herschel ("The Telescope," art. 56, page 81), says:—"The geometrical distinctions between the parabola sphere, and hyperbola, become mere theoretical abstractions in the figuring of specula, there being no practical mode of ascertaining, by *any* system of measurements on a *scale* what form the surface has," &c. I hope Mr. W. will eventually disprove this statement.

Prismatique.

THE LARGEST LOCOMOTIVE IN THE WORLD.

[20111.]—I send you details of what is claimed to be the largest locomotive in the world, recently turned out of the Central Pacific Railroad Works at Sacramento, U.S.A., which may be of interest to many of your readers. The *Sacramento Record Union* says:—"The work has been done in the most complete manner, and the engine is well-proportioned, not showing to a casual glance that she is so immense. A. J. Stevens, general master mechanic, designed and superintended the construction. G. A. Stoddard, chief draughtsman, made the drawings to carry out Mr. Stevens' ideas. The trial trip was a success, and Sacramento can now boast of a successful inauguration of locomotive building. The boiler was made by Chas. H. Hooper, foreman of the boiler shop, under the direction of Mr. Stevens, of the following dimensions:—Thickness of the shell, 7-16in. Otis steel; whole length of boiler over all, 29ft. 2¼in; shell, 60in. in diameter, 17ft long, containing 166 tubes, 2¼in. diameter; firebox, 108in. long by 56in. deep, made of 5-16in. steel, being thinner than the outside shell, so as to make steam easier; combustion chamber, 53in. long, 36in. deep. The crown sheet is supported by 37 bars, made of best bar iron, 5in. by ¾in., placed 4in apart, each bar supported by two slings strung to the waggon top of the boiler by two stays. The stay bolts in the firebox and combustion chamber are ⅞in. in diameter, and perforated with a 3-16in. hole.

"The dome is 26in. in dia. and 40in. high; the smoke arch is 56in. in dia. and 37in. long; the whole weight of the boiler complete is 14 tons. The cylinder of the engine is 19in. dia., stroke of piston 30in.

"There is an independent cut-off valve working on the back or top of the main valve, which is a double valve with a double exhaust at each end of the cylinder worked by six eccentrics. Two on each side work the link motion, and one each side works the cut-off on the cylinder. There is a steam cylinder in the cab attached to the reversing lever, to enable the driver to work the reversing-gear easily, also a cylinder on one side to work the steam brakes, which are attached to three pairs of the driving-wheels. There are four pairs of driving-wheels, 4ft. 6in. in diameter, two pairs of which are flanged to hold the engine on the track, and the others blank.

"There is an instrument attached to the back of the tender connecting with the draw-bar, called a dynometer, to test the strength and pulling capacity of the engine.

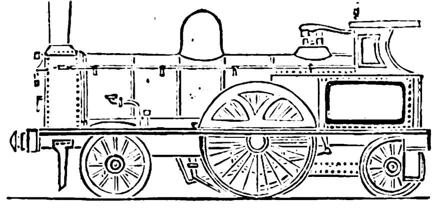
"The weight on the driving-wheels is 53 tons, on the forward truck 8½ tons, whole weight of the engine, with water, exclusive of tender, 61½ tons.

"The driving-wheel base on track is 15ft. 9in.; capacity of tender, 3,000 gallons of water, and 5 tons of coals. This engine is nearly all of an original design, and not copied from Eastern manufacturers. The double valves are an invention of Mr. Stevens, and are a new idea for a locomotive engine."

Scotchman.

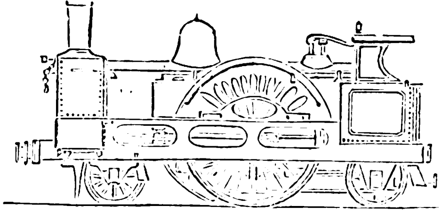
LONDON AND NORTH-WESTERN RAILWAY ENGINES.

[20112.]—To redeem my promise, I forward sketches of one of the "Bloomers," and "Cornwall," which I hope will be acceptable. The "Bloomers" were designed by Macconnell, a former "loco." superintendent of the company; there are two classes, distinguished as "large," and "small." The sketch I send is that of a "large Bloomer."



A few dimensions are as follows:—Drivers, 7ft.; Cylinders, 16in. by 22in.; Heating surface, 1,294 square feet; 195 tubes; boiler, 11·9 by 4·1; weight, 29 tons.

With regard to "Cornwall," she was designed in 1847, by Trevithick, for fast running. The driving-wheels were 10ft. in diam., the boiler being *under* the driving-axle. She, however, did not keep on the road well, and was on this account modified to the ordinary arrangement.



The chief dimensions are as follows:—Driving-wheels, 8ft. 6in.; leading and trailing, 3ft. 6in.; cylinders, 17½in. by 24in.; boiler length, 10ft. 6in.; boiler diameter, 3ft. 11in.; total heating surface, 1,070 sq. ft.; total wheel-base, 14ft. 10in.

Clyde.

GREAT NORTHERN ENGINES AND THEIR WORK, PAST AND PRESENT.

[20113.]—Many inquiries have been made in these columns regarding the engines which used to perform the express work on the G.N.R. before those now in use were introduced. Special interest attaches to the matter in the minds of those who have compared the work of twenty-five or thirty years ago with that now done. In a former letter I pointed out that, in respect of speed, the G.N. expresses of twenty-five years back compared very creditably even with the "Flying Scotchman" and Leeds express of the present day. So long ago as 1853, and, I think, ever since the opening of King's Cross terminus, the down Scotch expresses starting at 9.30 a.m. and 8.50 p m were timed to run from King's Cross to Hitchin (32 miles) in 40 minutes, and thence to Peterborough (44¼ miles) in 58 minutes; while the 5 p.m. ran from Hatfield to Hitchin (14¼ miles) in 18 minutes. In 1857 the special expresses to Manchester were put on, to compete with the L. and N.W., and then the time to Hitchin (32 miles) was reduced to 38 minutes, thence to Peterborough (44¼ miles) in 55 minutes and Peterborough to Grantham (29 miles, up the Globe bank) in 40 minutes. On the up-journey, the 44¼ miles from Peterborough to Hitchin were timed to be done in 52 minutes. Here, then, we have timed speeds of 50·5 and 51·1 miles an hour—start to stop. The trains usually consisted of from 8 to 12 coaches. Time was excellently kept, and after any delay at stations was often made up to the extent of several minutes in the longer runs. I have known the 32 miles to Hitchin done in 37 minutes. I need not remind my readers of the numerous gradients on the G.N R., which have been shown in the sections kindly given by Mr. C. E. Stretton in back numbers; but I may just remark that there is a two mile rise of 1 in 105 and 1 in 110 at starting, and then another of 1 in 200 continuously for eight miles to Potter's Bar, which is 250ft. above the starting point at King's Cross. Thus, out of the 32 miles, 17 rise about 1 in 200, and a summit of 250ft. has to be climbed. Therefore, I think I am warranted in saying that this run of 32 miles in 38 minutes, over such a road, by the old Manchester expresses, will stand favourably against the fastest narrow-gauge work done in the present day. Almost equally good was the run of the "up" express from Peterborough to Hitchin (44¼ miles) in 52 minutes, more than a third of the distance being up-hill, with fully a dozen miles of 1 in 200 rise. On the "down" journey, the 12¾ miles bank to Potter's Bar was ascended in 17¾ to 18 minutes. Down this and other inclines, speeds of 60 to 70 miles an hour were commonly run, with great steadiness; and I once timed a train at 72 for a short distance. As to weight and speed combined, I may instance a run from Hatfield to Holloway, with 16 coaches and one engine (a 6ft. 6in. rebuilt Crampton "single," with 16in. by 22in. cylinders), in 22 minutes, starting and stopping, the last 5 miles being up a bank of 1 in 200, and the last 2 miles having to be "slowed" over. So much for the work. Next, as to the engines.

The G.N.R., in the years 1851—60, had 27 regular express-engines. Of these, one was the well-known old experimental bogie-engine, No 215, whose 7ft. 6in. wheels are now running under No. 92. She has already been described in these columns, and I have no personal information as to her work. She was the only one of her class, and, so far as I could ascertain, was not a favourite or a success. Nos. 201, 202, and 222 (about which questions have often been asked), were also a class by themselves. They were of the celebrated "Jenny Lind" type, built by E. B. Wilson, of Leeds. Nine of the same class were employed on the L.B. and S.C.R., and five on the G.E.R. They had 6ft. "single" driving-wheels, 4ft. leading and trailing; cylinders, 16in. by 20in.; inside bearings to driving wheels; outside to leading and trailing; outside pumps working on driving-axle; peculiar fluted iron cover to dome and safety-valve; the former placed on middle of boiler; latter over firebox. They were much liked, and did excellent work. The main stock of express-engines, however, 23 in number, were divided into two classes: the Hawthorns (numbered from 203 to 214 inclusive), and the rebuilt Cramptons (numbered from 91 to 100, and No. 200), both having single drivers, 6ft. 6in. in diameter, and inside cylinders 16in. by 22in. They differed, however, in details. The Hawthornes (No. 203 of which class was in the Great Exhibition of 1851), had raised fireboxes, and the leading-wheels were set a little behind the smokebox. The Cramptons were originally built, like the "Folkestone" class on the S.E.R., with two pairs of leading-wheels, drivers behind firebox and intermediate crank-shaft. They were rebuilt by Mr. Sturrock with "single" driving-wheels on the crank-shaft, and a pair of carrying-wheels behind the fire-box, the leading-wheels being right under the smoke-box, as in the modern 7ft. "singles." They had flush-boilers and no domes; the safety-valves were over the firebox. This was also the case with Nos. 203, 213, and 214 of the Hawthornes, Nos. 204—212 having central domes with curiously-shaped flat-topped covers. Both classes had large boiler-power (about 1,300ft. h.s.), and weighed some 30 tons loaded, of which 13 or 14 tons rested on the drivers.

These engines did the fastest express work, especially between London and Peterborough, and also took their turns with the ordinary main-line trains, excepting the morning Parliamentary, and an afternoon moderately fast train to Peterborough, among the down trains, and the corresponding up trains, which were run with coupled engines. The other "single" engines on the G.N.R. were of two classes. Nos. 1 to 50 were the well-known "Sharps" (illustrated page 435, Vol. XXX.), of which I have previously given dimensions, the principal ones being—cylinders, 15 by 20; driving-wheels, 5ft. 6in., h.s. 748ft., weight 20 tons. Nos. 51 to 70 were "small Hawthornes," resembling the 203 express class, but having 6ft. wheels; cylinders, 15 by 21; h.s. 906ft.; weight 25 tons. Nos. 51-60 had flat-topped domes: 61-70 none. Both these classes occasionally took light fast or express trains, but were mainly employed on the ordinary stopping or short-service trains. I believe some are still in existence.

The old G. N. four-wheel coupled engines had cylinders 16in. by 22in.; driving and trailing-wheels, 6ft.; h. s., 904ft.; weight, 26 tons; no dome; were numbered 71—90, and were built, some by Wilson of Leeds, others by Hawthorne of Newcastle. Nos. 223—228, with 6ft. 6in. wheels and 16½in. by 22in. cylinders, were built at a later date. Nos. 101—199 were goods engines, mostly six-wheel coupled; wheels, 5ft.; cylinders, 16in. by 24in.; weight, 30 tons; all had domes; builders chiefly Hawthorne and Wilson. Nos. 216—221 were small four-coupled engines, with 11in. by 17in. cylinders and 5ft. wheels, originally built for the Ambergate line. Nos. 229—240 were the 7ft. "singles" built by Kitson, which are still running, and have often been described. They came in at a later date than I refer to. This completes the list of the old G. N. R., and I believe it to be correct in all respects. Such information as was not within my personal knowledge was communicated to me by a gentleman who was in the locomotive department at that time. This letter practically answers a number of long-unanswered queries, and I regret that my engagements have prevented my sending it earlier. **C. R. M.**

Wellington, N.Z., March 25.

INDIAN WORKMEN: ALSO THE WRITINGS OF "EOS" AND "KHODA BUX."

[20114.]—BEING myself a long resident in the East, I particularly enjoy and appreciate the writings of our former correspondents, "Eos" and "Khoda Bux."

When I was last in India I met a sonar, a Brahmin, who had come to Central India from Lucknow during the troubles of 1857. He was one of the most intelligent natives I ever came across. This old man, who was over seventy years of age, was named Bulwant Rao, learned his business from his father, who had had the advantage of being thoroughly trained as a watch and clockmaker by an Englishman who had settled in India about the year 1745, having left home in consequence of his having been a follower of Prince Charlie. He settled down as a watch and clock maker at Lucknow, and at his death in 1783 he bequeathed his business and stock-in-trade to the father of Bulwant Rao, a sonar, or goldsmith, of the Brahmin caste, who had come to him as a boy, and learned all he could teach him. When he, in his turn passed away, his belongings came to Bulwant Rao, who had the credit of being the best native watchmaker in Central India. I made this old gentleman's acquaintance in the following manner:—

Duty sent me to reside at the capital of a native State, and as my duties were not very arduous, and I had plenty of time on my hands, I decided on setting up a workshop; and when I had settled down in my bungalow, I unpacked my Holtzapffel's lathe and tools, and set to work.

In a day or two, I had a visit from a native lohari, or blacksmith, to ask for custom, should I require anything in his way. He was a very clever smith, and I found him very useful. He made me a number of small forgings; and caught at my ideas so readily, that I took a liking to him, and used to go to his place in the bazaar and watch him at work. He had a very nice back-gearded lathe 6in. centre, with a good slide-rest, which had been made at the Government Engineering Works, Rawul Pindee, or Roorkee—I forget which—where he had served an apprenticeship and had worked for years as a *maistru*, or, as we would call it, a journeyman. He was an excellent smith and a very fair turner. He was a Brahmin by caste, and his name was very similar to the Sonars, being Gunput Rao. He was, however, no relation, and of quite a different division of the caste.

From my spending a good deal of time at the vice and doing some turning in metal, and from my often going to Gunput Rao's workshop and remaining there looking at him and his brother at work, the attention of the natives round was drawn to me, and my servants informed me that it was current in the bazaar that I was of the *Lohari Ki Jat*. At any rate, my mechanical amusements began to be talked about, and Bulwant Rao heard that I had a lathe from which somewhat complicated work could be produced. So he paid me a visit, and I showed him my Holtzapffel lathe, its oval and eccentric chucks, and ornamental slide-rest, and how to ornament plain surfaces by use of the division-plate and a single point in slide-rest; also how to use the cutting-frame. He spent two whole days with me, and was very much interested in what I had to show him.

He told me that he had a lathe with a great deal of apparatus, with which his father used to do ornamental work like mine, but that he had never been shown how to use it. He had kept it all very carefully in the cases belonging to it, which had belonged to the Englishman. When with his father he had used this tool as an ordinary lathe, and also since it came into his possession, but he did not know how to do ornamental work with it.

So I went to his house and inspected it. From what I had read in the *Journal of the Amateur Mechanical Society*, the MECHANIC, and "The Lathe and Its Uses," I recognised it as a Rose engine. The standards, if ever there had been any, had been made away with, and the bed was not in use; the head was mounted on a low table about 18in. high, fixed to the ground, and the lathe was driven by a large wheel at the other end of the room, turned by a Coolie. When he did any turning he did not stand like an Englishman would, but sat on a mat cross-legged at the side.

The head was properly mounted between its vibrating points, but fixed immovably by wedges.

I made rough sketches of the arrangement, as I thought it would enable me at some future period to add to the capabilities of my own lathe.

Having, with some little trouble, put the tool together with the pattern plates *in situ* and having put up the supports for the guide-points, and fitted the levers and springs to their places and connected them together, I was able to show him the principle of the machine, and how, by acting on the lathe head from one side, he could cause a vibration which would make the tool in the slide-rest cut a wavy line on the surface of any work to which it was applied, and how the division-plate was used to adjust the successive lines to one another.

We proceeded to test the capabilities of the lathe as to side-work by utilising the pumping action of the back spring on the traversing mandrel. While doing this we discovered a parcel of screw-guides, of which there was a considerable variety.

He worked away by himself for a week, and was not long in finding out that a number of his pattern-plates and rosettes had an oval in them instead of a centre round hole. He discovered that he could by this alter his patterns very materially. He also mastered the principle of the oval chuck, and, before a month was over, he was able to utilise his tool to the utmost. As may be supposed, he and I became great friends, and when I was ordered to another part of India, he made me a present of two conundrum discs to mount on my lathe.

I shall be happy (if you would like to have them) to send you copies of the sketches I made of his own engine. **Gereb Admi.**

[Please send.—ED.]

SPECIFICATION OF A STEAM-LAUNCH.

[20115.]—WOULD any of your readers of the ENGLISH MECHANIC be kind enough to give their views of the following specification of a small yacht I am purposing to have built? The specification is by an eminent designer, and I want to have some criticism upon it by practical people.

Length, stem to after-post, 39ft.; extreme length, 42ft.; breadth, moulded, 8ft.; depth amidships, 5ft. 3in.

General Description: To be clincher-built of timber, with square yacht-stern and straight stem. To be decked forward and aft, and about 16in. round sides; but to be completely covered in with raised coach-roof, the coamings of which are to extend about 9in. above deck. Cabin forward of machinery-space, fitted with usual yacht-lockers and sofa seats; cupboard-fitted pantry in fire-end of saloon; aft of machinery-space to have accommodation for a man.

Keel of American rock-elm, 6in. by 4in., tapered at ends and under side to 3in.

Iron Keel Strap Galvanised, 2¾in. by ⅜in., to run right fore and aft from rudder-post to top of stem, secured to wood-keel by ⅝in. through bolts 2ft. apart.

Stem of British oak, sided 3in. moulded to drawing.

Stern-post main of British oak, sided 4in., moulded to about 10in. to keel, with boss for screw worked out of the solid, to be bearded off at after-edge to about 1½in. or 2in.

After-post of oak, 5in. by 3in.

Frames of American rock-elm, 1⅞in. by 1⅝in., spaced 9in. apart, and with two copper clenches between.

Floors.—Natural crooks of oak, sided 2½in., 4in. deep at centre line, and extending well up bilges, one at every second frame for 20ft. amidships, and one at every third frame at ends.

Keelson.—On top of floors extending right fore and aft of pitch-pine 4½in. by 4in.

Deadwoods.—Good oak crooks sided 3½in.

Engine and Boiler Seats of oak, and to be half chequed into floors and bolted.

Coal-Bunkers on each side of ship of white pine, feather and groove 1in. thick.

Bilge Stringer, ¾-length, 4 by 1½ of pitch-pine.

Beam Ledge of pitch-pine in one length right fore and aft, about 9in. by 1½in. amidships.

Planking, ¾in. thick, streaks to be in not more than 2 lengths, 5 bottom planks each side of American rock elm, rest of planking yellow pine, and top streak teak; no plank to exceed 5in. in width.

Deck, ⅞ yellow pine, feather and groove.

Beams of larch, sided 2¼in., and moulded 3in., coach-roof beams of galvanised cope iron ⅜in. by ⅜in.

Coamings of coach-roof of pitch-pine 1¼in. thick, and standing about 9in. above the deck; small rectangular windows, 9in. by 3in., let into coamings.

Coach Roof of ⅝ yellow pine, feather and groove, and covered with canvas, painted.

Bulwark of mahogany, 2in. high, fastened to covering-board with stout galvanised iron screws; rail on top of American elm 2in. by ⅜in., fastened with brass screw and dowelled.

Life Rail.—Stanchions of galvanised iron, not more than 4ft. apart, &c.

Fairlead.—Forward, of galvanised cast-iron, &c.

Companion of mahogany to main cabin, with mahogany steps down into cabin, flap to lift to get down to engine-room; also to men's room aft; the after scuttle to have light iron ladder.

Fastenings of copper or yellow metal throughout, the nails into bent frames to be clenched on rooves, the through fastening in beam-ledge and bilge-stringer to be clenched also. The centre line fastening may, however, be galvanised iron, and the iron keel is to be secured. ⅝ counter-sunk headed bolts, hove up with nuts on top of keelson; covering board to be secured to sheer streak and beam stringer with brass screws, all fastenings about deck to be brass. Fittings below, *painting and varnishing, &c., described.*

Engine, &c., 5in.. Willan's three-cylinder engine, three-bladed propeller.

Boiler.—Vertical, 4ft. in. high by 3ft. 9in. dia., shell B. boiler plate, 7-16 thick; crown of B.B. boiler plate, 7-16 thick; firebox and up-take tube best mild steel ⅜ thick, and across the firebox three Galloway tubes to be fitted of approved dia., &c., &c., &c.

Edinburgh.

MEDICAL REPLIES.

[20116.]—DIPHTHERIA (46928).—I never before heard of "the celebrated Dr. Field," and know nothing of any cases treated by him by means of sulphur. The queries as to the fungoid character of diphtheria, and its possible cure by sulphur, would lead me into a long, and, at present, unpractical discussion, for which neither time nor space can be spared. Anyone suffering from diphtheria should consult a medical man instantly—anyone who has only a theoretic interest in the subject, must consult the medical textbooks. The only practical point is, at present, that diphtheria is a highly infectious and contagious disease and that wherever bad drainage and filth accumulate, there diphtheria and its allies appear. Whether the systemic disease is the result of blood-poisoning from local fungoid growth, or the fungoid growth is a mere result of the diseased processes, is not easy to say in any of these allied diseases: but where the carrion is, there will the vultures be. Whenever diphtheria breaks out, the safety of other members of the family requires the most profuse ventilation of the sick-room, so as to carry off morbid exhalations before they are breathed by others.

CUTS AND BRUISES (46931).—I will write a paper on this practical and important subject; but at this moment am overworked and have not time.

SPRAIN (46943).—This peculiar feeling in athletes, when straining their muscles to the utmost, is hardly a "sprain," but rather a too great tension of the muscle, producing a strain for the moment. More careful action and pushing it rather less, are all I can suggest. It is probably a pain similar to that experienced in "ricking the neck." It is very foolish to risk the integrity of one's bodily structure merely for the sake of performing useless feats. Up to a certain point athletic exercises are healthful and invigorating—beyond that point they are dangerous and exhausting, and produce premature decay.

J. DENVERS (46968).—Query not answerable. Consult some good medical man, or take patient to a hospital physician, who can *see* her and examine her.

GRAVEL (46975).—Continue to abstain from all alcohol. Eat more sparingly, and starve down to normal weight, at the rate of a pound or pound and a half per week. Eat no sugar, not much flesh, and plenty of vegetables. When the gravel loads the urine, take—directly on waking in the morning—half a pint of hot water, a pinch of ginger, and a seidlitz-powder.

DISINFECTION.—The problem of dealing safely with "large quantities of clothing, bedding, furniture, rooms," &c., after they have become infected by small-pox and other diseases, say, in an hotel, is one that has often puzzled me greatly, and is one that must be adjudicated upon at the time by the responsible medical officer of health. The practical point is that, so soon as such sickness occurs, the patient should be removed into a clean, airy, but bare room, containing only the simplest and most washable things. Theoretically, all such materials as cannot be efficiently exposed to steam-heat at a temperature of 230° to 250° Fahr., should be destroyed. Practically, I rarely order such destruction unless in very special cases. A few months since, in consequence of neglect in arranging for the removal of a case of small-pox in a lady's maid at a west-end hotel, I had to adjudicate upon what was required for wealthy people coming to the hotel afterwards. The hotel was shut up, and practically cleared out and redecorated, and the cost was some £2,000. All this might have been prevented had the importance of the case been foreseen by the medical man who was called to see the case, and who "let it slide" until the patient was too ill to be removed without jeopardising her life. It may be laid down that all such materials, if put into a steam-boiler-case into which steam is turned from a high pressure boiler until it issues at a temperature of 220° Fahr. from a pipe at the other end of the steam-case will come out clear of infection after an hour's digestion. But this means destruction to much of such property as "T. R. S." inquires about. Carpets should be sent to a steam laundry, and other things must be boiled. The use of chlorine, or chloride of lime, for such property, means entire destruction. The goods come out discoloured and rotten. Small quantities of linen, &c., should be put direct into a 1 per cent. solution of carbolic acid, and afterwards boiled. I think I have already gone through this subject in the "E. M."

SEA-SICKNESS (47023).—An abstainer is less likely to suffer from sea-sickness than a user of alcohol. Take no physic in sea-sickness. It is the result of a mechanical disturbance, which continues until the muscles can co-ordinate with the unstable platform on which they are suddenly called upon to act, and digestion is therefore arrested. My own practice is to avoid the cabins where people are drinking spirits and defiling the atmosphere with vomit. Keep on deck if possible, well wrapped up, as much amidships as possible, where the motion is least and the air is clear and fresh. Take no food but draughts of thin well-boiled oatmeal gruel until the digestive power returns. All remedies are useless until the body has learned to adapt itself to the motions of its novel location.

James Edmunds, M.D., &c.

Grafton-street, Bond-street.

CALCULATING SIZE AND POWER OF BOILERS.

[20117.]—I DO not recollect to have seen the question about calculating the power and size of boilers answered. The examples given in Molesworth of the dimensions of boilers are in terms of nominal H.P., now out of date. Boilers are now calculated as actual H.P., which may be done in the following way:—

Example—Boiler-power is required for a single-cylinder condensing-engine. 20in. in dia., pressure of steam in boiler, 40lb.; speed of piston, 250ft. per min.; steam to be cut off at half-stroke. The actual H.P. of engine is therefore 40 + 15 × ·693 = 38·1 − 3·1 imperfect vacuum = 35lb. average pressure; then 314 × 35 × 250 / 33 000 = 83·2 H.P., say 83 H.P. To find the evaporation of water for 83 H.P., stroke 4ft.: 314 × 24 × 2 = 15,078 cub. in. of steam used per revolution; 15,078 × 31¼ = 471,187·5 × 60 = 2,827,125 cub. in. per hour = 16,360 6 cub. ft. of steam per hour; vol. of steam to 1 of water at 55lb. pressure = 474. 16,360 6 / 474 = 34·5 cub. ft. of water evaporated per hour. 1 cub. ft. requires ¾ sq. ft. of grate-surface, which gives 34·5 / ·75 = 25·875, say 26 sq. ft. of grate-surface; 26 × 16 = 416 sq. ft. of heating-surface, allowing 16ft. to 1ft. of grate-surface, requiring two boilers therefore, each having 208ft. of heating-surface and 13ft. of grate-surface. A boiler 6ft. dia., with a 3ft. tube, would give the following sectional area of heating-surface, viz.:—

Heating-surface in tube..........	3 75ft.
Surface under boiler	3 00ft.
Vertical sides at 3ft. each, estimated as 1 effective	3 00ft.
	9·75 sq. ft.

of heating-surface. 208 / 9·75 = 20ft. nearly = length of each boiler. Grate-surface, 13 / 3 = 4⅓ft. = length of firegrate for each boiler.

J. H.

CONUNDRUM BELLOWS FRONT CAMERA FOR 18 DRY QUARTER-PLATES.

[20118.]—FOLLOWING the advice of a correspondent of the *British Journal of Photography*, reproduced in "ours" Aug. 19th, 1881, I have made a camera of ⅜in. mahogany like his, but having only one box with bellows-front and having a sliding door at the back. I have put racks and pinion to the front for focussing, as also two narrow brass plates in front for raising the lens. The blocks for tripod I have screwed to the bottom of camera. The ruby glasses at the sides, I am sorry to say, are of not much use; weight 5¼lb. with lens; size, 10¾ by 7¾ by 5¾; the bellows are made of leather.

Cost: brass, &c., 1s.; mahogany 2s., rack and pinion 3s. 6d., lens 25s. (Lancaster's, Birmingham).

There is nothing loose except the lens of focussing-glass. Further particulars if needful.

FIG. 1.

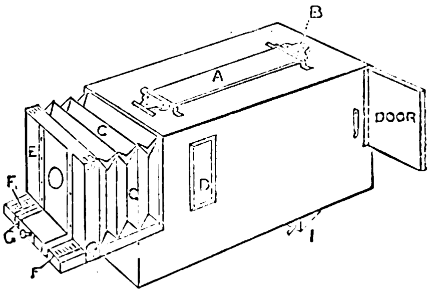
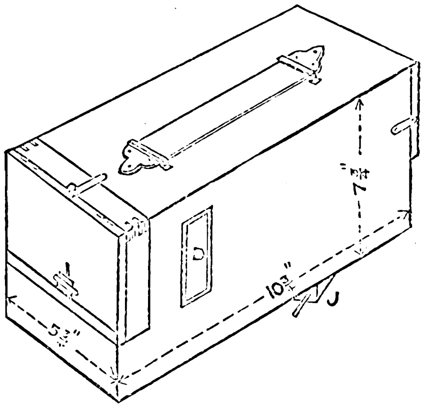


FIG. 2.



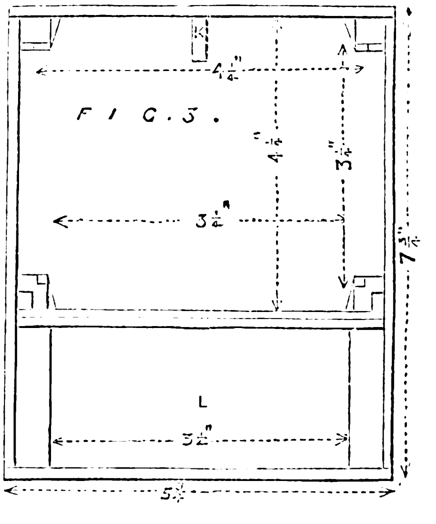


FIG. 3.

References to sketches: Fig. 1, open; Fig. 2, shut; Fig. 3, section; *a*, leather handle; *b*, brass; *c c*, bellows; *d d*, ruby glass (on each side); *e*, brass for sliding front; *f f*, rack; *g*, slot for front; *h*, for tripod; *i*, slide for fixing tailboard; *j*, three blocks screwed to camera for tripod; *k*, opening; *l*, well.

J. R. Brown.

Irthlingborough, Higham Ferrers.

GRINDSTONE TRUING DEVICE.

[20119.]—THIS tool, which is to be seen illustrated in several of the lists of American tools, seems a simple and effective arrangement for the purpose, but the price is very exorbitant, so also is Brunton's patent grindstone dresser. The prices of these tools run from £4 10s. to £10. Consequently it is quite out of place for amateurs to think of them. I have made a tool for myself that answers admirably. I have taken the lower slide of a small slide-rest, and mounted on it a small lathe head which is driven from an overhead on its spindle. I mount a cutter 6in. in diameter; this cutter is traversed across the face of the grindstone, which is revolved slowly in the opposite direction. The cutter is made out of one of Lloyd's cog-wheels, which had lost a number of teeth. I turned down the teeth till the stumps all stood up about a ¼in. above the bottom of the space, and made it the foundation of my cutter. I took this to a blacksmith, who made an old file into a ring about ⅜in. thick, and ⅝in. across the face, and this he drove in the wheel while it was red-hot, the wheel itself being cold; he put it in the vice, and with a cold chisel cut it across the edge into a very coarse file, requiring to heat it once or twice in the process to enable him to get a deep enough cut When this had been done equally all round, it was put into an iron box filled with burnt hoof-parings and placed in the fire and made red-hot, and kept so for two hours; it was then thrown into a tank of cold water, and when taken out the edge was so hard that no file could touch it. It answers perfectly, and a very few minutes suffice to give a true face to a grindstone.

The material out of which it was made, excepting the casting of small lathe-head and its mandrel, was waste, and of no intrinsic value. Exclusive of my own labour, which was my recreation, the cost of this really efficient tool was under four shillings, as follows:—

Lathe-head casting	1	0
Steel forging for mandrel	1	2
Babbit's metal for collars	0	6
Blacksmith, for fitting old file to wheel, as described	1	6
	4	2

Gereb Admi.

Erratum.—Wenham and Watson's Stands.—In letter from "Another F.R.M.S." (page 261), the last line but four should read "The additions in Mr. Wenham's *stand*" (not stage)

REPLIES TO QUERIES.

*** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[46276.]—**Newtonian Telescope.**—The large mirror should be, as you suppose, parabolic. Grind it to a spherical curve first, and flatten the curve to a parabola afterwards in polishing. Plenty of instructions in recent volumes.—Paugul.

[46346.]—**M.S.L.R. Engines (U.Q.)**—I saw the M.S.L. single-engine a few days ago, but was unable to procure dimensions. The cylinders are placed outside. The driving-wheels seemed to be 7ft. dia., or slightly over. The leading and trailing wheels have outside framing, and the driving-wheels inside; but the outside framing is carried along from the leading to the trailing wheels, and thus it appears that the driving-wheels have outside frames; but, as far as I could see, the framing was in no way connected with the driving-wheels. The engine is numbered 399, and dated M.S.L. Works, 1882, and was running express trains between Manchester and Liverpool on the Cheshire lines.—Meteor.

[46378.]—**Bevel Wheel.**—As my opinion is opposed to that of "Glatton" (see reply to query 46378 in No. 894, p. 223), I should esteem it a favour if he would give his reasons why he prefers a larger pair of wheels.—R. Kanthack.

[46394.]—**Timing French or Other Pendulum.**—I am not a watchmaker, but the expression you quote seems to me plain enough. If you examine any clock by taking the pendulum in your fingers and moving it slowly from side to side, watching the 'scape-wheel meanwhile, you will see that each time the pendulum moves to one side half a tooth passes the pallets, so that two beats are necessary in order that a tooth should pass Thus, for every tooth in the wheel two vibrations are necessary in each revolution of 'scape-wheel, and, if there are *n* teeth, there will be 2*n* vibrations of pendulum per rev. As these clocks are said by Britten to make two revolutions of 'scape-wheel per minute, we have twice as many beats per minute as there are per revolution, *i.e.*, 4*n*, or four times the number of teeth in wheel.—Glatton.

[46503.]—**Jamming of Tapered Journals.**—Imagine the part C B D not to exist, then if A B C is equal to the angle of repose, the wedge A B C would be just on the point of jamming. After going through a similar course of reasoning with regard to the lower half, B C D, we may imagine the two portions working together. This makes it clear that a wedge slanted on one side only may be half as thick at the back (in proportion to its length) as a wedge slanted on both sides. A mandrel may, of course, be considered as a circular wedge. I don't know that the jamming angle governs—I am not very sure that it should govern—the cone of a lathe-mandrel.—Paugul.

[46503.]—**Jamming of Tapered Journals.**—I am really much obliged to "J. J. A.," Liverpool, for his endeavours to help me; but though he thinks "such a rule as I require will not be readily obtainable," I feel convinced that there is such a limit as I have mentioned, and that the only question is, which of the two angles shown in my original query is correct? Let me define what I mean by "jamming." Suppose journal to be pressed with any force into bearing, and revolved slowly; the motion to be stopped and pressure removed (not reversed). If jamming has taken place, the journal will be found to be stuck (more or less tightly, according to end-pressure at first applied; but still, "J. J. A.," "if it means to jam it will be" stuck), and on applying force to move it, it gets loose with a jerk. If "the" angle is greater than the angle of repose, on relieving journal from end-pressure it will be found to be as free as ever. In the case of your water-cock, the pressure of water against one side of plug keeps the plug pressed against the opposite side of cock, and the friction prevents the weight of plug taking effect. —Glatton.

[46598.]—**Half-Chronometers.**—Your Stockton correspondent has not given a correct definition of the common use of the term. Morton's patent is an escapement never used, drawings of which are in Saunier, plate 10, Fig. 11; but half-chronometers, as they are called, are sold every day, and are lever watches with compensation balances; the term is shopkeepers' clap-trap to hoodwink customers, and nothing more. "Chronometer" is a word that can be applied to any timekeeper; it simply means a time-meter, and a verge watch or a Yankee clock is as much a chronometer as any kind of timekeeper, but as a trade term it is only applied to a watch with a detent escapement and a compensation balance. This was not always so; the word seems to have been first used by Harrison: he applied it to the timekeeper that got him the Government reward of £20,000 but his watch was not a chronometer as we understand the trade definition: it had a kind of verge escapement, a train remontoire, and a compensation curb, the remontoire to correct the variations of power in the escapement, and the curb to compensate the contraction of metals. This was, I believe, the first chronometer for which Harrison got his money, but the Government got a thing that was never used; a dozen of them never were made. The only thing used in a modern watch used by Harrison is the maintaining power, and that Reid says he got from a "roasting-jack." Chronometers are rated to the tenth of a second by the eye and ear only, and by practice, and is a very simple matter. A standard clock beating seconds is used. If you are testing, say, a marine chronometer that beats half-seconds, listen to the clock, and if you see the chronometer-hand falls as you hear the clock, it is on the second; if before, it will be one, two, three, or four-tenths fast. This you will determine by the time the hand is at rest on stroke before you hear the clock; if it beats with the clock in middle stroke, it is 5-10ths fast, and if it gets there before the clock it is 7, 8, or 9-10ths as the case may be; or if it is taken slow in the same manner, a little practice, and it is easy to tell to a tenth of a second with certainty. —T. M.

[46603.]—**Induction-Coil Failure.**—I scarcely know what to recommend, but should think the fault is in insulation of secondary, which should be two or three layers of paraffined tissue-paper. Glad you have altered the primary. Two layers of 16 only short-circuits the cell. If I were going to make a coil of your dimensions, I should have wound primary of two layers of twenty, or three layers of eighteen. If you do not succeed you may send it to me, and I will examine it.—George Tolman.

[46623.]—**Nos. of Midland Coaches (U.Q.)**—On noticing the carriages lately, I find that the vans are numbered separately from the carriages, and also that there is an innumerable amount of duplicates. Most of the small 4-wheeled coaches are duplicates, as they are now replaced by large bogie carriages. I notice also that most of the carriages in the continuous local trains in the London and Bradford districts are duplicates. Two duplicates and a van may account for the 3 carriages bearing the same number which "Dunbritton" saw.—Meteor.

[46650.]—**Electrical.**—(1) The current of a battery in absolute electro-magnetic units may be measured by means of a tangent galvanometer. Let r represent the radius of the galvanometer coil (in centimetres), and let there be only one turn; then the total length of the coil $= 2\pi r$. Then, if $i =$ strength of current, $i \times 2\pi r / r^2 =$ force (in dynes) at centre; or $i \times 2\pi / r = H . \tan \delta$, where $H =$ horizontal magnetic force at the place, and $\delta =$ the angle of deflection. Hence, $i = r / 2\pi . H . \tan \delta$. H and $\tan \delta$ can readily be found from the tables. If the galvanometer has more than one turn of wire, we shall put $r / 2\pi n$ instead of $r / 2\pi . -$. Another (relative) mode of measuring current strength is by observing how many cubic centimetres of hydrogen are given off per minute in the electrolysis of water. (2) Besides the deflections, you should know the horizontal magnetic forces at the places.—A Medical Student.

[46668.]—**Dyeing Fawn Colour.**—The following is a method of dyeing fawn on cotton goods:—First boil catechu in the proportion of 1lb. to 7 or 8 gallons of water; add, when dissolved, 2oz. of nitrate or sulphate of copper, and the solution, well stirred, is ready for use. Work the goods in this solution. Have ready some warm water, in which 2oz. acetate of lead has been dissolved. Wring out of catechu, and work in the lead solution for fifteen minutes; wash in cold water, and dry. The querist can vary the proportions almost at pleasure. If he wants household dyes he should try what he can do with Bismarck brown. There is also an iron-buff—yellower than the catechu-fawn—made by dissolving 4lb. sulphate of iron and 2lb. acetate of lead in a gallon of water. The clear liquor can be diluted at pleasure: but the colour must be brought up by passing through cold solution of soda-ash. It is really a rust colour.—N. C.

[46681.]—**Windmill Pump.**—"O." will find what he requires on p. 312, No. 325; in several of the back volumes there are devices for pumping water by means of windmills.—T. P.

[46713.]—**Bleaching Cotton, &c.**—First, for clothes or cotton goods that have not been bleached: boil the clothes in a soap ley for half an hour (yellow soap will do), rinse well in cold water, and put them into the sours for half an hour. Sours is a mixture of vitriol and water; no particular quantity is used, but the oil of vitriol is added to the water until it tastes as sour as a lemon. Now mix chloride of lime, one pennyworth to two gallons of water; rinse out of sours, and immerse the goods in the liquor (as the lime mixture is called), stir them about to let the liquor act on every part, lift them out occasionally with a stick, and the air will turn them quite white. When the process has been carried far enough, rinse well after the liquor, and hang out in the fresh air to dry. This process will not rot them, and will give every satisfaction. Caution.—Never allow these chemicals to remain in the reach of children, as they are poisonous; never use the liquor hot, or it will rot the clothes; and, remember, a thorough rinsing is necessary between each process. For ordinary linen, immerse in sours and liquor as above; or to remove stains, ironmould, &c., put one pennyworth of oxalic acid (poison) in two gallons of hot water, immerse clothes for half an hour, wring out and rinse in hot, then in cold, water, when the stains will have disappeared, leaving them white. I think this fully answers both queries on bleaching; but any further information with pleasure.—Lockstitch.

[46761.]—**Compensated Watch.**—I have been waiting to see if any one in the trade would answer this query. I also have bought a compensation balance watch, and the same kind of experience has led me to make inquiry. The result is that I learn that the "compensation balance" is simply a trade deceit. The title leads ignorant outsiders to imagine that a watch with a compensation balance is compensated and adjusted. The trade say, "How can you expect this? Look at the expense!" But outsiders cannot be expected to understand all this until it is explained. A fairly-made lever watch will keep a fairly regular rate, either losing or gaining with such regularity that the owner knows what he is about; but when the watch has a compensation balance stuck in, without being compensated, it being a delicate and sensitive piece of mechanism, the watch is seldom alike two days together. Sometimes its timekeeping is marvellous for a day or two; then, without warning, it has some eccentric variation and lets in its owner for loss of train or some other annoyance. If I had been acquainted with the difference beforehand, I should have preferred stretching a point to have a watch properly adjusted; as it is, I am saddled with an article which is a nuisance, and which yet I cannot afford to throw away. Will someone in the trade tell us if such a watch can be properly adjusted and compensated at any less cost than buying a new one?—M. F.

[46782.]—**Explosion in Loco. Fire-Box.**—The case mentioned by this querist is by no means the first of its kind, though happily it is not of frequent occurrence. Ed. Gobert says (page 244) it is the rush of air to fill a vacuum that causes this accident to happen; but he evidently has not had experience in this matter, or he would know better than to make such a statement; my own opinion is that a gas of some kind is generated by the contents of the tube, which, not being condensable, retains it pressure after all is cold, and when the plugs fit perfectly steam-tight, and the rupture in tube covered by the plugs, thus perfectly imprisoning the contents of tube, this accident may be repeated any time; but, luckily, this perfect imprisonment seldom occurs: hence the rare occurrence of these accidents.—LOCKSTITCH.

[46847.]—**Equation.**—I do not see that "A Medical Student" has solved the equation as a quadratic. Towards the end of his calculations we are introduced to an equation containing powers of β up to the fourth, and in the next line this is reduced to a cubic equation by taking out the factor $(\beta - 3)$. But how are we to know that this is a factor of the expression without solving the equation? Unless we knew that $\beta = 3$ we should have to make a good many trials. Mr. J. Lane Davies's solution, although it gives values of x, y, and z which satisfy all the equations, yet only does so by a curious coincidence. What he does, in fact, as pointed out by "A Medical Student," is to put the equation E into the form $x y / 2 - 3 = - (x y / 3 - 6)$. He then, in a roundabout way, squares both sides, by which he gets rid of the negative sign of the right-hand side of the equation. He then takes the square root of both sides, but omits to replace the negative sign; so that he gets $z y / 3 - 6 = - (z y / 3 - 6)$, or a positive quantity equal to a negative quantity. This can only be the case when these quantities are each $= 0$; and by a curious coincidence this happens to be in the present case, and $z y / 3 - 6 = 0$, from which $z y = 18$ −. This, however, gives us a clue towards the discovery of the solution, as, if we could prove the truth of this last equation, the difficulty would disappear, and no squaring would be required. But, after all, why should we expect to be able to solve the equation in the form of a quadratic?—M. I. C. E.

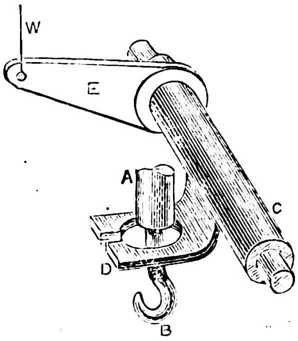
[46847.]—**Equation.**—The little real criticism which your correspondent's letter contains is frivolous though amusing, and this he prefaces with the information that "satisfying" is a relative and vague expression—for the benefit, I presume, of those of your readers who may not be in possession of a dictionary. The way he states his first objection is curious. He does so by quoting a truth well known to every tyro in algebra, viz., "Every quadratic must have, in one form or other, two roots." How the statement of a truth like this can form an objection to my solution he does not say. And then he proceeds to give a series of objections based upon the assumption that I never noticed what appeared to him *apparent*, forgetting or ignoring the fact that "apparent" is also a relative and vague expression; and he further objects to my solution on the score of its being "a very artificial one," and asks the question, "if completing the square on both sides in order to destroy them in the next line is not an 'impoliteness' to quadratics?" May I ask him if he can give any authority besides his own condemning the use of artifice in the solution of equations, and if it is not the usual and legitimate process to extract the square root after completing the square? So much for "A Medical Student's" criticism. I will only make one or two observations on the solution he has furnished. 1. It does not satisfy the conditions of an adfected quadratic by completing the square. 2. He has introduced, unnecessarily, two additional unknown quantities into the equation (an artifice, by the way, which he thinks others should not adopt), and which only succeeds in producing a cumbrous biquadratic expression, which is found by trial to contain the factor $(\beta - 3)$, and, moreover, his method of finding a factor is the most circuitous and bulky that has yet appeared in this journal, which, upon his own authority, is a great mistake in the science of mathematics.—J. LANE DAVIES.

[46850.]—**Electro-Magnet.**—If "Perplexed" will wind on each core five layers of No. 20 cotton-covered wire, it will make a first-class magnet. The resistance will suit a bichromate or Bunsen cell.—GEORGE TOLMAN.

[46862.]—**Telegraph.**—Wind twice the length of wire on the coils, than the line, if of the same gauge.—GEORGE TOLMAN.

[46865.]—**Cod-Liver Oil.**—When I was in Newfoundland five-and-twenty years ago I had symptoms of lung-disease, and was ordered to take cod-liver oil, to which I took a great disgust. I was, however, determined to overcome my reluctance to it, and went to see its preparation. I observed that the livers were allowed to get semi-putrid before the oil was extracted, so I procured some fresh cod-livers, and had them fried with mashed potatoes. I found them delicious, and really enjoyed my potato-cake fried in cod-liver oil taken from livers the day the fish was caught. In the winter I always had myself sponged with cod-liver oil all over after having my bath. As the oil was fresh and scented with essence of bergamot, it proved no inconvenience, and I found it was equally useful in this form as if taken internally.—GEREB ADMI.

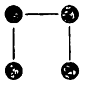
[46854.]—**Mechanical Action.**—I am sorry my first design was of no use. Will this do? Over each cell is a sort of bolt (A) sliding in guides (not shown) attached, like brackets, to sides of chest. The lower end is turned to a smaller diameter, and bent into a hook, to which the rod from zinc is attached. C is a rocking shaft, worked, as in former sketch, by means of a lever E, and wire W, from lid of chest. The lid, therefore, cannot move without rotating C, and in order to fix the lid, all we need do is to fix C. A piece of brass, D, has a hole of shape shown cut in it, and is fixed, like an arm, on C. The rod A passes freely through this hole, but the rod C (and, therefore, the lid), is locked, unless the narrow part of A is in the position shown, when the slot in D allows of the motion of C.—GLATTON.



[46867.]—**Bichromate Battery and Intensity Coil.**—You can have a coil to work with any number of cells. I cannot suggest a better cell than Bunsen's for lighting.—GEORGE TOLMAN.

[46871.]—**Platinising Silver.**—May I suggest to the querist whom "Nun. Dor." has replied to, another mode of rendering Smee's plates available without platinising, which I, some twenty years ago, "evolved from my inner consciousness," on finding that my plates were bare, and no platinum was to be got? It simply consisted in thoroughly cleaning the silvers, placing them on a surface of soft wood, and then piercing them well with holes with a fine needle. The rough burrs round the holes evolved the hydrogen at a tremendous rate, and the plates never wanted anything more doing to. Mere roughening is not of much use. I saw some pierced plates in an "air battery" at the present C. P. Exhibition, but I have seen none anywhere else, except mine.—B. H.

[46879.]—**Telephone Transmitter.**—At your request I send you description of transmitter. It is the arrangement of one of my assistants. Although simple, it more justly deserves being patented than any other I have ever tried. It consists of 3 pencils and 4 blocks. I have arranged it so that the compositor can set it up in lines and dots, thus—



The two free blocks are for connecting-wires. The pencils are ⅜in. square and 1¾in. long, cut from coarse-grained carbon, not lighting pencils, and are fixed on the centre of a horizontal sound-board of pine or spruce, ⅛in. thick, 8in. by 6in. It is the loudest and clearest of any, and never fails. The coil should be 1¼in. between flanges, 5-16 core. For primary wind 5 layers silk-covered wire, No. 24 gauge. Secondary, 10 layers, 35. Bell's receiver is all that can be desired. About 20 miles.—GEORGE TOLMAN.

[46892.]—**Japanning.**—This is quite unnecessary on copper vessels. Nothing can look better than the polished metal. In India copper vessels are often tinned to save trouble in cleaning. You can tin them yourself if you first clean them thoroughly. All you have to do is to heat them to the temperature at which tin melts, and rub them with powdered sal ammoniac, rosin, and melted tin. I have seen this done frequently by the Kalai Walla (tinman), in India.—GEREB ADMI.

[46899.]—**Heating Room for Turkish Bath.**—This can be done most economically with gas. Some sixteen or eighteen years ago I experimented a good deal on this matter, and was, I think, fairly successful. I took my idea of a hot-air bath from "Griffin's Hot-air Bath," No. 1281, illustrated on page 131, and found it efficient; this supplied me with hot air, but I had to devise another arrangement for ventilation, and for getting rid of the air charged with perspiration, and I made the whole apparatus myself out of the cheapest material. I shall be happy to write a paper on the subject.—GEREB ADMI.

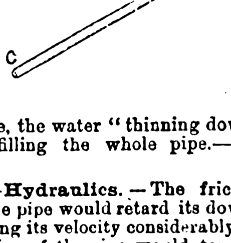
[46912.]—**Medical Coil.**—Wind on four layer No. 20 cotton-covered wire; six or eight layers No. 28 silk-covered for secondary. Fill the core with iron wires, and work the contact-breaker from the end. A brass tube placed on the outside of coil will regulate it to any nicety. If you cannot get a brass tube, copper will do, or get the tinman to make one in tin or zinc. A bichromate cell would work it, or two Leclanchés would work it for 20 minutes or half an hour.—GEORGE TOLMAN.

[46916.]—**Carpenter's Bench.**—You will find full instructions in a monthly periodical named *Amateur Work*, and if you have access to the back vols. of the ENGLISH MECHANIC you will, no doubt, after some searching, find what you want. At p. 271 of *The Forge and Lathe* there are full instructions, illustrated, for making a cabinet-maker's bench.—GEREB ADMI.

[46925.]—**Water in Gravel-Pit.**—I am truly obliged to "Glatton" and H. Barnaby, but I fear the difficulty will not easily be got rid of. No doubt I ought to have given more detailed information about this particular gravel-pit, which I will now try and do. At 9ft. deep I come to spring water, but on account of the slope of land and the use of a 6in. drain I can go 12ft. deep, and if I could only get rid of the water at a lower depth I could go 20ft. or 30ft. deep; hence my difficulty. I dug a well some two years since 18ft. deep, and I found the soil as follows:—2ft. of top soil inclined to be a little loamy or clayey; next 4ft. dirty round gravel, the next 12ft, a mixture of clean fine sand and gravel; the sand increased towards the 18ft., and I am inclined to think the lower I could go the more fine white sand I should find, as within half a mile of this spot the main sewer was put in about 100ft. deep, and it was all white fine sand—some call it silt, or running sand. I do not think there is a substratum of heavy clay, as H. Barnaby supposes, but am inclined to think the sand would lie so close that water cannot pass easily through it. I fear this subject will not be very interesting to the majority of readers, and may be taking up valuable space. If "Glatton," H. Barnaby, or any other kind friend would write to me, shall esteem it an act of great kindness.—H. BOOKER, Sidcup, Kent.

[46927.]—**Gas Bath.**—If paraffin would dissolve the lime I should think your plan of cleansing it would answer; but I would suggest you fill it from the bottom pipe the same as it now fills with water, afterwards I should well swill it out with water from the top pipe, and if the first operation does good service, I should repeat it several times. It is the only thing you can do to it besides having it taken to pieces and thoroughly done, which would be more expense and trouble than making a new boiler. These boilers are not a coil, but made up of sheet water-space layers so constructed that the heat from the burner acts on every inch of boiler surface. Geyser's instantaneous water-heaters would not heat the thirty gallons of water in the half-hour for the same consumption of gas. The establishment in question (which has died out) used to make some good and useful articles on principles which modern makers, though different in shape and design, strictly adhere to. Their forges were lit and worked by gas twenty years ago. People reinvent things and make them the subject of "patents."—JACOB MACLOSKIE.

[46930.]—**Hydraulics.**—In practice I think the pipe would be quite full, unless the diameter of the pipe is altogether out of proportion compared with the tank. But theoretically there would be an air-space or a partial vacuum near B, as shown in the figure, the water "thinning down" at first, but soon filling the whole pipe.—A MEDICAL STUDENT.



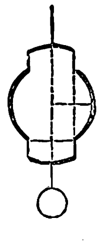
[46930.]—**Hydraulics.**—The friction of the water on the pipe would retard its downward progress, keeping its velocity considerably below what the inclination of the pipe would tend to make it, and tending, therefore, to keep it full. And if the head of water were large, the pressure at B being great the friction would be much increased, tending still more to keep the pipe full. But every increase in the size of the pipe increases the volume of the water much more than the friction, and tends to keep the pipe less than full. So that the question of whether the pipe would be full at the mouth depends on the pressure at B, the inclination and length and diameter of the pipe, and the value of the friction, and not only upon relative, but actual, sizes.—PAUGUL.

[46931.]—**Cuts and Bruises.**—Why do not some of the workmen join a centre of St. John's Ambulance? They would then learn the best methods, and be able, in case of need, to stop arterial as well as venous bleeding. "Ambulance Lectures," by Dr. Weatherly, price 1s., is a capital book, as is also one by the late Surgeon-Major Shepherd.—M. W. G.

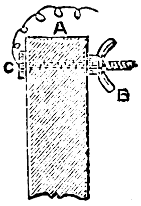
[46931.]—**Cuts and Bruises.**—I have no experience in the treatment of these with the glue, French polish, or black ink recommended by your correspondents; but I can speak very highly of tincture of arnica for bruises, and of calendula officinalis in cases where the skin is abraded or cut. They not only heal quickly, but take the "sting" out of the wound directly they are applied. A lotion is made of either of these by putting 30 drops of the tincture in a teacupful of cold water. A rag wetted with the lotion should be kept continuously applied to the part. These tinctures, with a little court-plaster, should be kept in every workshop.—DOCTOR.

[46931.]—**Cuts and Bruises.**—Some of your correspondents recommend glue and Friar's balsam; and so do I. Glue is handy, and of a healing nature. Friar's balsam is a most excellent thing, and one I am never without. In case of a cut from a chisel, wipe off the blood, apply the balsam, and bind up with brown plaster. I always find the latter better than the common yellow plaster. Being a joiner, I have seen some serious cuts now and again—some which have required the skill of the surgeon; but in ordinary cases, I have plastered up some hundreds of bleeding fingers. Some men shrink from these jobs. In extreme cases I have staunched blood with castor-oil. This is an excellent thing, and with two or three thicknesses of soft rag, will heal the place as well. I believe many a chemist is not aware of this.—FISHER SHAW.

[46942.]—**Resistance of Ring to Collapse.**—The maximum bending strains or moments when the ring and weight are suspended, will be at the top and bottom and at the two sides, and these will be all equal. This can be shown by the elementary rules of statics. The strains at the sides will be of an opposite description to those at top and bottom—the former tending to straighten the ring and the latter to make it curve more; hence there will be some point in each quadrant of the ring where there will be no bending strain. These points are called "points of contrary flexure." The position of the points is found by bisecting the radius on both sides of centre and drawing perpendiculars; it will be shown presently why this is so. At these points the only forces acting are the shearing strains caused by the direct action of the weight; we may, therefore, to make the calculations more easily understood, cut the ring at the four neutral points, and connect the pieces by very strong suspending links, as in the figure; the lowest piece may be taken as a beam supported at the ends and weighted in the middle—the bending moment of which is the well-known formula $Wl/4$. In this case l, or length of beam is = half the diameter of the ring—say, $d/2$, so that the bending moment is $Wd/8$. Again, the bending moment at the side of the ring is found thus: the crescent-shaped portion of the ring sustains a weight of $\frac{1}{2}$ W applied to its lower end; this multiplied by the ver. sine of the crescent, or $\frac{1}{4}\,d$, gives the bending moment at the side of the ring, or $Wd/8$. As this is the same as the bending moment at the top of the ring, it shows that we have found the points of contrary flexure correctly. All we have to do now is to find the "moment of resistance" for the particular section that the ring happens to be. Suppose the section to be square, as this is the simplest form, and let its side $= x$, which we have to find. The moment of resistance for a square is $Cx^3/6$. This is to be equated to the bending moment, or $Wd/8$. The Constant C may be taken at 5 tons for a safe load. W is 13 tons, and d, 8in., so we have $5x^3/6 = 13 \times 8/8$, from which x will be found to be about 2½in. The diameter of the ring is supposed so be measured from centre to centre of the square iron.—M.I.C.E.



[46944.]—**Battery.**—This query was addressed to Mr. Lancaster, but I hope I shall not be intruding to answer it. The best way would be to electrotype a copper head on the carbons. The batteries sold have a lead cap cast on, as you supposed. I beg to suggest a little plan I have tried with success. It consists of a brass rod with a head C. The rod is screwed. It passes through a hole bored in the carbon, and is clamped tight by means of the butterfly nut, B. The connecting wire may be soldered, as shown, or twisted round the rod before screwing up the nut. A is a section of carbon. To prevent corrosion of the connections, paint them over with melted paraffin-wax.—BEETLE CRUSHERS.



[46945.]—**Leclanche Battery.**—Take the cells to pieces, and well wash the broken carbon. Ordinary sal-ammoniac, clean water, and not the slightest trace of grease.—GEORGE TOLMAN.

[46945.]—**Leclanche Battery.**—You had better have new porous pots, as no doubt they have become choked with crystals, as also the carbons. You might be able to clear them by boiling them in water for several hours, but this you could only partially do, as insoluble matter has (after all that time) penetrated them as well as soluble. Pure sal-ammoniac should be used.—BEETLE CRUSHERS.

[46949.]—**Sodium Salts.**—I should say, in all probability, there is hydric sodium tartrate. Both the precipitates produced by KHO and NaHO would be soluble in an excess.—J. C. BELCHER.

[46949.]—**Sodium Salts.**—You mean bitartrate of soda, a salt very useful in analysis for the detection of potash. Caustic soda may be used in most cases as a substitute for caustic potash, the reactions being identical. I allow the students in my laboratory to use either, it being a matter of which comes first to hand.—EXPERIMENTER.

[46949.]—**Sodium Salts.**—There is such a salt as the one you mention. The formula you write is quite correct. Caustic soda, or sodic hydrate, will precipitate, when added to a zinc salt, the white zinc hydrate. Caustic potash or potassic hydrate produces the same precipitate. This precipitate is soluble in excess of the reagents also in ammonic hydrate or ammonic chloride. Re-precipitated almost entirely on diluting with water, or on boiling.—THOS. RICHARDSON.

[46952.]—**Reaction.**—Both salts named being "commercial," contain impurities in the shape of alumina, silica, iron, magnesia, and possibly lime. Those present in the salt (NaCl) would be precipitated by the carb. of potash, while those present in the latter would fall immediately on making a solution.—EXPERIMENTER.

[46952.]—**Reaction.**—If your NaCl and $COKO_2$ were pure, and if these were really the salts you used, I think no precipitate should have been given. Possibly your NaCl contained magnesic chloride, in which case you would obtain a precipitate of carbonate of magnesium, leaving KCl, &c., in solution.—THOS. RICHARDSON.

[46952.]—**Reaction.**—The precipitate was no doubt caused by some impurity in the salts: in order to find out of what the precipitate consists, it would be best to analyse it if the querist possesses the necessary things. The following reaction would take place:—$K_2CO_3 + 2NaCl = Na_2CO_3 + 2KCl$.—J. C. BELCHER.

[46953.]—**Pearlashes.**—The ordinary method of assay with bichloride of platinum, if done with care, will give very accurate results, and may be relied upon to give results varying no more than ¼ per cent or less.—EXPERIMENTER.

[46953.]—**Pearlashes—Estimation of the Potassium Carbonate.**—The main thing is to possess a correct standard solution of H_2SO_4 (1cc. = 040) standardised by precipitation with $BaCl_2$. The analysis is performed as follows:—10grm. of the sample are dissolved to 500cc. with distilled water, agitated, and filtered if necessary. Measure off 50cc. (corresponding to 1grm. of the sample) transfer to a beaker, add a little neutral tincture of litmus, and add from a graduated burette the standard H_2SO_4 until the liquid has a reddish tinge; if now the solution be boiled, the blue colour will be restored owing to the CO_2 being driven off; add a little more standard acid till the liquid is violet, and again boil; repeat this until the solution is neutral, and boiling no longer renders it alkaline, taking care not to make the solution acid towards the end of the operation, if you do not happen to have a standard solution of sodium hydrate at hand to work it back with. Each cc. of the standard H_2SO_4 = ·069 grm. of K_2CO_3. With care this ought not to differ more than ·5 per cent. on the same sample.—J. C. BELCHER.

[46954.]—**Dividing Apparatus.**—To F. W. MACKENZIE.—Referring to p. 277, Vol. XII., ENGLISH MECHANIC, I see that a Mr. Joyce is mentioned whom I have forgotten long ago. I overlooked this query at first, and have been very busy since. If you merely want to drill a division-plate for ordinary lathe use, the plan I mentioned would be found near enough, and a great deal more accurate in its results than a good many by the "best makers" are. But, again, if you want to make a "dividing apparatus," it is worth doing well if at all, and for this purpose the edge of the dividing-wheel itself must be made of two flat rings, bolted together so as to be able to alter their relative positions, and by comparing together different groups of their teeth, in order to ascertain the truth of every part of the circumference. I have a strong idea that I described this method of making a dividing-wheel many years ago, but at the present moment I cannot refer to my private index of these matters in the ENGLISH MECHANIC, that for me have more particular interest, as I have lent the book containing it to a correspondent of the paper who has hitherto proved as deaf as I am physically to my prayers for a return of the same. As to size of a tangent screw, within moderate limits, one might say, the greater the diameter the better; not less than three times the acting thickness of the wheel into which it works. Then a wheel (that is to say, a "cut" wheel, finished by means of a screw-hob), of which the thickness is ⅝in., should have a screw nearly or quite 2in. diameter; otherwise it is almost, or, say quite, impossible to get the wheel-teeth what they ought to be in a good job. Remember, the less you leave for the finishing-hob to do, the better for your peace of mind.—J. K. P.

[46955.] — **Elementary Optics.** — Spherical abberration results from the surfaces of a lens being spherical, thus bringing the outer rays to a focus nearer the lens than the more central rays. This is clearly a result of the outer zones of the lens being too much curved, so we have to flatten them, the amount of the flattening depending upon whether the rays are parallel, divergent, or convergent, and so on. This is a simple case, obtaining freedom from spherical aberration (aplanatism) in a single lens, but I believe it answers the query, how is it done? The conditions of aplanatism in objectives, microscopic and telescopic (which are aplanatic as well as achromatic) is necessarily more complex, and could hardly be usefully stated in the "Reply" column.—PAUGUL.

[46957.]—**Battery.**—Make the following solution: 100 parts of water (by weight), 10 parts of cyanide of potassium, 1 part of cyanide of silver. Place the solution in a jar, across the rim of which then lay two metal rods. From one rod suspend in the solution by a metal wire the articles to be plated, and from the other by a silver wire, a piece of silver. Connect the rod with the poles of the battery, and leave until the plating is sufficiently thick. For gold plating or gilding, 1 part of dry chloride of gold, 2 parts of cyanide of potassium, 100 of water. The articles to be plated should be thoroughly cleansed from grease, &c. The expense of gold-plating is such that I do not think it would repay "Amateur." Electro-plating is explained in a book called "Magnetism and Electricity," by Fred. Guthrie. Collins' advanced series.—W. F. K.

[46961.]—**Battery.**—To MR. TOLMAN.—Have you soaked only one end of the carbon plates? The wax will scrape off clean with a file. You must have two carbon plates in each cell.—GEORGE TOLMAN.

[46961.]—**Battery.**—It is the paraffin-wax that has prevented the action of the battery. Stand the plates on the kitchen-stove till the wax has all melted off. Another time do not dip the plates in the wax, but paint it on the parts required with a brush.—BEETLE CRUSHERS.

[46967.]—**Coin Brooches.**—To "ALFOJOE."—I beg to dissent from your assertion, my friend "Revel," that binding wires are out of the question in soldering coin-jewellery. If the wire you use is of a consistent size (it may be got as fine as silk if you need it), you may solder any sized coin and ring. I never have any difficulty, but I own it was not so in "the long ago." Experience has taught me little expedients in the work. I give you a couple of figures to illustrate my mode of binding and holding the rings, &c., in position, while soldering them together. There are other ways, but I give these as the most simple way I know. Fig. 1 shows the ring bound in position upon the coin, and held in a pair of pliers B, Fig. 1. The solder in very small pieces is placed on each side of the ring at A; borax having previously been applied and the moisture expelled by a low heat. The wire should be so arranged as not to touch the coin just where the ring is to be attached, and should only touch the ring sufficiently to hold it in position. Another way, as in Fig. 2, is to lay the coin upon a flat piece of charcoal or pumicestone, and bind it across with a piece of wire to prevent slipping, as at B. In this figure you will observe that the ring is held by a wire, which in its turn is held by the thumb or finger, the coin being securely bound, as before mentioned. Whichever plan is adopted, the after-part of the work is the same. Bring the heat gently up with the blowpipe, taking care to keep the solder over or near where you wish it to run. Do not play the flame upon the ring, but just away from it; blow steadily and without force. It will be a little help to you if both the coin-edge and the edge of the ring are squared off with the file. The ring is then more likely to keep an upright position during the process of soldering. The smallest coin ever made can, I am sure, be manipulated in this way.—Alfojoe.

FIG. 1

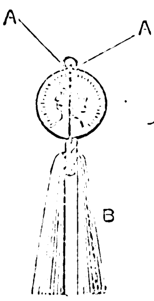
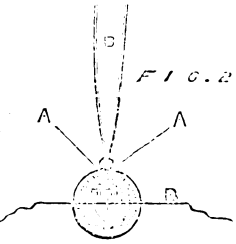


FIG. 2



[46973.]—**Musical Shorthand.**—The book you inquire about, entitled "Musical Shorthand for the Representation of Harmony as well as Melody," was written by J. Walis, and published in Ryde during the year 1875. I am unable to give publisher's name.—Fred. T. Gissing, Shorthand Writer, Lincoln.

[46976.]—**Canary.**—Your canary does not suffer from asthma. Birds so diseased hardly ever sing, and when they do it is with difficulty. The heat of the gas stifles the bird, especially if it is hung close to the ceiling, the heat being greater overhead. Remove the bird into another room where there is no gas, or place a piece of thin muslin over the cage at night.—A Breeder.

[46977.]—**Folding-Canoe.**—A folding-canoe is a very troublesome thing to make, and not entirely satisfactory when made. The best form is that which consists of curved longitudinal ribs or ribbons, hinged at the stem and stern so as to fold down flat upon the central frame of kelson, stemson, and sternpost, something like the hood of a phaeton. But if "G. J. H." tries to construct his canoe on fairly fine lines, he will find the attachments of the curved ribs very difficult, and the connection of the solid floor or battens nearly as much so. By carefully studying one of the Rev. Mr. Berthon's folding-boats, which, however, are always made with bluff bows and round sterns, he may succeed in making a more or less shapely canoe. A simpler plan is to get two thin, straight-grained white deal boards, 9ft. long, 9in. wide, and ¼in. thick, strengthening the inner edges of these by nailing a strip of ash or beech ⅝in. square, and hinging them together at the ends, so that they will lie parallel and flat, and yet can be sprung open to a width of 2 or 2½ft. in the middle. The hinges at the ends may be fastened to an upright piece 9in. long, 3in. wide, and 1·5in. thick at the inside edge, tapering to nothing outside, but slightly rounded. Or one of each of these uprights may be nailed to one end of each of the sides, a ¼in. deep, 8in. wide, rabbet being made to receive it, two ½in. 3-holed brass hinges being used to fasten the other ends of the sides to these upright pieces, which will act as stem and stern-post. The bottom may be made of thin white deal, ⅛in. thick, strengthened by cross pieces ½in. wide and 1in. deep. These cross-beams should be 6in. apart amidships, or even less, gradually becoming wider apart, until at the ends they may be 1ft. or more from each other. The bottom must be cut to such a curved shape as will fit between the sides when opened out, and should be 25in. or 26in. in the widest part, which should be at about three-fifths of the length from the head of the proposed canoe. The cross-beams should project ⅝in. beyond the edge of the bottom, and should be notched out so as to rest upon the upper edge of the lower strengthening fillet. Four feet of the bottom should be covered with strips of ¼in. thick deal, 2in. wide, with inch spaces between them, to form a floor for the canoeist to sit on. About 1ft. of this floor should be behind (abaft) the centre of gravity of the canoe, and the rest before it. To keep open the upper part of the canoe, two cross pieces must be fitted, which may be about ⅝in. thick, 2½in. wide, and at their ends pieces of sheet iron or brass must be screwed, and bent down at right angles so as to clip the outside of the top edge, and means must be provided to prevent these cross pieces from slipping out of their places. The aftermost of these cross-pieces will support the canoeist's back-board, the other the stretcher for his feet, the lower edge of which may be hinged to the forward end of the floor. Finally, a covering of elastic tarpaulin, or, better still, of that strong india-rubber cloth used for waggon tilts, must be put over all. This may be nailed to the woodwork with flat-headed wire tacks, or made loose, and just drawn over the frame, and made so that it can be laced across the top of about 2ft. of the fore and after part of the canoe. Such a craft would require a light double paddle, about 7ft. long, with blade 6in. or 7in. wide. Indian shape is the handiest. It is convenient to have the paddle in two pieces, jointed like a fishing-rod, by a bit of stout brass tube. A 6ft. bamboo mast could easily be added, passing through a hole in the forward cross piece to a step on the floor, and a sail made of one breadth of 48in. or 50in. linen or cotton, bleached or unbleached, the fore leach 3ft., the after leach 5ft., bent to a light bamboo yard; but the canoe would only sail before the wind. The weight of this craft would be about 30lb. She would carry about 60lb. for each inch of immersion—that is, about 3in. with a sitter of 10st.—Robinson Crusoe.

[46978.]—**Canaries.**—You either give them improper food, or your cages are placed in an unhealthy spot. Examine the nests and see whether the young birds were troubled with vermin. I have lost many from that cause.—A Breeder.

[46983.]—**Concrete Bed for Engine.**—For making the concrete use one of Portland cement, four of gravel, and two of sand; the gravel and sand must be perfectly free from loam if you want good concrete. You cannot have anything better for engine bed; and where you have a good surface a loamy sand will answer very well. Mind and get the bottom on solid ground.—F. R.

[46984.]—**Hardening Copper.**—I suppose you mean sheet-copper. It can only be hardened by hammering it—a feat not to be performed by a novice. It requires a skilful hand to do it.—Jacob Magloskie.

[46985.]—**Gilding the Edges of Mounts.**—Have tried the gilt paper, but never made a decent job, and now use for the purpose the ordinary "liquid gold" (fine gold-dust in ether), sold by the water-colour makers, and can make them look well. Can be laid on either with a fine brush or a pen, just according to width required. You can have it either dull or bright, just as you fancy.—Experimenter.

[46987.]—**Tinning or Bronzing Small Malleable Castings.**—To tin, lay the articles in a weak solution of oil of vitriol and water to cleanse off all dirt; then rub them over with spirits of salts and dip them in molten solder; wipe clean while hot. For the others use copper bronze paints.—Jacob Magloskie.

[46987.]—**Tinning or Bronzing Small Malleable Castings.**—10 parts diamond fuchsin and 5 parts Hofman's methyl violet, are dissolved in water or sand-bath in 100 parts alcohol of 95 p.c., then add 5 parts benzoic acid, and boil from five to ten minutes, until the whole has acquired a brilliant bronze colour. This varnish adheres firmly to all articles, possesses a beautiful gloss, and is very durable.—B. P. Bismarc.

[46988.]—**Straightening Shaft.**—Certainly this can be done, by means similar to those used upon railway and tramway rails, &c. Have you not observed men at this? A strong frame, shaped like the letter Y, has a powerful screw in the middle; the ends are claw-shaped, and grasp the rail or shaft, and the screw is brought to bear upon a chalk-mark indicating the hump. Experience teaches the amount of bend in the opposite direction necessary to straighten the shaft.—J. J. A., Liverpool.

[46990.]—**Ships' Compasses.**—Ships' compass needles are generally magnetised by rubbing with a permanent magnet; but the easiest way is to use, if at hand, a coil and a battery, looking out to put the needle in through the coil the right way, by first magnetising a needle, and trying its polarity. Of course, anybody who has studied the subject would know the polarity of the coil at once by the direction of the current.—Torpedo.

[46990.]—**Ships' Compasses.**—The best way is to place the piece of metal in a coil through which an electric current is made to pass; but you would probably find it quite sufficient to rub it with an existing magnet, rubbing the end you wish to be the north or blue end with the south end of your magnet, and always taking the magnet up from the centre of your intended magnet. If your compass needles are, as they should be, of about the size of knitting-needles, the above method will do well.—Paugul.

[46991]—**Wages.**—It seems to me most unlikely that you have set out the whole of the facts, and in your case there may be some special circumstance which would affect the advice to be given you; but I may state, as an abstract point of law, that wages, whether payable weekly or otherwise, like any ordinary debt, may be recovered at any time before the claim is barred by the statute of limitations.—Schyremote.

[46994.]—**Brass Door-plates.**—The composition was merely sealing-wax run on the plates when they were hot, and then scraped off with a scraper.—Beetle Crushers.

[46995.]—**Sutton's Storage Battery.**—The answers depend upon the conditions, which are not stated. If the electromotive force of the dynamo exceeds that of the secondary sufficiently to be able to send a fair current into it, the cells should be charged all at once in series. If this is not the case, a simple commutator should be used, which will reduce the series enough to allow the current to pass, and to place them also in multiple arc so as to divide the current among them. There is no danger in handling, but there might be a slight shock, which indiarubber gloves would prevent.—Sigma.

[46997.]—**Piano Warranty.**—Without knowing the exact words used in the warranty given, it is impossible for me to say what would be its legal effect. But as the piano seems to have been in use for three years, the broad question would probably be whether the strings have broken by reason of any defect in the manufacture or through wear and tear. If from any defect, the makers would most likely be liable upon their warranty to repair them; but not so in any other event.—Fred. Wetherfield, Solicitor, 2, Gresham-buildings, Guildhall.

[46997.]—**Piano Warranty.**—To Mr. F. Wetherfield or Mr. W. H. Davies.—The "warranty" of a piano is simply a responsible declaration that it is well and substantially put together, and is of good and properly-seasoned material. Such a fault, for example, as a continued liability to broken strings would, if it could be traced to a faulty scale, prove that it was not well made, and would render the guarantor liable either to make good the defect, or to exchange it for a new piano. But if it could be shown that the number of broken strings was not greater than might reasonably have been expected, from the amount of work it had received, or that it was caused by rusty wires, the maker could not be held responsible, since he could not be expected to exercise control over the piano after it had left his hands. Though, in the latter case, I think few makers would claim total exemption (unless they were threatened with legal proceedings), but would, for their own credit sake, willingly bear a portion of the expenses of repair. In the instance referred to by Mr Jones, the rusting of the strings was evidently caused by the cloth that underlies the strings having become damp. I have often known this to be the case, and believe it to be the effect of acetates used in dyeing the material, and, on this account, use none but self-coloured woollens for the purpose. This is, however, rather a delicate point of law, on which I would rather not give an opinion. The phrase "loose touch" is rather vague, and may mean either that the touch requires less pressure, or that the keys have begun to rattle. If the former is meant, it is not usually considered a disadvantage; but it may easily be rectified by adding to the balance-lead at the end of the keys. If the keys rattle on their pins, it can only have been caused by constant wear, and would be quite outside the conditions attached to the warranty.—W. H. Davies.

[46999.]—**Piano Repairs.**—To put a new string on an upright piano, it will, first, be necessary to remove the action, which is kept in its position by steady-pins and buttons. After turning the buttons, the action should be pulled forward at the top, and then lifted out of the dowel-holes at the bottom. If the damper-rail is attached to the action, it must, of course, be removed with it; but if otherwise, it will make the action lighter to handle if it be first removed. The bottom door may be taken out like the top door. The wrest-pins belonging to the broken strings may then be taken out by unscrewing them with the tuning hammer. One end of the new wire should then be pushed just through the pin-hole, and about a couple of turns given to it from left to right, when the wrest-pin can be hammered into its place, and the wire passed round the hitch-pin, or pins, at the bottom, and cut off about 2in. above the pin it is intended for, and treated as before. The wire may now be guided between the bridge-pins; but before tightening it will be necessary to see that the wrest-pins are knocked into their proper level, and that the wire is at the bottom of the hitch-pins. I should strongly advise a renewal of the cloth that seems to have caused the injury; the strings may then be cleaned from rust with a little fine emery-cloth, and slightly oiled to prevent a recurrence. In replacing the action, it must first be allowed to drop into the dowel-holes, and then slightly pressed forward at the top until it is felt to slip into its place. The operation is perfectly simple, and in no case should force be exercised, for if this is necessary there must be something wrong. The best motto to be observed in all such cases is to take your time, and not to get in a flurry if things do not seem to go right just at first.—W. H. Davies.

[47003.]—**Storage Battery.**—What kind of gain is proposed in using a storage battery (which is sure to waste a large part of the energy put into it, and would require constant attention) to do work which a simple battery will do? Of course it might be used if there were means of occasionally charging it from a cheap source, such as a dynamo; but to charge by a battery in order to do no work but what a battery would do better, is mere waste. A storage battery so charged is useful only when we want to accumulate the prolonged work of a small battery so as to apply it, and get the results for a short time of a powerful battery.—Sigma.

[47006.]—**Collodion Balloons.**—The usual method is to take a glass-flask the size of the required balloon, and pour sufficient collodion in to form a coating all over, and then to pour the surplus out. Then, while wet, take a quill and move it round inside the neck, so that the collodion then sticks to it on all sides. Then suck the air out through the quill, which will make the balloon collapse, so that it can be drawn out through the neck. —W. H. L. H.

[47006.]—**Collodion Balloons.**.—Clean a flask of 4 to 6in. dia. well, and pour into it collodion, that from the least highly nitrogenised gun-cotton being the best. Now turn the flask round so as to coat the whole inside of the flask; invert it, and pour the superfluous collodion out. Let the film dry. Now twist the edge of the film on a quill let down into the neck of the flask, and draw the balloon out; but be careful to arrange matters so that the air can freely escape as the balloon leaves the flask.—R. Kanthack.

[47008.]—**Ferrous Oxalate Developer.**—I find those negatives, developed with the above, intensify with mercury better than those developed with Pyro, as I could never get the latter quite white. —W. E. K.

[47008.]—**Ferrous Oxalate Developer.**—There are only two methods that I know of for intensifying a plate developed by the ferrous oxalate developer—one before varnishing, and the other after. (1) Having developed the plate, wash it and expose to sunlight until the unaltered silver salts take a brownish colour, then proceed as usual. (2) If, after varnishing, iodine be added to some more varnish till it becomes of a light port-wine colour, and the plate is revarnished with this, the plate will be found to be intensified. I learnt these methods from Capt. Abney's book on "Instruction in Photography."—F. H. H.

[47010.]—**Magneto-Electro Machine.**—(1) Take a coil of wire through which the current passes, and move it along the horseshoe, always in one direction from end to end. The resistance of 60 cells would be very great, as they are so small. I should join up half in multiple arc, or even more. (2) You could use the machine-magnet to magnetise the steel one. (3) Coils to be wound so that if horseshoe were straightened out, the wire would always be wound in the same direction.—W. H. L. H.

[47014.]—**Steam-Power.**—You will probably not be interfered with by any official for using a steam-engine. But I can speak from experience as to the way in which the water company will mulct you. I find that the best way to be comfortable all round is to have a gas-engine.—O. P. Q.

[47015.]—**Portable Greenhouse.**—I would not advise "Glatton" to botch up his greenhouse in the manner he mentions, as it would be a very unsightly object. Widen the grooves for the glass, so that the panes overlap in the usual manner to allow the rain to run off; and, if necessary, get another pane or two of glass, and fill up the grooves with putty.—Os.

[47015.]—**Portable Greenhouse—Glass Not Meeting.**—If "Glatton" has never seen a greenhouse glazed entirely, without the glass in the roof touching at all, he cannot do better than try the same plan in his own where needed. The annexed letter H laid down will explain it, ⌶. This, we will say, represents a section of the old-fashioned window lead; if, therefore, "Glatton" places a piece between the two squares he alludes to, so that the edges will be towards the centre bar, and press or rub the edges of the lead on to the glass, he will find it will answer his purpose well, and keep all drip out. "Glatton" can either slide the lead upwards on to the two panes at once, or place it on to the first pane, and then slip the other into it. I do not know upon what principle his greenhouse is constructed, but I should not be surprised if "Glatton" did not do more than the two panes he refers to, the plan or system being so very good, and well worth a trial. Do not be persuaded to use cement on any account, the rather get a large pane of glass, and overlap it ½ to ⅝ of an inch, if you dispense with the lead.—Horticulture.

[47018.]—**Marine Screw-Propeller.**—I am of opinion that the advantage of your plan would be negative; that the speed of boat would be decreased. The stream of water from the first propeller would impinge on the second one, which would do little more than act as a drag, as it could not lay hold of such agitated water. The only way, I think, in which you could gain by such an arrangement would be by having the after-propeller fixed to a shaft running through that belonging to the forward one; the propellers to revolve in different directions, the after one the fastest, and, of course, to be of right and left-handed pitch respectively. If you use two propellers, as you suggest in query, let the after-one have a quicker pitch than the forward screw. Can you not enlarge your present propeller? An apron over the stern would lift the water so as to cover propeller within moderate limits.—Glatton.

[47020.]—**Mus. Bac. Degree.**—Residence at Oxford or Cambridge is required for any degree of either university. There is a B. Mus. of London, but this examination, as all London examinations are, is far "stiffer" than that of any other university. Besides, you are required to pass the London Matriculation at least a year before you go in for the intermediate B. Mus., so that it will take you about 2½ years before you get your degree. Write to the Registrar of the University of London, Burlington-gardens, London, W.C., for the prospectus of the Intermediate B. Mus.; or get a Calendar of the University of London.—A Medical Student.

[47021.]—**Telescopes.**—The querist, as far as I can judge, must have obtained his information about the above at the Crystal Palace, from someone who has not tried them, as, when I had that pleasure they were not even achromatic except for a very small space in the centre. I could see as well again with 12s. tel. of Negretti and Zambra. The o.g. is about 1½in. in diam.—W. E. K.

[47022.]—**Shafting.**—Are you sure that the noise is in the bearing? I have known a belt to rub against an iron bar and produce a great noise like a big fiddle-bow: this was attributed by the "engineer" (!) to any cause but the right one, until I noticed this bar, which he had fixed up to keep the belt from slipping off the pulley. Possibly you may find something foreign to the shaft rubbing against it. Have you taken bearing apart and examined brasses for bright spots? If not, do so, and scrape them down. I have heard of plumbago being applied with advantage as a lubricant in a somewhat similar case to yours. If you find out the cause of the noise, I hope you will let us know.—Glatton.

[47024.]—**Secondary Batteries.**—To "Sigma." —I am afraid the querist would find that the game would not be worth the candle-power of the lamp. A good many Sutton cells would be needed to work the lamp, though they need not be large ones. I do not like to give random answers to questions which may induce my readers to expend time and money with unsatisfactory results, and to give a trustworthy answer would require a good deal more thought than I can devote to a matter which on the face of it would be an unprofitable affair. It must be remembered that the secondary battery gives us nothing; on the other hand it charges a commission of some 40 per cent. for receiving and returning the power we put into its custody. Therefore, if we want to charge a storage battery from a voltaic battery, the question at once arises, Why not use the battery itself? The only convenience would be that we might use only just so many cells as would overcome the force of one secondary cell, and then, by a commutator such as Planté uses, charge a number of secondary cells in multiple arc by a slow current, and use them in series as required. For such a purpose I should employ four large Smee cells of the odds and ends description, mounted in series permanently, and so that they could be used in actual work along with the secondary. But it would be a costly mode of getting light.—Sigma.

[47026.]—**Melting Brass Dust**.—I doubt your "large" fireplace will have too large a flue for your purpose. It will take too much fuel to maintain a proper draught. A friend of mine tells me he once made a very successful brass-melting furnace by building a grate with firebrick, and continuing the flue up to a considerable height with 6in. drain-tiles.—Glatton.

[47027.]—**Electric Current.**—Nearly all the tubes of force which run from one pole to the other of the permanent magnet are concentrated in the substance of the iron ring, one half traversing the upper and the other the lower half ring. Each convolution of the coil, in ascending from its lowest position to its highest, cuts each of these tubes once, and all in the same direction, namely, from below to above. In descending, the same tubes are cut, each once, in the opposite direction, namely, from above to below. So we see that the soft iron ring is chiefly used for the concentration of the tubes of force. In current off commutator only the two coils at the neutral points yield. There is, at present, no better ring armature than the Gramme, nor any other form, that I am aware of, that would not give alternating currents.—A Medical Student.

[47030.]—**Watch Repairing.**—To "Alfojoe." —In reply to "Country," I fancy, from your description of the state of your watch, that you have "topped" the wheel too much—*i.e.*, you have shortened the teeth so much that they pass the verge-pallets. To remedy this defect, your whole efforts must be directed to setting the wheel forward. This will have to be done by filing away a portion of the potence-slip, also the counter-potence, which is the name given to the square-shaped stud with a horizontally-pierced hole in, near to the under edge of the top plate, and which carries the "follower." Take off a little from each, filing perfectly square, and then try the escapement. If found short still, take a trifle more off each as before. You will, of course, have to take the watch to pieces to do this; and the collet and hairspring should be removed, which is easily done with a penknife. Before doing this, mark the position of the end of the hairspring, so that it may be replaced in its former position. To try the escapement, set the wheel in its place, together with the verge, and, with a pointed peg, press forward the wheel as the balance is being moved backward and forward as it ordinarily goes. There should be the same amount of "drop" and "draw" to each pallet. At this point I must pay "Fellow-Workman" the compliment to refer you to some drawings of the verge escapement, in one of his articles upon watch repairing, published about three weeks ago. You will there see exactly how the escapement should be set to work correctly, as he gives an accurate description of the "drop and draw" of the 'scape wheel teeth upon the verge pallets. The little slit which carries the wheel-end pivot is movable. If there is too much drop upon the bottom pallet, force the slip a very little way through. To do this accurately, score a fine line across the face of the potence and slip; by that means the minutest alteration is observable. If too much drop is found at the top pallet, then the slip must be moved the reverse way. Observe, after these alterations, that the 'scape-wheel is not bound in the holes. It must be perfectly free. Small steel broaches are used to free out the holes. The watch is set "on beat" after being put together. To effect this, place your thumb, while holding the movement in the left hand, upon the contrate wheel, and, noticing the position of a certain bar of the balance, or the banking-pin, and making a small dot with a needle or drill point where it rests, press the contrate wheel forward in the way the watch goes; this will send the balance to one side. Now notice exactly the distance the pin or bar moves, and make another dot; then press the contrate-wheel on again, to send the balance on the other way. Mark the distance it runs till the fall comes; make another dot, and notice if the first-made dot is exactly central. It must be so for the watch to be "on beat." Presuming the drop is right, and the wheel free and beat correct, the escapement may then be considered perfect. If it is really your intention to try to put new verges to the other watches, you will find almost insurmountable difficulties, unless you have had some experience at turning. It is only after several years of practice in various simple ways that the necessary light-handed skill is acquired. If you are not gifted with the bumps of patience and perseverance, I should advise you not to attempt it. You can get a verge turned, and properly freed and 'scaped, for about 3s., providing you do the other part of the work. You will find advertisements of workmen to whom you could send the job if you refer to the "Sixpenny Sale Column." All you would have to send would be the "top-plate," with regulator cover screwed on; balance-wheel, with hairspring collet on; balance-cock, 'scape-wheel, potence, and follower. If, after this, you still wish to try your hand, I will do what I can to put you in the way. I may add, however, that the subject has been ably treated by other correspondents not so very long ago.—Alfojoe.

[47032.]—**Stonehenge and Sun Worship.**—The following is extracted from Mr. Geo. C. Yates's paper, as reported in the Proceedings of the Manchester Scientific Students' Association:—"Directly in the entrance line to the circles at Stonehenge stands erect an unwrought monolith, 16ft. in height, popularly called the 'Friar's Heel.' A person standing on the so-called altar-stone at the summer solstice will see the sun rise immediately over the 'Friar's Heel,' the top of which stone exactly coincides with the line of the horizon."—Diamond.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last, "Meteor" has replied to 46346, 46623.

46427. Electric Engine, p. 69.
46430. Colours on Fabrics, 69.
46447. Gauges for Lead Pipes, 69.
46451. Spring Blinds, 69.
56455. Educational Prize Trust, 69.
46466. Staining, 70.
45470. Diagrams of Oscillating Engines as on London River, 70.
46471. Great Eastern and Great Northern Joint Line, 70.
46474. Chime Clock, 70.
46476. Dull Window Glass, 70.
46477. G.W. Engines, 70.
46478. L. and N.W. Engines, 70.
46479. Steam Carriages, 70.
46483. Diamond Work, 70.

46652. To "Clerkenwell Clockmaker," p. 161.
46653. Finishing Flax, Twine, and Cord, 161.
46694. Brick-kiln with Down Draught, 162.
46695. Spark Condenser, 162.

QUERIES.

[47035.]—**Safety-valve for Kitchen Boiler.**—Which is the best safety-valve for the boiler of a kitchen range, both for an open and for a close boiler?—PLUMBER.

[47036.]—**Photographing Public Buildings.**—To MR. WETHERFIELD.—Allow me to call the attention of amateur photographers to a fact not, I think, generally known—viz., that no public building can be photographed without the permission of the Board of Works, as I learnt to my cost when, after having taken a long walk in the early morning for the purpose of photographing the sculpture at the base of the Albert Memorial, I was prevented from doing so by one of the keepers on the ground that I had no order. I should be glad if Mr. Wetherfield could inform us how far the Board of Works have power to make such arbitrary rules without giving notice of the same among their other by-laws on their notice-boards? Also, whether it is necessary to obtain an order to draw or sketch public buildings?—J. P.

[47037.]—**Watchmakers and Jewellers**—Is there any Directory published of these trades, similar to those published by Kelly of the builders, engineers, stationers, and other trades?—W. B.

[47038.]—**Mustel Organs.**—Can any of your numerous readers describe the double expression in the harmoniums of Victor Mustel. In Vol. XXIV. of the "E. M."? I find a description of it as patented by W. E. Evans; but this is a different arrangement of it. I believe in Mustel's instruments there are two small reservoirs in addition to the large reservoir—one for the treble, and one for the bass.—J. H. K.

[47039.]—**Clock Query.**—I have an American clock which strikes so fast that it is almost impossible to count it. Can any of our readers kindly inform me what is the cause of this, and the best method to remedy it? and oblige—CHICK.

[47040.]—**Filmography.**—To MR. PUMPHREY.—I have been anxiously hoping that Mr. Pumphrey would give us some account of his latest departure in filmography. I have a camera lens, &c., for work with ordinary double dry plate slides, and although were I buying a new one, I should have little hesitation in adopting the filmograph, I have not yet seen any method which seemed to me feasible of adding the use of the films to what I already possess. Now, however, Mr. Pumphrey advertises in your "Sale Column" a filmographic dark slide to be applied to ordinary cameras, and if he would give us some description of it, it would, I am sure, be of interest to many of our readers as well as—AMATEUR.

[47041.]—**Rain-spots on Green Velvet.**—How can I remove rain-spots from green velvet?—DELTA.

[47042.]—**Fixing Alarum to American Clock.**—I have a small American clock, by Seth Thomas, maker, and I want to fix an alarum to it. The face of the clock has a hole (perhaps 2in. diam.) in the centre.—MINING AGENT.

[47043.]—**Camera.**—I have an objective, 3 c.m., of Jamin, at Paris (portrait et paysage). Will any kind reader give full particulars of size, &c., to make a camera for it?—A DUTCH SUBSCRIBER.

[47044.]—**Gramme Engine.**—One of my friends intends to make a model Gramme engine. He will follow Ganot's "Physics," who gives core 180 mètre, 32 bobbins, 4·4in. each, diam. wire core 9-10mm., diam. wire bobbins 11-10mm. He wants still following particulars: Diam. bobbin, wire of bobbins, silk or cotton-covered? Can the horseshoe magnet be replaced by an electro-magnet? If so, what dimensions, diam. of wire, and quantity? A distinct description will be thankfully received by—A DUTCH SUBSCRIBER.

[47045.]—**Wire Harness for Weaving.**—Could anyone give me any information about the machine for making wire heddles, mentioned in Vol. XIII., No. 313, letter 1624?—H. MACMILLAN.

[47046.]—**Telephone Experiment.**—Will any owner of a pair of "Bell" or other magnetic telephones assist a hard-up inventor by trying an experiment for him?—thus: Soak some cotton wool in salt and water, and pack the wet wool into each ear, so as to get as large a contact surface as possible; stick one of the ends of wire from each binding-screw of the telephone into the cotton, and put the telephone diaphragm downwards on a piano or musical-box, and if any hearing can be obtained two to each wire from the telephone; connect respectively, a 2in. slip or wire, and a copper or platinum one, and let these dip into a glass of acidulated water, and note the difference of hearing; if any, report progress in the "E. M."—CONCHLEA.

[47047.]—**Medical.**—To DR. EDMUNDS.—I am troubled with a red patch or rash on the breast. It comes and goes without any apparent reason, and sometimes altogether disappears. Within the last few days it has appeared under my right arm. In both places it seems to grow amongst the hair which covers these places. As I do not wish to see it spread any further, I should be glad if you would point out the cause and suggest remedy or means of avoiding the ailment.—SUNFLOWER.

[47048.]—**Greenhouse.**—I have a large greenhouse connecting two parts of the house together, wall along one side, and glass the other side, end, and roof. I had thought of having a vine or two along the wall, but have heard that flowers will not do well along with a vine. Is this so? Can anyone make some suggestion as to laying out the place to look well?—EXPERIMENTER.

[47049.]—**Gilding Book-edges.**—Can anyone tell me the best way to gild the edges of book-leaves? I tried both the receipts given in Spon's "Workshop Receipts," but the gold leaf would not stick on to the edges properly with either of them. My book of gold-leaf has pieces of waxed tissue-paper adhering to each leaf to take it out of the book with.—J. K. B.

[47050.]—**Hot-air or Vapour Baths.**—Surely some of your readers can give us the benefit of their experience in the construction of hot-air or vapour baths for domestic use? It is quite twenty years ago since Mr. Urquhart lectured and wrote on the Turkish bath and its many advantages; and it has now become quite fashionable for both ladies and gentlemen to spend a month or two at hydropathic establishments. But as the cost of residence in such runs from six to fifteen shillings a day, it restricts the use of such establishments to the rich. An arrangement for such baths in one's own house, in which the bather could attend on himself or herself, or if an invalid could be looked after by a relation without expense, would be a real boon to the poorer gentry and the middle class generally. So many fathers, brothers, and sons are now fair amateur mechanics, I am sure that a paper of expicit instructions for the construction of such would be welcomed by many. If the principles were only fully detailed, many amateur mechanics could apply them to their own houses, and give their families the benefit of what is too often looked on here as a luxury, but which, in the East, is recognised as a necessity.—ISABELLE STUART.

[47051.]—**Crutches, &c.**—Can anyone tell me the kind of wood used for making crutches and wooden legs? I wish to make a pair of stilts, and require a light, strong and straight-grained wood.—R.

[47052.]—**Paint on Mowing Machines.**—I have several times noticed a kind of paint of a silvery nature on grass-mowing machines and the like. On examination, I believe the iron first is painted white. Would some kind correspondent inform me how it is made?—DAYLIGHT.

[47053.]—**A Question for Spectrum Analysts.**—I have recently gone into a house where there is a small conservatory inclosed by ground-glass windows. Both the previous occupier and myself have found it almost impossible to keep plants alive in it, and that, evidently, from no fault in the amount of heat supplied. The few plants that do drag out a miserable existence are pitiable to look at, and induce in one a fit of melancholiac every time we visit them. I may mention that the windows face the south, and there is, therefore, plenty of sun. Now it has struck me that the fault probably lies in the windows being ground-glass? and that possibly the actinic rays of the sun are obstructed by this glass, and prevented from reaching the plants. Has anyone taken the spectrum of sunlight through common ground-glass? And if so, what light does that spectrum throw upon this question? If I am right, can anyone tell me whether any other glass than plain clear glass will do, as the conservatory looks into a yard, and I would therefore prefer something that would obstruct vision. That is, is there anything that will obstruct the vision, and not obstruct light and the life-giving portion of the sun's rays?—ADIANTUM.

[47054.]—**Incandescent Lamps.**—There are now being sold small incandescent lamps (5-candle power), said to be lighted up with two Bunsen cells. Could any of "ours" kindly inform me if it is possible to light one of the lamps with Leclanché cells, and how many would it take to do so? Are not six or eight Leclanchés equal to two Bunsens? and can this number of cells be joined up without setting up a resistance? Also, kindly tell me the greatest number of quart Leclanché cells that can be joined up without losing any power. The above lamps are 2s. 6d. each.—BELL.

[47055.]—**Cardboard**—Is often used for flaps and shutters of small dark slides, and answers extremely well. I wish to know how to make this cardboard suitable—it must be elastic, stiff, smooth, and durable. I have tried to saturate "Bristol-board" with hot glue. This, however, softens in damp weather. I also tried thick coating with shellac varnish; but this, too, has its defects. Will some experienced friend give his experience?—E. B. F.

[47056.]—**Bacteria.**—Will somebody give a practical hint on the best means of keeping barm (intended for distilling alcoholic fermentation) free from objectionable germs, or is there a means of separating them from the proper torulæ. The barm in question is made on the Continental system from rye and malt meal, and lactic fermentation, encouraged by its standing 24 hours before the active fermenting mother is added. I find acetic germs are developed in a few days, and that all the maladies of Pasteur would appear unless the mother barm were changed frequently. I find the barm skimmings of a back attenuated with such yeast contain no bacteria. I consequently use such skimmings as "mother"; but, unfortunately, barm containing bacteria, or with an old "mother," does not throw the yeast to the surface. So I cannot avail myself of skimming. During this warm weather, would it be advisable to keep all barm-tubs covered? If so, with what—linen or wood? Would be very grateful for any information.—CYGNET.

[47057.]—**Glaze or Enamel on Iron.**—In the MECHANIC of Feb. 2, two recipes were given for a coating of glass on iron, one of which, it was stated, would not stand wet; the other, on trial, was found too infusible for the purpose required. Perhaps some of your numerous correspondents will oblige by giving a recipe for glaze or enamel easily fusible on a surface of iron, say at a low red heat, and which would stand exposure to the weather. Colour is of no consequence.—L. A. S.

[47058.]—**Chlorate of Lime.**—To W. J. LANCASTER AND A. ALLEN.—Will you be kind enough to give me a practical process for the manufacture of chlorate of lime? A method by chlorine gas preferred. Also, can chlorate of lime be made from bleaching liquor or bleaching powder at 35%?—JAMES LEATHERBARROW.

[47059.]—**Iron Boiler Chimney Rusting.**—I have a vertical boiler with wrought iron chimney projecting through roof of building about 9ft., and do all I can I cannot keep it from rusting. Paint, tar, &c., all come off in a few days. It has only been up about 12 months, and what with scraping and painting, the original 16th iron is reduced to 1-32nd Can any reader kindly suggest a remedy? and greatly oblige—F. R.

[47060.]—**Atmospheric Nitrogen.**—Has it been determined what quantities of combined atmospheric nitrogen are brought down to the soil by rain in the form of nitric acid? If it has, can anyone give me the quantities per acre per annum?—LEHRER.

[47061.]—**Mixing Brass for Melting.**—Will any reader inform me how to mix brass for melting, so as to have it to a nice yellow colour and soft?—AMATEUR MOULDER.

[47062.]—**Plaster Casts.**—Will some kind reader inform me how plaster of Paris casts are finished after being taken from the mould?—as I cannot get a glossy appearance upon mine.—ANXIOUS.

[47063.]—**Hydraulic Mortar.**—Is it possible to make an hydraulic mortar containing caustic alkalies, as my materials contain caustic alkalies, and I want to make a firm mortar? Will any of "ours" kindly oblige with a formula?—DEEPDOWN.

[47064.]—**Flight of Rifle Bullet.**—Suppose a rifle-bullet to be fired at a mark 600 yards away, with a wind blowing at right angles to the line of fire, what curve (in a horizontal direction) does the bullet describe in consequence of the wind, and, if the deviation of the bullet is 6in. at 100 yards from the muzzle of the rifle, what will be the amount of deviation at each successive 100 yards? Will some mathematical friend oblige?—A RIFLEMAN.

[47065.]—**Gaiffe's Medical Battery.**—Would Mr. Lancaster, or someone else who knows, kindly inform me how the coil in Gaiffe's medical battery is constructed? I have access to one which had, originally, a small chloride of silver cell. This has been removed, and the coil is used with a small bichromate cell, and it gives a much more powerful current than a coil three or four times the size, which I constructed myself. I don't like to take it to pieces, as it is not mine.—OS.

[47066.]—**Scissors and Razor Grinding Machine.**—Will anyone oblige by giving me instructions (with a sketch) for making the above, a small one to run as light as possible, with only one treadle, as I have only one leg for driving of it?—ONE LEG.

[47067.]—**Dynamite.**—I was much interested in "M. C.'s" account of dynamite, and should like to know his opinion as to whether it should be applied on the surface of a root or rock, or put in a hole bored for the purpose? Some of the workmen complain that the dynamite vapours, after the explosion, give them a headache. Is this "M. C.'s" experience also? Does he consider it equal or superior to tonite, gunpowder, or litho-fracteur for blasting tree-stumps?—S.

[47068.]—**Swelling and Pain about the Knees.**—Five weeks ago, my son had a somewhat severe attack of rheumatism throughout the right leg, the result, I think, of getting thoroughly wet a day or two before the attack. After a fortnight's duration, the rheumatism, during the following week, gradually left the leg until, at the end of the week, there was scarcely a trace of it left; but after three more days had passed it returned with increased vigour to the knee, where it seems to be settled, and which, at this time, is rather stiff and swollen, and extremely painful if walking is attempted. It is worse when heated. Will Dr. Edmunds give a little advice on the above? Will he also give a little advice concerning my daughter, who is the subject of slight swelling and pain in both knees, resulting from falling on the knees whilst skating on a rink a few months ago?—PONTUS.

[47069.]—**Fruit-growing.**—Wanted the name of a good work on growing strawberries, raspberries, black currants, and other fruit?—HIGHLANDER.

[47070.]—**To Mr. Allen.**—Could you give me a list of harmless aniline colours for confectionery—blue, black, red, yellow, and green? Also, if the ordinary commercial colours will do, or must they be specially prepared for the purpose? And can they be mixed one with the other to alter the tints, or must each be used by itself?—HIGHLANDER.

[47071.]—**Railway Trucks.**—To MR. CLEMENT E. STRETTON.—Would you kindly give me the exact lengths of the trucks used for goods traffic for various purposes, and the widths? I know the widths vary very little, but I think the lengths are different with almost each Company. Strangely, Barry's "Railway Appliances" does not give any lengths at all in the article on Trucks.—MEM. SOC ENG.

[47072.]—**Zinc from Spelter Fumes.**—Can any of your readers inform me a way to precipitate zinc from the spelter fumes of a dirt furnace? They are a great nuisance to the neighbourhood, and it would be a saving if the zinc could be caught It has been suggested that a bridge of red hot carbon in the flue would answer the purpose. Have any of your readers any experience in the matter, or could they suggest any other way?—GARNET.

[47073.]—**Astronomical Eyepiece.**—Will "Aldebaran" kindly advise me as to an astronomical eyepiece I wish to purchase for a 2in. terrestrial, 30in. focus, by Harris, Holborn? The telescope has good definition, but the field is not so bright as in modern instruments, in consequence, I think, of the o g. being made of the old-fashioned green glass. What kind of eyepiece ought I to get, what power, and what would be about the cost?—TIRO.

[47074.]—**Steam-Whistle.**—I am wishing to make a new whistle to my 2½-h.p. engine, as the one now on it is far too small and shrill, and I shall be much obliged to any of our kind readers if they will give their opinion or opinions as to whether I shall be able to make one out of an old force-pump barrel. It is made of a very good piece of brass pipe and perfectly true. It is 1½in. in dia., and 6in. long, being 1-16in. in thickness. I want a very strong and deep tone, as it has to be heard a long distance, and distinguished from two other steam whistles. Also, their opinions whether allowing the steam to strike on the bell through a number of small holes drilled in a circle of the same diam. as the bell will make any difference as to the sounding of the whistle, or whether I must make a perfect circle? The former will be much the easiest for me if it will answer. Also, what is the proper distance for the edge of the bell to be above the plate from which the steam issues? May I have the bell any length, or is there a limit? I always have from 50lb. to 60lb. of steam in at the time I should use the whistle.—REHCSAF.

[47075.]—**Oval or Elliptic Chuck.**—In the "E M." No. 852, July 22nd, 1881, Dr. Schobbins has an article with the above heading. Not having sufficient mathematical knowledge, I cannot make out either what he proves or how he proves it. Could not some of your readers give a plainer statement than that published by the doctor? As a further and relative question, it may be asked—"Does the 'Elliptic cutter' produce the same kind of curve as the chuck does?"—R.

[47076.]—**Bunsen Battery.**—To MR. BLACKWELL OR "CATON."—I should like to know the process in its entirety. I have got a good spark. Silver and gold-plating and gilding are most particularly wanted; but I understand to get the various shades the articles have to be previously coppered. Kindly say how to make the several solutions, and if the acids have to be removed from the cells when not in use? Do the solutions require heat? Thanks for former replies.—AMATEUR.

[47077.]—**Case Hardening.**—Can any reader tell me how to effectually case-harden two wrought-iron collars for the ball-bearings of my tricycle? Can it be done with prussiate of potash? I was going to make these collars of steel; but as they have grooves turned in them, I was told they would fly to pieces in hardening. Is this so? An answer will greatly oblige—CYCLE.

[47078.]—**G.W.R. Engines**—Can any correspondent inform me what single and four-wheel coupled engines (N.G.) have the vacuum and automatic brakes? and also give their numbers and stations, if possible?—CLARENCE FIELD.

[47079.]—**Regulator.**—Will any horological reader inform us what the index plate at the bottom of regulator pendulums is for?—FRED NASH.

[47080.]—**Fits.**—I should feel grateful to Dr. Edmunds if he would kindly inform me of the probable cause and cure of periodical fits to which I am subject, and which have occurred for the past seven years at intervals of about three months, and always during the night when asleep. During the attack I make a great noise, become bathed in perspiration and very violent. When roused before the fit is entirely over, I feel very much frightened, and always awake with a headache, and feel very weak. I, myself, think they are epileptic.—MEDICINE.

[47081.]—**Polishing Granite.**—How is this done? Particulars will oblige. I have some small blocks of concrete to dress and polish. Any information will be most acceptable.—GRANITE.

[47082.]—**Hardening Leather.**—Will some reader inform me of a way to harden leather, so that it will stand for valves in a soda-water machine? The valves in new machines work for a long time, and are very hard. Could the leather not be compressed in a die to render it more durable?—D. W. B.

[47083.]—**Diabetes.**—Would Dr. Edmunds kindly give his advice?—I am a young man between 21 and 22 years of age. I have been suffering, more or less, for three years from a complaint called diabetes memphis. Have been to many doctors without obtaining permanent relief. Doctor I am under at present says it is due to the liver making too much sugar, which is excreted by the kidneys. The remedies I have been trying lately have been bodeia in the form of a pill, and lactic acid—but both have failed to effect a cure. Feel a hot burning pain over the kidneys, flitting from side to side, and a soreness over the region of the stomach. Am an engineer by trade. Would Dr. Edmunds say if there is any chance of being permanently cured? Would a sea-voyage do any good? If so, where is it best to go to?—DIABETES MEMPHIS.

[47084.]—**Ebonite Coefficient of Expansion.**—Will some reader kindly tell me if ebonite has a negative coefficient of expansion? And if so, what is the value of it?—LEHRER.

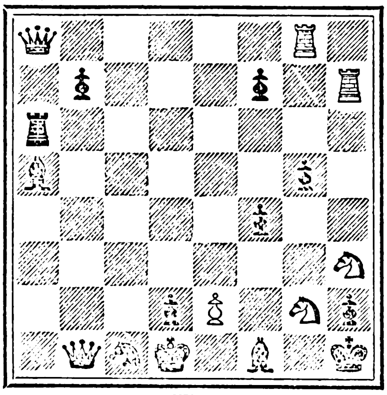
[47085.]—**Dynamo-electric Machine.**—To GEORGE TOLMAN.—Many thanks for answer to former query a few weeks back. I have tested my armature, and found that there was a leakage between iron ring and coils of wire. I therefore unwound it and insulated the ring with two layers of tape, and rewound the coils. The coils are all wound in one direction, and I have connected the end of one coil, and the beginning of next one to one copper slip, and so on to the end of last coil, which is connected to the beginning of first coil and copper slip. My pole pieces are screwed to base, and are 6in. high, 5in. wide, with a 5¼ circle cut from them in which the armature revolves. The electro-magnet which I have used is of ¾in. round iron, each leg is 6½in. long, and is wound with about 20ft. of 16cc. wire each, and it is stood upon the two pole pieces. When excited with a battery and the armature revolved, I get a small deflection of galvanometer, but no spark, and when connected to collecting brushes I get no effect at all. What would be the best form and size of electro-magnet, and size and quantity of wire to give best results? Any suggestions as to failure will be acceptable, as I am still—IN WANT OF HELP.

CHESS.

ALL Communications for this department must be addressed to the Chess Editor, at the office of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden. W.C.

PROBLEM DCCLI.—By C. R. BAXTER.

Black.

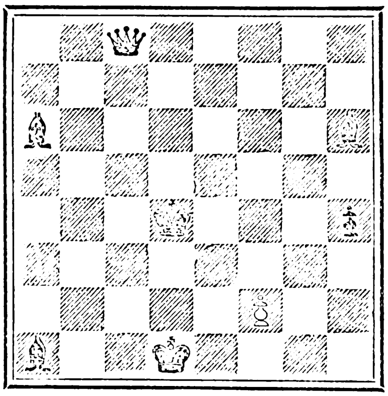


White.

White to play and mate in three moves.

PROBLEM DCCLII.—ANONYMOUS.

Black.



White.

White to play and mate in three moves.

SOLUTION TO 747.

White.	*Black.*
1. B to Q 5 2. P to Kt 3 (ch) 3. Kt to B 4 4. B or Kt mates	1. Kt to Q 7 (a) 2. Kt takes P (b) 3. P takes Kt, &c.
3. Kt to Kt 7, &c.	(b) 2. B × P
2. P to Kt 3 (ch) 3. Kt to Kt 7 4. Mates	(a) 1. B takes B 2. B takes P 3. Anything
2. Kt to Kt 7, &c.	if 1. P takes P

NOTES.

If in main play, 2. $\frac{\text{Kt to Kt 7}}{\text{Kt to Kt 6}}$; if 1. $\frac{\text{K B takes P}}{\text{Kt to Q 7}}$ 2. $\frac{\text{B to B 2 (ch)}}{\text{B covers}}$ 3. $\frac{\text{Kt to Kt 7}}{\text{Kt to K 5}}$; if 1. $\frac{\text{B to Q 5}}{\text{Kt to Q 7}}$ 2. $\frac{\text{B takes B}}{\text{P takes P}}$ 2. $\frac{\text{Kt to Kt 7}}{\text{Kt to Kt 6}}$.

SOLUTION TO 748.

White	*Black.*
1. Kt to Q B 7 2. K takes P 3. Kt mates	1. R takes P (ch) 2. R moves
2. K to K B 6 3. Kt mates	1. R to Q 7 2. Anything

NOTICES TO CORRESPONDENTS.

SCHMUCKE.—Your solution to 748 is correct. You are right as to 745; but 746 is more elegant than difficult.

A. BRIGGS.—Thanks for the problem, which shall be examined and reported on. You have solved 748 correctly.

Holloway's Pills.—These famous Pills purify the blood, and act most soothingly on the liver, stomach, bowels, and kidneys the great main-spring of life. They are wonderfully efficacious in all ailments incidental to females. To the emigrant, traveller, soldier, and sailor they will be found invaluable in the time of need.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6 Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, May 31, and unacknowledged elsewhere:—

A. J. HERBERT.—National Bicycle Co.—Swansea Zinc Co.—H. Sugg.—Jas. W. Queen and Co.—R. Ledger.—F. W. Reynolds and Co.—R. Sadler. T. Clarke.—Colleague.—Yoshi.—Clerkenwell Clockmaker.—R. M. Tuttle.—W. B. P.—Geo. Neville. A. J. Smith.—Lime-Light.—Denny Lane.—Gereb Admi.—J. M. L.—Jimbo.—F. J. N.—Beginner.—J. H. Huxley.—Fred. Walker.—LL.B.A.—P. M.—Malleable.—Akakia.—R. S. Baxter.—H. L. Crate.—More Light.

BLACKBOARD. (Various recipes in back numbers. If we are to understand that the board is already painted, it will probably be best to go over it with a coat of black paint in which turpentine has been used as the principal vehicle. Some blackboards are first treated to a priming coat, then they have one or two coats of oil paint in which very finely-powdered coke is mixed. Finally, the flatting coat, mentioned above, is put on. These boards bite the chalk well, and it is readily rubbed off; but you want something to "dry quickly," without saying what you mean by quickly. You will find nothing quicker than the turpentine paint which will also answer the other conditions.)—J. TINDAL. (Apparently you are suffering from sciatica, and should consult a medical man. You will find one alleged remedy on p. 575, No. 804—viz., homœopathic pilules of colocynth. A liberal use of lemon or lime-juice is said to ward off attacks.)—J. M. (Heat the bulb and tip the mercury gently down to the top end.)—J. R. (See replies 46510, in recent numbers—No. 893, for instance.)—A. D. D. (If you look to the index of our last volume, you will find more than thirty references to tricycles, and we recommend you to read the papers by "D. H. G.," if you cannot make up your mind by consulting our advertisement columns.) PACKINGHAM-STREET, ISLINGTON. (You do not say what metal the ornaments are made of, and have also forgotten to put a signature. We suspect the copper colour is either a bronze powder laid on with varnish (Bessemer's paint), or else a deposit by the electrical method. See replies in recent numbers.)—G. HARDWICK. (Answered many times. The flow-pipe must rise all the way to the bend. You can heat as many houses as you have boiler-power for, but the pipes must not be all on one level. The furthest point from the boiler must be the highest. See "Reviews" in this number.)—A. B. (If by Clark's you mean all the modifications of the chain-brake, the London and North-Western and the North London use it extensively. The Caledonian, Somerset and Dorset, London and Tilbury, Great Eastern, London and South-Western, and some small branch lines have a few coaches fitted with it.)—A CONSTANT SUBSCRIBER. (If you work such an engine at 100 revolutions per minute with a boiler-pressure of 15lb., it will do the work required. The nature of the question leads us to wonder how long you have been a "constant subscriber.")—LA DAMA. (We are afraid that you have not comprehended the position. Your experiments do not touch the question.)—BONANZA. (Query of too limited interest. You can get the names from any of the dealers; but it is impossible for any one to say whether investigations would be of commercial use.)—W. K. J. (Glue 1, water 2; melt; add 4 parts of glycerine, a few drops of carbolic acid, and sufficient powdered whiting to make the mixture look milky. Pour into a shallow vessel to set and cool. May be modified in several ways.)—INCUMBUS. (Directions for making an incubator on p. 311, No. 793; p. 465, No. 773.)—G. B. (See reply 46977, this number, and the indices of recent volumes.)—GALVANI. (Four. 2. No one can say without trying.)—CYGNET. (See recent numbers. A dynamo-machine would be necessary to make an economical installation.)—G. T. (You do not say what is the material. Silk and cotton require different preparations. See p. 182, No. 810, or p. 273, No. 792. Paraffin oil does not smell when properly consumed.)—CAMBRIDGESHIRE BOY. (Use white-lead (see that you get it) tinged with best Venetian red. Some chemical action was the cause of the change in the other mixture.)—BRAKE-BLOCK. (See the advertisement columns, and read the discussion in the last volume, wherein the subject was exhausted. 2. Messrs. Crosby Lockwood and Co., Stationers' Hall-court, E.C., will publish the book you name.)—B. T. A. (You should procure a copy of the specification. A small scale model would be made only with difficulty, and as to working it by hand, the results would be *nil*.)—A BEGINNER. (Merely the finest plumbago applied carefully to all parts with a camel-hair brush. We suspect that you did not connect the plumbago surface of the cast with the copper wire.)—

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

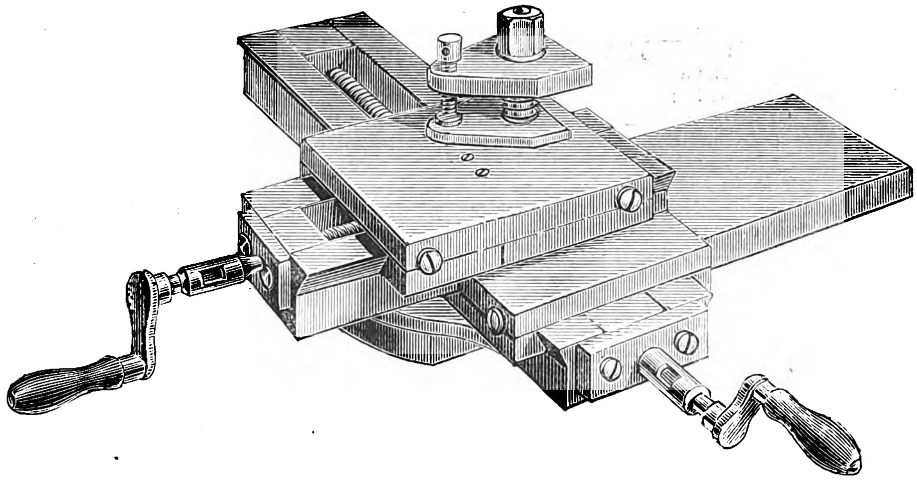
FRIDAY, JUNE 9, 1882.

METAL-TURNING SLIDE-REST.

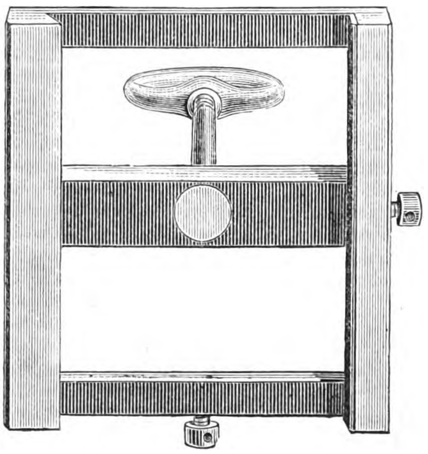
By J. H. Evans.

Having been compelled by pressure of business to delay my articles, I have received in the mean time very many letters asking for information upon a great number of different subjects, and as the metal-turning slide-rest has formed one of the principal topics of inquiry, I have thought it one of the most useful tools to illustrate and describe.

There are, of course, a number of different kinds of this particular tool; but I think the one here shown is the most useful for general amateur purposes. In the first place, it will admit of a larger diameter being turned, and the metal cradle is a surety of its being always square to the bed of the lathe if properly adjusted. It will be seen that the rest is composed of three slides, the first being fitted to a gunmetal cradle, one side of which is planed to an angle, the other being square; and on the latter is fixed a strip of steel: this is pressed against the cast-iron slide by a capstan-head screw. The steel strip has two objects: first, it forms a means of preventing the point of the screw damaging the slide, and it also admits of a certain amount of elasticity in the centre, and does away with the necessity for the extreme accuracy in the fitting between the angular and vertical sides of the cradle. When these are fitted quite closely, the side unprotected (viz., the angle), is likely to be damaged when the rest is being inserted in the cradle. The second slide is held to the lower plate by two bolts, the centre having a circular recess turned out, about 1in. diameter and ¾in. deep, and fitted to a stud, which is screwed firmly into the lower or first slide. Upon this stud the second slide moves when it is required to turn a cone or taper, and to fix it in any position required the two bolts are tightened. There are two ways of arranging the circular motion: either by having a radial slot each side of circular part of the second slide, and the bolts tapped into the lower one, or to turn out a T-groove in the lower slide, and a round hole in the second one. In this case a recess must be cut out in the lower plate to allow the head of the bolt to be inserted; the ends of the bolts project through the second slide, and a hexagon nut, with a thin loose washer, is fitted to the bolts. This mode I much prefer, and usually adopt, as the motion is better, and you can work the rest entirely round if necessary. I make the second slide long enough for the winch-handle to project over the end of the first slide, as if the slide can be turned completely round, as it can if made the latter way, it is much better for taking a surface cut than using the top slide for the same purpose, especially for heavy work. The plate which forms the top of the second slide is cast in the solid with the base of the top slide, and is fitted in the ordinary way, the one angle being planed up true to the lower surface, and the loose slide held to its place by two screws with heads countersunk, and two set-screws to adjust the slide to a perfect fitting. The top slide is fitted in the same way precisely, and on the latter the tool-holder is fixed, this latter being after the pattern introduced by Professor Willis, which is certainly the best at present known; but I will point out that what I consider the best way to fix the tool securely in the rest, is to tighten it by means of the screw at the end of the angular piece of the tool-box, which screw I always make with a capstan-head with lever-holes in it. It will be found that much less force will hold the tool more securely than by using the spanner to the hexagon nut in the centre of the tool-holder, if, when the tool is placed, the nut and screw are adjusted till nearly in a line with the stem of the tool, and the screw then tightened.



The screws are fitted to the slides in the same way as those of the other slide-rests—viz., with a collar on the end, which is countersunk into the gun-metal end plates, which plates are fixed with two steel screws; the screws are cut 10 threads to the inch, and covered with a metal cover to keep the shavings from getting into the nut, and so causing wear and tear that is, to a certain extent, prevented by the latter arrangement. The end of the second slide is usually prepared to take the spiral wheels, so that the rest can be used for cutting screws, or Elizabethan twists, in conjunction with the spiral apparatus. This rest is for the purpose of enabling the amateur to turn such work as would be found extremely difficult without its aid, in fact, almost impossible. Although strictly for metal-turning, there is no reason why it should not be used for roughing over hard woods, and I find amongst my clients that it is used extensively for this purpose; as, by way of example, if a large ivory hollow is required to be turned out inside, by using the rest we have now under notice, the ornamental turning rest is saved a deal of rough usage, and much time also turned to account, as the heavy rest will do the work in much less time.



Having given a brief outline of the tool, and a few examples of its use, I will describe the best way of setting about making it, and I need scarcely say that the first thing to do will be to make the patterns, and as this is always a matter of trouble and expense, it may be saved, as in other subjects upon which I have written, by securing castings from those used at my establishment. Assuming, then, that the castings are at hand, the first part to set about will be the gunmetal cradle. From the engraving it will be seen that it has a strong bar across the centre, which is planed in the same manner as the outside fittings, and should be just free in the centre of the bed. There is no necessity for accurate fitting in this case, as the screw seen in the front is for the purpose of drawing it up square to the bed, and when being used this screw should be adjusted before the binding bolt is tightened to secure it to the bed. The lower parts of the cradle being planed, it must be reversed on the planing-machine and chucked, as it is termed, perfectly square to those parts already done, and then the fitting with the bevel on the left side planed up true, allowing sufficient space for the steel bar on the right-hand side, which will be about an eighth of an inch. By way of a finish to the look of the work, a neat hollow is made on each side. This is easily done by placing a round-nose tool in the machine, and takes but a few minutes. When this part is entirely finished, the lower cast-iron slide, which fits into it, should be planed to fit it. This part is 1ft. 3in. in length, 4in. and ⅞in. at the bottom. It is made sufficiently long to allow the rest to be brought away from the centre, in order to turn a large diameter; the thickness is ⅞in. Having gone so far, it is chucked on a true surface-plate in a lathe, and the hole bored and tapped true to the surface in the end; the radius at the front end, where the divisions are seen, being turned at the same settings. This, of course, can only be turned by a semicircular movement. The hole should be tapped ½in.; and for cast iron, the Whitworth thread will be the best. I consider it the best way to fit in the wrought-iron stud, upon which the second slide revolves, and then turn it perfectly true to the outside. If it is not so when the slide is turned upon it, the two edges will not always coincide. This is important, especially where there are divisions. So far, then, the foundation is well forward. I had better point out that the lower slide—in fact, the whole rest—is held to the bed by the metal cradle. This being the case, we always make the binding bolt of steel.

This, well fitted to a countersunk-hole, and the cast iron fitting the bevel in the cradle, when tightened, the latter will draw the rest flat down on to the bed, and the side-screws being adjusted, it is consequently square all ways.

The casting for the second slide must now be planed, top and bottom, to the desired thickness, 1in. and ⅝in., the bevels on each side planed at the same time. The actual width across the top is 3½in.; but if it should be necessary to take another cut, it does not in the least matter if it is a little less.

The opening in these rests we do not plane out: if the patterns are well cored and cast there is no necessity; they are 1¼in. wide, to allow room for a good substantial nut. When this slide has been properly scraped up, it should be placed on the surface chuck in a similar way to the lower one, and the hole turned out perfectly true to fit the pin that is fitted to the bottom slide, which, by the way, should have the T-groove turned out while it is on the surface chuck, as it is absolutely necessary that it should also be quite true to the pin. The recess should be large enough to admit of ⅜ bolts being used undercut to ¾ for the head. This is, as I have mentioned, the best way of arranging this; but if the radial slot on each side is preferred, being more easily accomplished, they should be set out with dividers; then with a large drill holes are bored as closely together as possible, filed one into the other with a round file, and finished with pillar and crossing files; to those possessed of machinery for such a purpose this may seem a long process, but I take it for granted that most amateurs at all events have not such. I will proceed as if the former plan is adopted; therefore, when the T-groove is turned out, a recess must be cut out at one portion of it, to allow the head of the bolt to pass in freely. This done, a hole in each side of the second slide working upon it must be made exactly opposite the centre of the groove; and the bolts have a plain part which fits into this, and the screw above it; it is better to have a thin loose washer under the nut, which latter should be steel, or iron casehardened. I prefer steel, as casehardening is, after all, only skin deep. This part being so far made, the two slides may be put together, and the lower one held in the vice while the top plate and slide are got up together.

The third slide, it will be seen, is cast in the solid with the plate that forms the top of the second, one side strip being also cast on it. To proceed with this it must be planed wherever a surface and fitting are required, and where the slides work should be scraped up and the bearings well rubbed together; when perfectly true and flat, a little fine oil-stone powder may be used as a finish just to work them well together. The side strips must not be any thicker than will admit of their passing freely over the nuts that hold the first and second slides together. It will be seen that there are two set-screws in the front slide to set up or adjust the slide.

The top plate of third slide is made in exactly the same way, the thickness of these two being ⅜ of an inch, the length 6in., and width 5in. In the corner of the top plate the tool-box is fitted, the one under notice being that introduced by Professor Willis, and is, as stated, the best at the present time in use—the centre pin is made of steel, and is screwed into the cast-iron plate with a ¾ Whitworth screw and home to a shoulder, the latter being 1in. in diameter, and ¼in. thick; the part that extends is screwed ⅝in., and has a long steel nut 1¼in. long. The object of its length is to admit of various cutting frames and wheel-cutting apparatus being used at different times, on the bottom, and resting on the cast-iron plate—a piece of steel ⅜in. thick, and of a triangular form. It is turned out to pass freely over the collar of the steel pin on which it moves, and at the point which is the greatest distance a semicircular groove is made for the point of the capstan-head screw to bear upon. The top plate is ⅝in. thick, and extends over the front sufficiently to allow two steel studs to clamp the centre of the tool, which, for a 5in. lathe, will be about ⅝in. square. In the centre of the top plate a curve is turned, into which a loose washer fitting the same is placed, under the hexagon nut, and between the two, a short spiral spring, to keep the upper one in its place. As I have said, I have found from experience, that the capstan-screw is the best to tighten the tool into its place, and not the hexagon nut. In giving a short explanation of this tool-holder, I wish it to be understood that I do so entirely for the benefit of the uninitiated, almost all mechanics and amateurs being well acquainted with it already, it having been in use for many years.

Having, then, all the slides so far ready, we pass on to the screws, which are ten to the inch, and square threads. To cut these, of course, a self-acting lathe must be used, as they are long, and being square threads, no other means can be obtained. The second slide being 14in., and the top 9in., of course, in cutting such screws, the slender guide must be brought into use to stay the spring and vibration caused by the length. The nuts must form the next part, and these may be made of either cast iron or gunmetal. I must say I prefer the latter, both in theory and practice, and as they will naturally wear more or less as they are used, I should certainly advise the extra caution of splitting the nuts across and fitting in two screws to set them up, in order to take up as much of the loss of time as possible. I have found this answer very well, and do so with all my best slide-rests now. It will also be found that the screw will be worn more towards the centre, as the generality of work is of such a length as to bring into use that particular part of it more than any other. This, I may say, comes under the denomination of general wear-and-tear, and when worn so as to in any way interfere with the work to be turned, it must undergo a course of repair.

The screws made, having, of course, the collars, which fit into the metal end-plates, which latter are ⅜in. thick, and countersunk to ¾in. diameter for the collars to fit, and held to the end of the slide by two screws, as seen in the engraving, I may point out that the boring of the cast-iron slides is a most important matter, and will require great care in laying out, the end at which the point of the screw fits being bored to the size of the bottom of the thread, the opposite, of course, just above the top of the thread, so that a good fitting may be made. The end of each screw projects sufficiently, for what we term a pipe-handle—that is, with a cylindrical hole with a mortice slot for the end of the screw to fit into to keep it from turning round. These we always consider the best for such a rest. We are now drawing to a close with the making of this tool. I think it will be well not to omit the covering of the screw to keep out the shavings. This is done with a piece of tube cut in half, and a semicircular slot cut in the nut between those screws that hold it to the plate or slide. I remember that the rest sent to the engraver for this illustration will not show this, as it has not the covers to the screws, it not being quite finished; but I consider it an improvement, therefore suggest its being done; at the same time it is not an absolute necessary.

And now a few words as to the dividing of the front for turning tapers, &c. A centre line having been obtained on either the first or second slides, one should be divided into degrees of a circle, and figured at every 10. If this division is put upon the second slide, the reading line upon the lower one should be left until the rest is fitted into the lathe for which it is made, and a true and perfect cylinder turned with it; and when this is done, the reading line should be carried on to the other slide, exactly opposite the zero, or starting-point of the division. We generally put the division on the second slide, and read from a line upon the bottom; but it is really not of much importance as long as a perfectly distinct reading is obtained.

I trust these few remarks will be of service to many of our readers who are interested in such work; and those whose abilities are directed to metal-turning will find this one of the most useful additions to the amateur lathe.

SOUND-SIGNALLING AT SEA.

ONE of the most interesting classes of exhibits at the recent Naval and Submarine Exhibition included the appliances used for producing sound-signals employed as warnings to vessels in the vicinity of the coast, and also as a means of communicating amongst themselves indications of their presence and of the directions in which they are steering. All seamen look upon fog with the greatest dislike, for the simple reason that it practically blindfolds them. In the stiffest gale and the darkest night, at least they can catch occasional glimpses of the beacon-lights; but in the state of the atmosphere generally termed fog, the most powerful artificial lights are invisible, and even the mid-day sun is obscured. In the old time, when near a coast, masters of fog-bound vessels invariably adopted the safer plan of lying-to until the atmosphere became sufficiently clear; but with the advent of steamships, and the competition of rival lines, when quick voyages are the desideratum, the over-cautious practice of bygone generations is almost forgotten, and navigators push on through the densest fogs, trusting to dead-reckoning, and, if near a coast, to the use of the lead, to give them an idea of their position. The practice is fairly safe if the vessel proceeds only slowly, and is in parts not much frequented by shipping; but in the busy highways of the sea it is now recognised as imperatively necessary that all vessels, whether under steam or sail, shall give indications of their presence by sound-signals. For many of the devices employed we are indebted to the Americans, who possess a large seaboard which is frequently visited by fogs; but some of the signals now used were invented more expressly for indicating to steamers and other vessels on the large American rivers and inland seas, the course intended to be taken by the signalling vessel. Within the past twenty years or so a great development of sound-signalling apparatus has been made in this country, Prof. Tyndall, as adviser to the Trinity Board, having devoted much attention to the subject, especially as regards the coast-marking signals. International regulations for preventing collisions at sea prescribe, as compulsory for all mercantile vessels, certain signals to be made at frequent intervals whenever the atmosphere is clouded by fog, mist, or snow; and further, steam-vessels have an international code of signals on their steam whistles, which indicate the direction of their movements. The use of these signals is, however, optional on the part of steam-vessels, and as they are given by from one to three short blasts, they are not altogether trusted, for it has happened not unfrequently that they have been interpreted incorrectly, for the simple reason that one of the blasts has not been heard on board the vessel it was desired to warn. Amongst the instruments for making sound-signals on board ship, there are bells, fog-horns, gongs, and whistles, the latter blown either by steam or air. Whistles are generally adopted on steam vessels, and when kept in proper order and attention paid to their utterances by both the signaller and the signalled, are useful devices, especially when means are provided for changing the pitch, but there is liability to choking, and frequently an indefiniteness about the first blast, which is apt to mislead. Sometimes, when the tap admitting steam to a whistle is opened, there is only a rush of water, or condensed steam, and the sound, if any, is uncertain. At other times the sound, though not clear to those on board the signalling vessel, may be distinctly heard by the watch on the other ship; but the signallers are apt at times to repeat, thinking the first was not heard, and then uncertainty and confusion are introduced. For this reason various modifications in the form of the "whistle" have been made, the principal object being to avoid choking. Whistles on the plan of organ pipes have been adopted, and one by means of which two distinct sounds can be produced has been received with favour. Reeds on the principle of both the beating reed used in organs and the free reed, have been adopted to horn bodies with good effect, one of the best being perhaps a recent introduction from America, which is intended for use with a code made up of eight long and short sounds. Compressed air, at about 6lb. to the square inch, is used to produce the sound in this apparatus, but, if necessary, it can be connected to one of the ordinary whistles, every signal being sounded automatically when once set. There is, however, an objection to the use of several sounds of different pitch, owing to the well-founded belief that sailors will not readily distinguish them when the atmosphere is loaded with the watery particles forming fog; hence it is considered by many advisable to limit the number of different pitches to two, which, probably, may most conveniently be separated by the interval of an octave, the code to give the compass signals being built up of long and short sounds on the two notes. In the case of the siren trumpets employed around the coasts, Mr. Holmes has devised a method of construction, by which two notes can be obtained from one instrument, but at present it is not much used. The researches of Prof. Tyndall and the late Prof. Henry, have proved that no appreciable effect towards obstructing the transmission of sound is produced by either fog, rain, or snow, but there are certain peculiar states of the atmosphere, not yet thoroughly understood, when it is said to be acoustically opaque, although it may happen at the time that it is optically transparent. On these occasions, sounds generally heard distinctly to very long distances, seem to be dissipated by meeting with reflecting surfaces, and to fail in carrying-power, a phenomenon confined to no particular weather, but occurring as often during fine clear states of the atmosphere as during fog. A contrary wind has an important effect in connection with the transmission of sound; but, as Prof. Stokes explains, its action is indirect. When a sound is generated in perfectly still and uniform air, it is propagated or spread out in spherical shells; but when a wind is blowing, the difference in velocity of the strata of the atmosphere disturbs the spherical form of the sound-waves, and they are propagated with an upward direction which has the effect, so to speak, of tilting them up over the heads of observers; hence, sounds are often heard at the masthead which are inaudible on deck. These facts are of small moment in the case of vessels meeting one another; but where the object is to warn ships of their proximity to the coast they are of much importance. No fog-signalling apparatus yet devised can be trusted in all states of the weather to give warning to a greater distance than two miles, which is, however, deemed sufficient, as sailing vessels can wear and put about in a mile; but it is of importance that the fog-signals when heard should indicate the lighthouse to which they belong, and that, to a certain extent, is accomplished by varying the periodicity and duration of the sounds. The siren is the most powerful sound-producer known, and since 1874 a considerable number have been placed around our coasts and several on board lightships, which are, however, generally provided with gongs, a distinct and sufficiently powerful signal when the lightships are themselves in deep water, and vessels can approach near enough to hear the sounds. Sirens are, as a rule, worked by compressed air, supplied by hot-air or gas-engines, which also rotate the discs; but some are worked entirely by steam. In Holmes's modification of the cylindric siren, the escaping air is made to rotate the apparatus without the application of a strap from the engine. When steam is used a pressure of about 70lb. is required; but with air 30lb. suffices to give the best result in both cases, though the higher the pressure, and the larger the volume of the blast, the louder is the sound. The siren at St. Abb's Head, on the coast of Berwickshire, is always heard at a distance of two miles, and frequently at the Isle of May, which is distant more than a third of a degree, or 21 nautical miles. The disc in this siren is 12in. in diameter, it has 10 ports, and the pressure of the blast is 20lb. It makes 1464 revolutions per minute, thus giving a note due to 244 vibrations per second. In all cases, whether sirens or reeds, the trumpet attachment is used, and the sound producer is adapted to give its fundamental note. In the case of the reed, which is usually of steel or German silver, 18in. long, $2\frac{1}{4}$in. broad, and tapering from $\frac{5}{8}$in. to $\frac{1}{4}$in. thick at the free end, it is tuned by regulating the length of the vibrating portion, while the siren is adapted to its trumpet by regulating the speed of revolution, and consequently the number of vibrations. Experience has shown that while a musical sound is vastly superior in carrying power to a mere noise—though the latter may be initially much louder—the choice of note is practically limited between 180 to 420 vibrations per second, and the most effective is probably that due to about 250 vibrations. So far as the coast-marking fog-signals are concerned, there is little to be desired except some definite and easily understood system of distinguishing them; but there is room for improvement in the signals used by the mercantile marine, especially by sailing-vessels, and it may be that the late Exhibition at the Agricultural Hall will eventually be the indirect means of introducing a code of sound-signals, and a thoroughly satisfactory apparatus for producing them.

THE ACHROMATIC OBJECT-GLASS.—I.

BY W. BRADBURY ("ORDERIC VITAL").

> Nam possumus sic figurare perspicua et taliter ea ordinare respectu nostri visûs et rerum quod frangentur radii et flectentur quorsumcunque voluerimus.—BACON, "Opus Magus."

MORE than six hundred years have elapsed since that ingenious Englishman, Friar Bacon, wrote the above passage. "For," says he, "we can so fashion transparent bodies, and so arrange them with respect to our eye and the object, that the rays shall be refracted and bent into whatsoever direction we may desire." Thus it appears that even so early as the 13th century, it had been discovered that the direction of a ray of light was generally altered by the shape of the substance through which it passed. If the substance was in the form of a flat plate no perceptible alteration was caused; but if it was wedge-shaped the ray was thrown aside from its natural path. A still more wonderful appearance resulted; if the substance had a bulging or convex form—that is, when it was in the shape of a round disc, thick at the middle and rounding off to a thin edge. Rays traversing it were so disposed as to form at a certain distance behind it, a small inverted image of the object from which they proceeded. Or if the convexity was so great as to make the substance almost globular, the apparent size of small objects seen through it was much increased. Bacon writes:—"We can cause the Sun, moon, and stars to descend nearer to us in appearance." Such results were naturally looked upon as magical, and found a fitting notice in a book devoted to the mysterious and wonderful. But incomprehensible as such appearances were to those early students of nature, they were destined to yield results of momentous import to succeeding generations. They were the germs from which have sprung the modern telescope and microscope, two instruments which have enlarged man's knowledge of his surroundings more than any other scientific instruments ever discovered. By means of the former we can examine those brilliant orbs, of whose system the earth is but a small and insignificant member; while, with the aid of the latter, we can scrutinise those organic beings whose minuteness places them utterly beyond the reach of the unassisted eye, and of whose very existence we should otherwise be absolutely ignorant.

[*] It would be a difficult, if not impossible task, to find out who was the first to hit upon the arrangement of glasses constituting a telescope. In the present instance, we are not concerned with the history of the instrument, but simply with the development of one of its most essential portions. In a telescope there are two agents in operation: one, producing an image; the other, magnifying it. These are termed respectively, the objective or object-glass and the eyepiece. Telescopes may be divided into two classes: if the image-producer is a mirror, throwing back the rays to form an image in front of it, the instrument is a *reflector*; but if it is a glass lens, through which rays pass to form an image behind it, the instrument is a *refractor*.

With regard to the first-mentioned class, exhaustive details of several methods of working mirrors have appeared in the pages of the ENGLISH MECHANIC; and anyone with mechanical aptitude, and plenty of patience and perseverance, has all necessary instructions for the production of a good instrument. But the same cannot be said respecting the refractor. Information relative to the final corrections of an object-glass is scarce, and the extent to which these corrections can be, and are, carried out, constitutes the chief difference between a good and an inferior instrument.

The production of an achromatic object-glass is a much more difficult undertaking than that of working a truly parabolic reflector; instead of one surface, four are requisite, which, though less in area, need equally careful fashioning. A certain proportion of foci has also to be observed, which proportion can scarcely be arrived at, except by experiment on the glasses intended to be used. An eminent authority tells me, that two discs of the best glass, classed in the same brand, seldom give equal results with the same curves and methods of working; a very slight variation in their optical qualities, though both may be equally good, necessitating a change in curvature. But the procedure adopted in the figuring of one optical surface should, to a very great extent, hold good in the case of another; hence I regard the investigations of Mr. Wassell as most important contributions to the literature of the subject; being of extensive application in the general production of optical surfaces, as well as of special service in figuring specula.

During the last five years, I have occasionally contributed to the pages of the ENGLISH MECHANIC, articles on the mathematical treatment of the object-glass. I have endeavoured to explain the rules of Barlow and Coddington, embodying therewith the tabular values of Herschel,* and to arrange them in a convenient form for reference. Opinions may differ as to the value of optical formulæ. Those who cannot understand it, or have no need of it, are apt to look upon optical equations as so much incomprehensible nonsense: those who can use it intelligently, as a guide to practical work, think otherwise. After making a little inquiry, I am able to say that the formulæ above-mentioned are found of considerable service to practical men, though, of course, this does not imply that equally good results may not be accomplished without them. Mathematics, in relation either to optics or to any other science, must be no more than a servant, ready to obey the will of the master. What the mind conceives, mathematics can express in a definite, tangible form; but unless we have a correct apprehension of what we mean by the terms we employ, formulæ containing them can only be a source of confusion.

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[*] I am indebted for most of the historical matter herein contained to an able article on the Telescope, by PEARSON, in Rees' "Cyclopedia."

But even the possession of correct rules, and the necessary knowledge how to apply them, is only one element in the production of an object-glass. Any one who works a set of curves, calculated by one or other of the preceding formulæ, would probably find the result fall far below his expectations; yet I apprehend he who would use a set of curves merely because some one else found them to answer admirably, would have even greater cause for complaint. It must be remembered that, algebraically, the specified radii produce partial correction only; also, it is further assumed that the optical properties of the glass agree with certain figured values, and that the surfaces can be wrought correctly to certain curves, neither of which conditions can be absolutely satisfied. The values yielded by any recognised formula must, therefore, form the foundation only upon which the superstructure is built, and the goodness of the object-glass will depend upon the extent to which it is possible to employ that delicate manipulation, which raises the production of the artist so far above that of the mere workman.

In the present series of articles I purpose showing, so far as I am able, the theoretical conditions that must be satisfied in the formation of an object-glass. It may seem unnecessary to dwell upon this subject at any great length, but circumstances will probably cause it to be otherwise. It has been suggested to me, that if theory can show approximately the form of surface required, it will be easier for the practical man to explain the mode of working which such a form necessitates, or to show where and how the practical differs from the theoretical form. I am also anxious to place on record some account of the practice of the early artists. Information on such matters is not very plentiful. I have been able to collect but little, yet I trust it may induce others who possess such knowledge, or who may have ample means of reference to published works, to send to these pages whatever details they may have, and thereby render the subject as complete as possible.

I am induced to attempt the preparation of these articles solely by the consideration that there is one who is both able and willing to take up the practical part. Had it been otherwise, I could not have asked our most obliging Editor to grant space for matter which must be wearisome to many and uninteresting to others. I am sure the readers of the English Mechanic have good cause to congratulate themselves that there is amongst the circle of correspondents so accomplished a contributor as "Prismatique." Having been for many years in actual contact with the best work and best methods of working, he can speak authoritatively on the subject of optical manipulation; and readers may rest satisfied that the instructions he has already given, and those which in due time I feel assured he will also give, are such as could, or would, be furnished by very few indeed. I can also count upon the hearty co-operation of Mr. Wassell, whose exhaustive details on specula-working, lead me to think, that we may confidently look to him for simplifications and improvements in the methods of working object-glasses.

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* I have not been able to give an account of the analysis of Sir John Herschel, as I have not access to the "Philosophical Transactions" for 1821, which contains his paper. Perhaps those who have will send an abstract to these columns.

THE BOLTON RANGE FINDER.

In the annexed engravings we illustrate the application of a range finder, patented by Mr. T. Bolton, of Calcutta, being a modification of the system used by Major Weldon, R.A. It is a small reflecting instrument, light and durable, which is carried as an attachment to the belt when employed for military purposes. A range of 1,000 yards can be taken by two men with the assistance of the instrument in two parts and a tape, in less than 30 seconds; 2,000 yards in 60 seconds, &c., after a few minutes' instruction in the use of the instrument. Size of each, 2in. by $1\frac{3}{4}$in. by 3in., including handle; weight of each, 5oz. Fig. 1 shows the method of taking a range by two men. Both stand facing each other, having decided upon some object, the distance of which is required, and which should be seen reflected in the mirrors of both instruments. No. 1 at A, with the instrument marked "base 1 in 40," and the case containing the tape marked "the Range" stands still, and, presenting the open face of the instrument towards the distant object C, applies his eye near the edge of the open face of the box, and looks through the aperture above the reflector on the opposite side, seeing by direct vision, the instrument held by No. 2, and the reflected image of the distant object, to the right or left, in the mirror below. No 2, with the instrument marked "right angle," faces towards No. 1, and, holding the end of the tape, moves away in a direction at right angles to the distant object C, and is guided by observing that the instrument held by No. 1, as seen by direct vision through the aperture, coincides with the reflected image of the distant object as seen in the mirror. When No. 1 observes in his mirror the image of the distant object coinciding with the instrument held by No. 2, as seen by direct vision through the aperture, he stops paying out the tape, which is being run out by No. 2, and reads off the range in yards. No. 2 in moving out should stop at intervals, and holding his instrument steady, in correct alignment, notice any pre-arranged signal from No. 1, by the raising of his arm a certain height as to whether he should move out further, or come in, to find the correct position B.

Fig. 1.

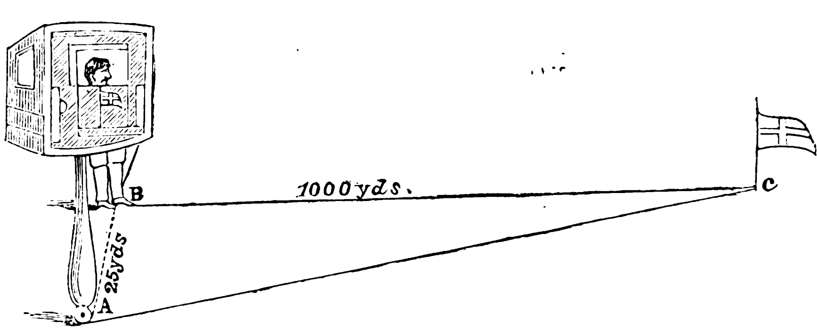
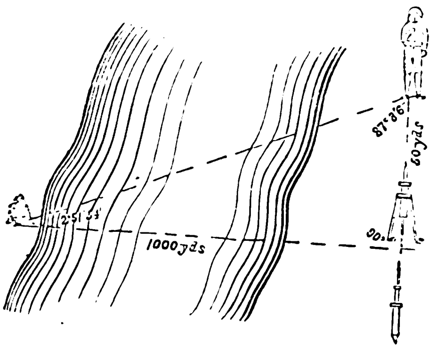


Fig. 2 shows the method of using the instrument, as adapted for one man in survey reconnaissances. Accurate distances can be measured by one person having one instrument, tape, and two staves or poles in a few minutes without any calculation. Size of instrument, 2in. by $2\frac{3}{8}$in. by $3\frac{3}{8}$in. including handle. Weight 8oz. Let the distance of an object O from the observer at A be required; set up the tripod staff at A, and by the upper mirrors or right angle of the instrument lay off the right angle O A B, fixing the spiked staff some 10 or 20 yards distant from A at the point B. Should it be found, on reverting to A, that staff B has not been placed in the correct position, the staff A should be moved a little to the right or left by the adjustment provided on the top of the tripod, till the right angle is correctly formed by the reflected image of O coinciding with the staff B, seen by direct vision; care being taken that the staves are set up perpendicular by the plummets attached. The observer then proceeds to lay off the base A C; he fixes the pin attached to the tape under staff A, and, being guided by the staves A B, he walks backwards in the same straight line, allowing the tape to run from the case as required; and, holding the box to his eye as before, he looks into the lower reflector of the instrument marked "base 1 in 20 or 40" until he gets to position C, when the staves A and B, seen in a direct line through the aperture, coincide with the image of O, as seen by reflection in the mirror, at which place he reads off the range from the numerals on the tape.

Fig. 2.



The instrument has been officially tested in India by order of the Commander-in-chief, and has been found so simple and efficient that it is being introduced into the British army there and the forces of the neighbouring independent States.

PRACTICAL NOTES ON PLUMBING.—XXXV.*

By P. J. Davies, H.M.A.S.P., &c.

(Continued from page 277.)

Next examine Fig. 202. This is a very handsome lavatory arrangement. The valves are shown fixed, and are of the lever kind, fitted as in Fig. 200, excepting that the pull arrangement is of the crank kind, see D, Fig. 202; this crank is also shown fixed in the skirting at E F G, and attached to the ends of the lever. H is the washer for fixing into the bottom of the basin, as at Q, Fig. 197. J is the straight Hunch trap, shown and described in Fig. 69, A, in the Building News of September 9th, 1881, (page 327, Vol. XLI.); great care must be taken to fix a proper-sized air or vent-pipe at vent, to such a waste-pipe. The water is in this diagram supplied through a lion-head inlet spout, but is not nearly so good as that shown in Fig. 200. The overflow holes are shown at B, and a separate pipe, I, taken right away to discharge over an open head, or otherwise. K is the hot-water valve for hand-washing or shampooing, L the cold; both of these valves are connected to the breeching-piece, and by indiarubber tube to the rose or jet.

Fig. 203. This is an angular lavatory basin showing the arrangement of pipes, valves, &c., together with breeching-piece and union, as at the left-hand side of the figure at ARM, HOT and COLD; it also illustrates the leaden breeching-piece on the right-hand side at cold. The hot water may flow up the pipe at A, whilst the cold may enter at "cold," and from there by the pipe B to the arm of the basin, and out at the shell inlet D. There is a new arrangement added to this lavatory basin—the

distilled water pillar ; this is supplied through a tin pipe ; *a* is also filtered water.

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* From the *Building News*. All rights reserved.

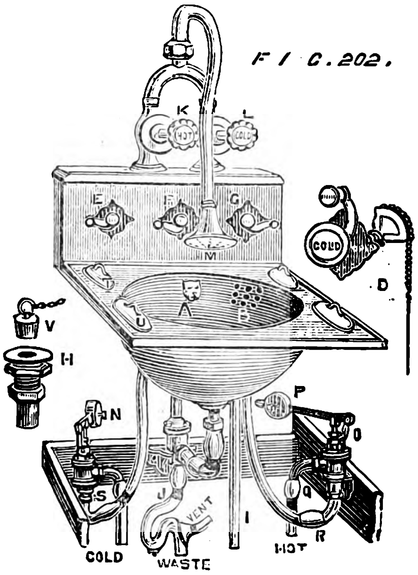


FIG. 202.

FIG. 203.

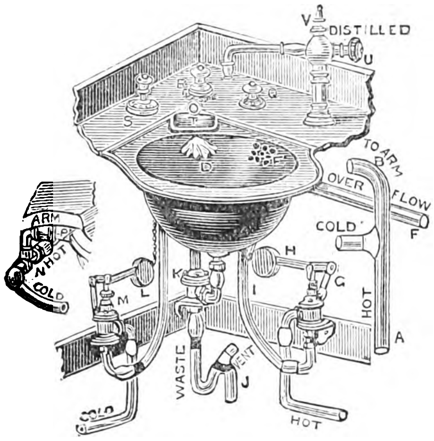


FIG. 204

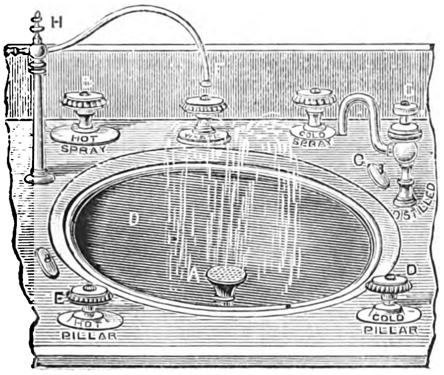


Fig. 204 illustrates the top part of a very beautiful lavatory, having some additional work. This has the usual waste-pipe, as at Fig. 198 (see waste-pull), it also has screw-down valves fitted below the slab instead of the lever arrangement. The reason for the employment of these screw-down valves is, that they may be adjusted to any pressure, so that the water may fountain or spray up at any required temperature or force. A shampooing pillar B is also provided with rubber tube and rose, which can be attached at a minute's notice, and in such a manner that both hands are at liberty to wash, &c. There is also a pillar G, for filtered or distilled water.

The hot and cold water supply valves are fixed below and branched one into the other, so as to allow the water to come up a small pipe fixed *inside* the waste-pipe, but quite separate from the waste-pipe and from each other; the most suitable valve for this work are the ordinary loose valve stop-cocks, fitted with hot-water rubbers and unions, as shown at A B, Fig. 205, or the valves may be of the Shank's, Fell's, or other makers' box pattern, for fixing upon the slab, as illustrated at Fig. 206. A is the cold inlet; B the outlet, which may be taken to the arm of the basin or to the bottom, as in 204; C is the hot inlet; D the outlet, which can be branched into the pipe B; or, as is now the case, be taken separately into the basin. Some plumbers have an objection to the use of valves, especially for hot water. Where this is the case, a good ground-in gun-metal cock must be used, which, under certain circumstances, is far the best. Such a cock, to work with levers, &c., is illustrated at Fig. 207. This is fitted with union A and B. The top of the plug or key has a square hole cored in, so that a square bar of iron will turn the plug or key, instead of having the cock-key K (Fig. 208). When the cock-plug has a square head, and the key K (Fig. 208) has to be used, take care that the rod of the key is not made too long to ride upon the plug of the cock, for, if allowed to do so, it will not only work stiffly, but be apt to jam, so that it cannot be moved to turn the hot-water off or on. Many bath-cocks work stiffly this this account. Occasionally, plumbers will use a three or four-way cock for the hot and cold supply to lavatory basins, such as shown at E J (Fig. 189). When this description of cock is used, caution must be exercised to fix a safe under the plugs, as, in a very short time, especially if working under a high pressure, they are sure to leak, owing to the sudden expansion and contraction of the metal, by reason of the rapid change of temperature caused by the hot or cold water. Another evil will be found if the gland D, in two, three, or four-way cocks, is screwed down too tightly, for these glands are invariably made in such a manner that, on tightening the gland down, the packing is made to *press upon the shoulder of the plug*, which, of course, tends to tighten the plug into the shell, and so cause jamming of the plug or key. It should be remarked that many "cockeys" (cock-makers) call a cock-plug a key (K, Fig. 208), and some a socket; while other firms call it a socket-key, and the handle B is called a lever, cock-lever, bath-handle, &c., &c.

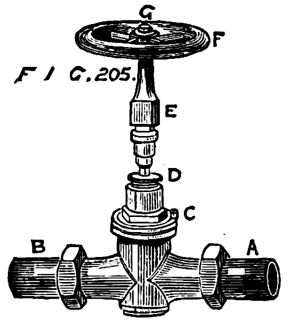
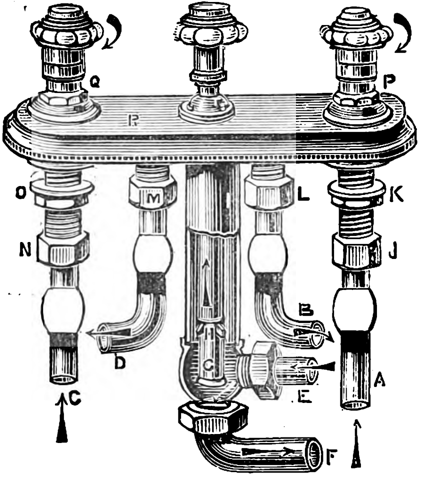


FIG. 205.

FIG. 206.



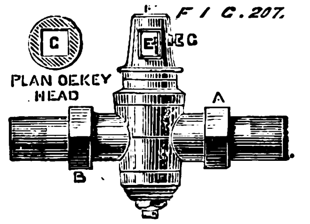


FIG. 207.

FIG. 208

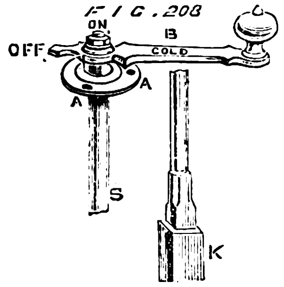


FIG. 209.

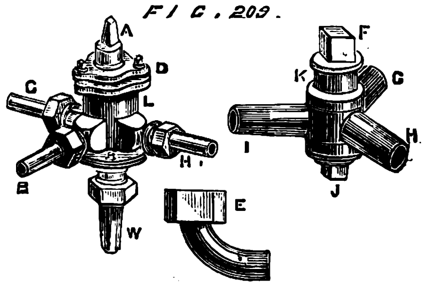


Fig. 210 is a lever having a pointer for indexing when the cock is open, shut, &c., and used for a three or four-way cock.

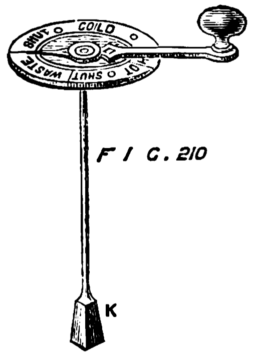
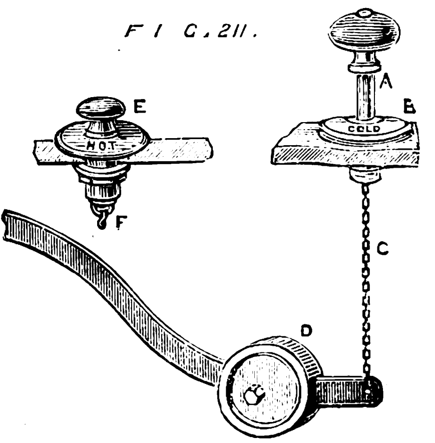


FIG. 210

Fig. 211 illustrates a pull for screwing to the slab or top of the lavatory; A shows it when turned round and held up. This is done by a small pin working within a slot. I J H illustrates the pull and the fly-nut G.

FIG. 211.



THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURAL, AND LODGMENT.*

By JOHN WATSON WARMAN,

Associate of the College of Organists, London.

[90, a.] IT remains only to add that there is one way of Cranking the *Key* which may often be found useful,—viz., by what may be termed *Crank-and-Return;* that is to say, each Key is so sawn out that it presents on *plan*, at the desired point, a small semicircular or segmental Arch, of a deflection equal to Key-tail Semitonal distance. The Sticker or the Wire then rises or otherwise proceeds from what we may call the centre of the crown of this Arch, and thus comes exactly over or under the spaces between the Keys of a Set that is not Skewed or Cranked in any way. By this means a set of Wires, or Trackers, or even of Stickers, may pass through one or more Manuals, and yet allow the latter to be Straight and otherwise unaffected,—as when it is desired to have a Drumstick Coupler working to and fro between such Trackers or Stickers running from said "Arches."

An *Instance* of the preceding Treatment—including a Drumstick Coupler—occurs, or did occur, in the fine 4-Manual Organ erected by Hill in All Saints', Margaret-street, London.

INSTANCES AND EXEMPLARIES OF MANUAL KEY SYSTEMS.

b, We now proceed to give a sufficient number of *Instances and Exemplaries* of Manuals, and of the Key and Coupling Actions immediately involved with them (the Injunctions given being, of course, in harmony with the Regulations just laid down),—which Exemplaries will, as I believe, be found the best under all Normal circumstances.

c. WITH ONE MANUAL. — In Instruments having but ONE Manual, the structure of the latter, and of the Action involved with it, is, or may generally be, of so simple and optional a character, that no particular directions will be here required,—considering that the present *Department* is that of *Manuals*.

d. WITH TWO MANUALS.—*No.* 1 *Treatment.*—This is an Instance furnished in the Organ erected by Nicholson of Worcester, somewhere about the year 1864, for the Parish Church of Faringdon, Berkshire. The Manual Sections are of the usual kind,—i.e., Great and Swell Organs. The Claviers are Projectant from the main Body of the Case, but are not Reversed; the vertical distance apart of the Manual Playing Levels is just under 3in. The General Lay-out of the Inside is of the Normal kind, so far as the Manual Sections are concerned, the Great and the Swell Soundboards being at one same level, and with the latter Section set behind the former; the Palletts of the Great-Organ, and consequently their Pulls, are set at that side of their Soundboard which is nearest to the Player, and they thus come nearly close to the Case-front; the regular Palletts and Pulls of the Swell-Organ are set in the same way, thus coming just beyond the Passage-Board which separates the two Manual Soundboards; but there is a second set of Palletts and Pulls, at the back of the Soundboard, to supply its lowest octave; the Pipe-Order of the Great is Semitonal with the Bass Set-off; and the Pipe-Order of the Swell is with Smallest Pipe at middle. The number of Sounding-Stops is 18. Fuller particulars of this Instrument will be given in *Department* ENTIRE ORGAN.

The Great-Organ Keys are of ample length (see here at *r*, *Bis*, ante), and are perfectly Straight on Plan. The Swell-Organ Keys are of such length that their Tails a little overhang the Great-Organ Key Tails, and are on Plan Skewed aside, so that such [Swell] Tails are exactly the Half Semitonal Key-tail distance "out" (to the *right* hand; see here at 93, *s*). Each Swell-Organ Key is, at a point near its Tail end, Notched-out on both of its side-faces, in order to furnish an opening or passage for the Stickers next mentioned,—these latter having to pass between the Swell Keys without touching them, and consequently without deriving any Guiding assistance from the said Notchings in them (see here the more detailed description already given, at *u*, ante).

The Great-Organ Action commences with a sufficiently long and wide flat Sticker, rising from and Wired into each Key-Tail, and passing—as just said—between the Tails of the Swell-Org. Keys. These Stickers, each of which is provided at its top end with a Regulating Button, act under the Noses of a set of Fanned Backfalls which run at once (excepting of course those for the Set-off Pipes) to the Pull-points vertically beneath each Pallett,—the direction of such running being thus from the said Stickers to a point farther into the Organ than are the latter. Concerning the actual width of these Stickers see more definitely at *h*, next, 7th paragraph.

The Swell-Organ Action commences with a Square of the ┬ form, resting on and thus being in direct contact with each [Swell] Key-Tail. It is, of course, the fore Nose of such Square which is so in contact, the vertical Arm of the same being thus behind its Key-tail, and extending downwards in the usual way for drawing a horizontal Tracker; and the remaining horizontal portion of the Square thus projects backward into the Organ,—in order to form a member of the Coupler Manual to Manual. These Squares are not Fanned, but are set square and parallel,—running direct to a "Whole" Roller-Board.

The structure of the said Coupler Swell to Great is made, with the aid of the rear arm of the ┬-Square aforesaid, by a set of Backfalls, a set of Stickers, and a set of Blocks. The Backfalls are all placed square and parallel, and at the Half Semitonal Key-tail distance apart, and are thus, on Plan, exactly correspondent with the Swell-Org. ┬-Squares: the length of each such Backfall (see here at *g*, next, 2nd parag.) is such as to just exceed the horizontal distance from the rear end of the said ┬-Square to the fore edge of the Great-Organ Sticker. These Backfalls are set at as great a height above the Swell-Org. Manual as is practicable (see again *g*, next, 2nd parag., Defect 3; and at *h*, next, last part of 3rd parag.), and at such an area posit that their fore Noses enter just between the Great-Org. Stickers; consequently, the rear ends of these Backfalls come—the Swell Key Tails having (as already said) been Skewed—exactly vertically over the rear ends of the ┬-Squares. A Sticker, having its lower end furnished with a Regulating Button, runs down from each Backfall rear-end to the corresponding rear-end of the ┬-Square, thus uniting these two ends. Affixed to the side-face of each Great-Org. Sticker, and at such a level as to come exactly beneath the fore-Nose of the Coupling Backfall, is the small driving-Block,—Buffed at its top surface. The Coupler is, of course, thrown into or out of Action by the lowering or the raising of the Beam carrying its Backfalls.

The Contact of the Coupler Great to Pedale is made by means of an Ordinary Sticker, Wired into the Tail end of its Manual Key in the usual way (see here again at *r*, *Bis*, ante).

The Contact of the Coupler Swell to Pedale is made (see *g*, next, 3rd parag.) precisely as is the Great to Ped., except that, owing to the presence of the Square Nose directly on the Key-tail, the Wire of the [Swell to Ped.] Sticker is obliged to be kept sufficiently forward to allow the said Nose to be set behind such Wire.

e. The Treatment that has now been described possesses a large number of good points, of which the chief are the following:—(1) There is no actual Crossing of one *Action* by another, the passing of the Great-Org. Sticker between the Swell-Org. Keys being really all the Crossing existent. (2) The Great-Org. Manual easily admits of Regulation at the Front—by means of the Button already mentioned—, and this without disturbing the Regulation of the Coupler Swell to Great. (3) The whole of the Coupler Manual to Manual can be easily and quickly Removed, and taken entirely to pieces. (4) The Swell-Org. Keys, *except* those connectable with the Pedale (see *g*, next, 1st parag.), are also readily Removable. (5) The Manual-to-Manual Coupler, even when taken all to pieces, can be made to retain its Regulation unaltered, because every piece of which its mechanism is composed admits of being Numbered. (6) Simplicity is ensured in the structure, as all the Actions consist of the fewest practicable number of parts. (7) The amount of the work Skewed is slight, being confined to the Swell Keys, and to the Backfalls of the Coupler Swell to Pedale; and the Skew of even these is definite and easy, being *exactly* (see *m*, next, 11th parag.) the Half Semitonal Key-tail distance. (8) The Overhang of the Swell-Organ Key-tails gives an approach to uniformity in the lengths of the Keys of the two Manuals (see *g*, ante). (9) The Man.-to-Man. Coupler is rendered perfectly independent of any Skewing or Fanning in the Backfalls which lead from the Great-Organ Keys. (10) The Fanning of these Great-Organ Backfalls permits of the 1st Stickers of this Section's being made of good length,—desirable in this particular case (see again *g*, next, 2nd parag., Def. 3; and *h*, next, last part of 3rd parag.), and yet for the Wind-chest of such Section's being kept at a level sufficiently low to avoid difficulties through restricted height,—such restriction also being here the fact (see *l*, next, 4th parag.): a *Whole* Roller-board to the Great Organ would, indeed, have been here almost impracticable,—at all events with Wooden Roller-stocks.

These Advantages speak for themselves. As regards the second-named of them, the reader should now turn to certain Heads (as at *m*, next, 11th and 13th parags.) for some abstract consideration of the question of Front Regulation, and as to under what circumstances it is, and under what it is not, desirable. As concerns the seventh named, it is to be borne in mind that the Skewing of the Keys of one of a pair of Manuals, and the consequent "throwing out" of one set of Key-tails relatively to the other set, are not here in one respect of moment, because, as one same Pipe Order is *not* observed in the two Manual Sections, one Setting-out cannot possibly be made to serve for *both* of the Roller-boards of such Sections: also the Skewing of the Swell-Org. Keys here prevents any Skewing in the Backfalls of the Coupler Swell to Great. But the said throwing out interferes with the provision of a *Clear* Coupler (see directly with *Defects*, at *g* next, 1st parag.).

At this point collate the present Arrangement with that of the Hoddesdon Instrument (comm. at *m*, next).

(*To be continued.*)

WATCH-CLEANING AND REPAIRING.

By "A FELLOW-WORKMAN."

(*Continued from page* 277.)

YOU will find that the drill-bow is not satisfactory, as the chuck being rather heavy, it objects to being suddenly stopped and reversed in motion, which should be done very carefully; but a driving-wheel may be easily fitted, by having your standard B about 6in. higher than the rose at A. A wheel may be fitted as shown Fig. 58, which will enable you to turn out some excellent work; but everything depends upon the way in which you go to work; it is the general fault with amateurs to be over-anxious and impatient: they want to get the job done to see how it will work; they don't give themselves time to think about what they are doing. They file away at random, don't stop to see whether they are filing round or flat, offer it when it is too late, then *try* and make a "do" of it, succeed in making a "neetle creeper" of it, then try and do a job with it. After wasting time and material, they come to the conclusion that "they don't believe it is possible for anyone to do it"; but if you will follow my advice, I will show you how to make one of the prettiest and most interesting tools that ever entered a workshop, at a very trifling cost. A, Fig. 54, is made of steel, with brass rose or ferrule; it should be turned up, and drilled in the turns; the standard B should be made of brass, and should be stout and firm, cut out a piece at the bottom so as to fit firmly over the body of your turns, then make a square hole right through and drive in a plug, or wedge R; now cut a slot in B to receive foot J, and dovetail it in, same as in a potence, and make it firm with soft solder; put it in its place in the turns; now put on piece which holds drill H, which should run a true centre; push the drill up against the face of B, and make a centre mark; now remove drill and put in its place a female centre; now take a good pivot-drill, shorten it by cutting it off with a file—don't bend it, as it is necessary that it should be perfectly straight; leave sufficient of the drill to go just through B. Now put the back of drill in female centre, and point of drill in the centre mark on B. Turn the drill gently with a light bow, and press lightly with the bar having the female centre; when you have drilled half-way through B, go through a similar operation on the other side of B, and, if you have worked true, your holes should meet. Now take a piece of steel wire a shade smaller than the hole required, put it in the turns and turn a point at the end (that should be true with the outside) the same size as small hole already made in B. Now make the end, as shown Figs. 59 and 60, the cutting edge should be at angle, A to B, Fig. 59. If you get it too acute it will jabber; you must use a half-round file to get the sides. Fig. 57 is the driving-wheel, A is Fig. 56, B is standard, C handle, D wheel, E pinion, which is held by nut screwed on other side of B, and a little pin to hold wheel from slipping off. The wheel should be made of hard wood, weighted with lead. The groove can be made, after the wheel is weighted, by setting it spinning and holding some sharp instrument against it, unless you can get some friend to turn you up one. Now turn up a harbor for chuck C 57, fit it into chuck and solder it. Now I will return to the barrel: you make the small hole first to fit the small pivot of arbor: if the large hole is in the cover, you can then make large hole; but if the large hole is in barrel you have simply to remove the cover and *enlarge* the other hole.

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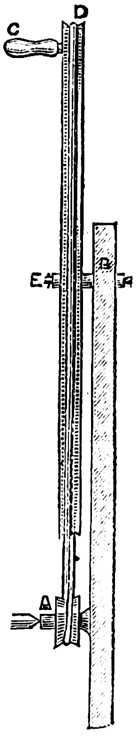
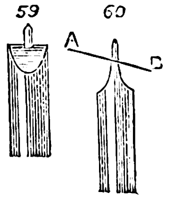
FIG. 58.



FIGS
59 60



(*To be continued.*)

A LIGHT ELECTRIC MOTOR.

UNDER the heading "Etudes Préliminaires pour la Construction d'un Moteur Electrique Léger," M. Tissandier gives, in *La Nature*, an instructive account of a bichromate battery and experiments made with it. After numerous experiments for determining the best composition of the exciting liquid, the nature of the receivers, the limits of thickness one might give the carbons and the zincs, the number of these latter in each element, in order to a maximum production with a minimum weight, he was led to make a large surface-model, which has so far given satisfactory results. The twenty-four elements mounted in tension, drove a small Gramme motor of half-horse power. The work produced, measured with a Ruffard brake, was about 14 kilogrammetres* per second during an hour, and 10 kilogrammetres in the following hour. The Gramme motor was not specially made to work with the batteries, and the conditions were unfavourable; still, it is proved that bichromate batteries offer much greater constancy than has been supposed.

The new type of battery consists of an ebonite trough 3mm. thick, and measuring 0·35m. long, 0·16m. deep, and 0·14m. broad. In it were placed vertically thirteen carbons and twelve amalgamated zincs alternately. The carbon-plates are 2½mm. thick, the zinc plates about 1mm. These plates are fixed with pincers to longitudinal bands of copper, which, in their turn, are screwed on the outer edges of the ebonite trough. Notwithstanding its lightness, the element thus mounted is very solid, and may be shaken violently without carbons or zincs being the least deranged.

The ebonite vessel has, at its lower part, a tubulure by which it communicates through a caoutchouc tube, with a receiver containing bichromate solution. On raising the receiver above, or lowering it below, the level of the battery element, the latter is filled or emptied; that is, is made to act or stopped. The element contains about four litres of liquid;† and the solution being very concentrated, its electric resistance is less; so that the interior resistance is diminished to advantage of the production. The total weight does not reach 8 kilog.

The production (*debit*) of this battery is variable, and may become very considerable when the exterior resistance is slight. In an experiment with a hot and very concentrated liquid, a mean current of 110 ampères was obtained during 20 minutes, with a difference of potential at the binding screws of 1·68 volt. This represents a yield in disposable work of 18 kilogrammetres per second. The ebullition was so impetuous that the liquid was driven violently out of the vessel, putting an end to the experiment. Under these conditions, the electric energy at disposal corresponded to a horse-power with a weight of 33 kilog. One would not seek to obtain this result practically; but the efficiency in normal conditions is still pretty favourable with a less production; and then the battery will work in a continuous and constant manner during an hour and a half to two hours.

The following figures give a fair idea of what may be obtained; they are the average of a series of experiments made on resistances of variable discharge.

A battery of eighteen elements, mounted in tension, weighs 140 kilogs. In a circuit of 0·54 ohms resistance, it will give a disposable electric energy of 135 kilogrammetres per second during about an hour and a half, with a current of 50 ampères. A suitable motor will yield, at the brake, 100 kilogrammetres of the 135 at disposal in the exterior circuit. The motor will weigh about 50 kilograms; thus the result reached is as follows:—

With a weight of 200 kilogs. battery and motor, it is possible to produce a continuous and constant work of 100 kilogrammetres per second, during an hour and a half.

But this result (the author proceeds) obtained in our preliminary researches is far from being the "last word" in solution of the problem of light batteries with large yield. Some experiments already made enable us to affirm that the production of electricity may be prolonged. (1) By agitating the liquid, which is easy with use of communicating vessels; (2) by adding fresh quantities to the warm and exhausted liquid ; (3) by using M. Reynier's enveloper (or partition) for the negative.

A battery of 18 elements, weighing 140 kilog., the weight of two men, might thus, very probably, furnish, during more than two hours, a work of 1¼ to 1⅓ horse-power, or of 12 to 15 strong men. Such a battery with its motor, would be easily raised in a small elongated aërostat, presenting little resistance to the air.

M. Tissandier further studied the mode of action of a two-vaned screw (2·8m. in diameter), driven by a small Siemens dynamo, weighing 65 kilogs. The vanes had an inclination of about 35°. The motor was actuated by Faure accumulators, made by M. Reynier. With 40 of these, mounted in tension, the screw made 100 turns in the minute, the coil of the motor making a thousand; the work was about 80 kilogrammetres.

The air-current produced was intense at 102 metres from the apparatus, and could be felt distinctly at 10 metres distance.

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* It may be useful to remind readers that the kilogram = about 2⅕lb. avoird.; the metre 40in.; the millimetre ·04in.; the litre 1¾ pint.

† The composition of the liquid (in weight) is: water, 100 parts; bichromate of potash, 16; sulphuric acid, 37.

THE ELECTRIC ARC IN VACUO.

IN a note communicated to the French Academy of Sciences, MM. Jamin and Maneusier describe some experiments they have made with an electric arc in vacuo, the current being furnished by a Gramme machine. Having taken an egg-shaped glass tube and placed in it two carbons of ·15 metre length and 4 millimetres diameter, arranged point to point, and separated by an interval of 4 millimetres, when the vacuum had attained about 12 millimetres light began to break forth, not only in the form of a highly-luminous arc between the carbon points, but from all parts of the carbons, and similar in appearance to that ordinarily seen in Geissler tubes. Each carbon was surrounded by a blue aureola, that of the positive carbon being the paler. The carbons subsequently became heated, reddened, and then got white hot, not only at their ends, but throughout their length; they were then rapidly volatilised by the combined effect of the heating and the electrical currents. Whatever be cause of this volatilisation it is certain that carbonaceous matter is given off in a vaporous state. The vessel or tube is filled with a blue gas somewhat similar to the vapour of iodine which gradually deepens to the colour of indigo. Afterwards the vapours are condensed on the sides of the vessel, which become opaque, and that ends the experiment. The deposit thus collected resembles finely-divided carbon, and dissolves with effervescence and incandescence in nitric acid. Is it pure carbon, or is it a composition of hydrogen and carbon? This is a question which is reserved for further experiments. To avoid this summary termination of the experiment, the single carbons were replaced by two bundles of similar carbons. In this case, the currents divided into a large number of flows, less intense than the single flow; all the carbons gave light at the same time, and, heated the less, the more numerous they were. There was hardly any volatilisation, and the effect was prolonged as long as one wished. The carbons were then replaced by copper rods ·003 metre diameter. The same effect was produced with still greater success. If the current was too strong the copper melted. It always partly volatilised, and was deposited in a thin layer on the glass. It is plain that the experiment can be varied by using different metals, different gases, and by operating under different pressures.

WHY WE COUGH, AND HOW WE COUGH.

EVERYBODY coughs sometimes, and, judging by the quantity of patent cough medicines sold, many people must be coughing all the time. Most persons suppose that a cough is a cough, the world over, and what will cure one will cure another; and so they prescribe for themselves and their friends all sorts of sirups, home made or proprietary, with the consoling assertion that "it can't do any hurt if it don't do any good." How do you know it can't do any hurt? Do you know its ingredients, and, if so, have you studied their effects upon the system in health and in disease? Do you know the condition of the patient you are prescribing this for—his constitution, his habits of life, his past history?

Let us see what a cough is. It is a sudden and forcible expulsion of the air from the lungs, preceded by a temporary closure of the wind-pipe to give additional impulse to the current of air. The effect of these spasmodic expirations is the removal of whatever may have accumulated in the air-tubes, whether a foreign body from without, as when a particle of food finds its way into the wind-pipe, or an accumulation of mucus secreted by the air-passages themselves.

Coughing is in part a voluntary act. We can cough whenever we wish to, but frequently we are compelled to cough when we don't wish to. Nerves are divided into two classes, sensory and motor nerves. The former carry intelligence to the brain; they report any disturbance on the frontier to headquarters. The motor nerves then carry back the commands of the general to act. You tickle a friend's ear with a straw, and his hand automatically proceeds to scratch the itching member. A tickling sensation is produced in the throat by any cause whatever; the brain then sends back orders to the muscles concerned to act so as to expel the intruder, in other words to cough. And that is how we cough.

The source of the impressions may be various. Frequently it is due to an irritation of the respiratory organs by foreign bodies, dust, and acrid vapours, admitted with the air in health, or to damp, cold air itself, if the organs are particularly sensitive, or to the presence of mucus, pus, or blood, in disease. Inflammation, from whatever cause, acts as a source of uneasiness.

There are, as we all know, many different kinds of cough. Thus we have the dry cough without expectoration, and the moist cough with expectoration. We have the short, hacking cough, resulting from slight irritation, and the violent, spasmodic, and convulsive cough, caused by a greater degree of irritation or some peculiar modification thereof. Then there are the occasional, the incessant, and the paroxysmal cough, terms that explain themselves. Hoarse, wheezing, barking, and shrill coughs are due to the tension or capacity of the rim of the wind-pipe or other portion of the tube. The hollow cough owes it peculiar sound to resonance in the enlarged tubes or the cavities in the lungs, if such exist. Sometimes the exciting cause of a cough lies not in the lungs and respiratory organs, but in the stomach, liver, or intestines. In other cases there seems to be no real cause; it is purely nervous or hysterical.

Cough remedies should be suited to the kind of cough in question, and attempt, if possible, to remove the cause. It is evident that a cough may be lessened either by removing the source of irritation, or by diminishing the excitability of the nervous mechanism through which it works. Both methods are generally employed, and most of the popular cough medicines consist of an expectorant and a sedative, in some mucilaginous or saccharine menstruum. Sedatives lessen the excitability of the nerve centre through which the act of coughing is produced. Opium in sufficient quantities will stop any cough, but if the secretion goes on accumulating, the patient must be allowed to cough, or he dies of suffocation.

Glutinous and saccharine substances lessen irritation, and as it frequently happens that much of the irritation which occasions the cough exists at the root of the tongue, and in portions of the throat which can be reached by troches and lozenges slowly dissolved in the mouth; hence these often afford relief, especially in dry, hacking coughs and the so-called tickling in the throat. Iceland moss, marshmallow, and gum arabic belong to this class. Their power is probably due to their covering the inflamed and irritatable surface directly with a mucilaginous coat, and thus protecting it from the action of the air and other irritants. An inflamed surface, whether within or without, is rendered worse by friction; therefore, in bronchial troubles, the inflamed surfaces are greatly irritated by the very act of coughing. Hence, persons are advised to "hold in," or try to refrain from coughing. All coughing beyond what is absolutely necessary for the removal of the accumulated mucus should be avoided, because it injures the parts affected by friction, and because it exhausts the patient; or the muscular exertion involved in a violent fit of coughing is very considerable indeed, and the muscular effort exerted by a patient with a bad cough during the twenty-four hours is really more than equivalent to that of many a man in a day's work. Both sedatives and mucilaginous substances can be employed, then, to check the excessive amount of coughing over and above that required to relieve the lungs and bronchial tubes of their accumulated mucus. To facilite the removal of this, expectorants of various kinds are administered, according to the necessities of the case.

The difficulty in the way of recommending any one kind of cough remedy is that different coughs require different treatment, and what will relieve one may aggravate another. Then, too, the general health of the patient must be attended to, and the secretions kept open, etc. In short, the maxim, "What is one man's meat is another man's poison," applies here as elsewhere, and induces us to protest against the use of any nostrum simply because it cured a neighbour.—*Medical Weekly* (U.S.)

SOME NOTES ON ALLOYS.

In a recent work on "Metal Alloys," published in Germany, the author, M. Guettier, gives a few suggestions on the subject of fusing the metals:—1. The melting-pot should be redhot (a white heat is better), and those metals first placed in it which require the most heat to fuse them. 2. Put the metals in the melting-pot in strict order, following exactly the different fusing points from the highest degree of temperature required down to the lowest, in regular sequence, and being especially careful to refrain from adding the next metal until those already in the pot are completely melted. 3. When the metals fused together in the crucible require very different temperatures to melt them, a layer of charcoal should be placed upon them, or if there is much tin in the alloy, a layer of sand should be used. 4. The molten mass should be vigorously stirred with a stick, and even while pouring it into another vessel the stirring should not be relaxed. 5. Another hint is to use a little old alloy in making new, if there is any on hand, and the concluding word of caution is to make sure that the melting-pots are absolutely clean and free from any traces of former operations.

Soft Alloy.—This alloy will adhere so firmly to metallic, glass, and porcelain surfaces that it can be used as a solder, and is invaluable when the articles to be soldered are of such a nature that they cannot bear a high degree of temperature. It consists of finely pulverised copper or copper-dust, and is obtained by precipitating copper from sulphate, by means of metallic zinc. Twenty, 30, or 36 parts of this copper-dust, according to the hardness desired, are placed in a cast-iron or porcelain-lined mortar, and well mixed with some sulphuric acid having a specific gravity of 1·85. Add to the paste thus formed 70 parts (by weight) of mercury, constantly stirring. When thoroughly mixed the amalgam must be carefully rinsed in warm water to remove the acid, then laid aside to cool. In ten or twelve hours it will be hard enough to scratch tin. When it is to be used it should be heated to a temperature of 375° C., when it becomes as soft as wax by kneading it in an iron mortar. In this ductile state it can be spread upon any surface, to which, as it cools and hardens, it adheres very tenaciously.

Alloy for Small Articles.—This alloy melts at a lower degree of temperature than the one just described, and is very hard without being brittle. Bismuth 6 parts, zinc 3 parts, and lead 13 parts. The three metals, after having been well melted and stirred together, should be poured into another melting-pot and melted again. This alloy cools with remarkably clear-cut edges, and if the articles made of it are dipped in diluted nitric acid, then rinsed in clear water, and polished with a woollen rag, the raised parts of the surface will have a fine polish, while the sunken parts will have a dark grey, antique appearance, which forms a pretty contrast. The proportions of the different metals, dividing the alloy into 100 parts, are: bismuth 27·27, lead 59 09, zinc 13·64.

Alloy for Small Castings.—Bismuth 6 parts, tin 3 parts, lead 13 parts. This alloy should be melted, run into bars, and laid aside till wanted, when it should be remelted. Bismuth 3 parts, tin 1 part, lead 1 part. This second alloy for small castings is harder, and yet it is not brittle. It can be finished with a contrasting surface of bright polish and dark grey, if it is washed in nitric acid, well diluted, rinsed, and polished with a woollen rag, as described in the alloy for small articles, given above.

White Alloy.—This amalgam can be turned, filed, and bored; does not adhere to the mould, and will retain its polish a long time after exposure to the air. Cast iron 10, copper 10, zinc 80.

Alloys for Medals, Coins, &c.—Kraft's alloy, melting point 104° C. Bismuth 5, lead 2, tin 1.

Homberg's alloy, melting point 122° C. Bismuth 3, lead 3, tin 3.

Rose's alloy, melting point 93° C. Bismuth 2, lead 2, tin 2.

Amalgam for Coating Plastic Castings.—Tin 1 part, mercury 1 part, bismuth 1 part. The quicksilver is to be mixed with the white of an egg, and added to the tin and bismuth when they are thoroughly melted and blended. The alloy while still hot forms a pasty liquid, which should be applied with a brush.

THE GREENWICH VISITATION.

The annual visitation of the Royal Observatory Greenwich, took place on Saturday last. The Astronomer-Royal, Mr. W. H. M. Christie, presented the annual report to the Board, which stated that the course of observation which his predecessor in office, Sir G. B. Airy, had carried out for so many years had been continued without essential alteration in the main features. No alteration has been made in the subjects of observation, which continue to be the sun, moon, planets, and principal stars, with other stars from a working catalogue of 2,500 stars. It is proposed soon to prepare a new working list, extending the catalogue to stars of the sixth magnitude. About 1,600 stars were observed in 1881. Observations with the transit circle made in the year ended May 20 were as follows:—Transits, the separate limbs being counted as separate observations, 4,374; determinations of collimation error, 304; determinations of level error, 312; circle observations, 4,283; determinations of nadir point, 311; reflection observations of stars, 394. Fifteen observations of Comet *b*, 1881, four of Comet *c*, 1881, and six of Comet *a*, 1882, have been obtained on the meridian S.P., the latter being continued. A new determination of the flexure was made on January 2 last, the resulting value being + 0 03″. The mean of time determinations since the beginning of 1879 is + 0·13″. The following observations have been made with the altazimuth for the year ended May 20:—Azimuths of the moon and stars, 697; azimuths of the azimuth-mark, 404; azimuths of the collimating-mark, 410; zenith distances of the moon, 404; zenith distances of the collimating mark, 406. The number of places of the moon observed is, with the transit-circle, 108, or 8·8 per lunation; with the altazimuth, 190, or 15·4 per lunation. The diameter has been measured, with the transit circle, three times in R. A., 13 times in N. P. D.; with the altazimuth, 13 times in azimuth, 35 times in Z.D. Thirteen occultations of stars by the moon (10 disappearances and three reappearances) and 30 phenomena of Jupiter's satellites have been observed. Comet *a*, 1882, has been observed on seven nights with the Naylor equatorial. The solar eclipse of May 17th was observed for determination of the corrections to the moon's R.A. and N.P.D. and to the diameters of the sun and moon. During the eclipse, which only lasted an hour and 12 minutes, 18 differences of R.A. of cusps, 10 differences of N.P.D. of limbs, and 9 differences of N.P.D. of cusps were observed. A few sketches of Mars were made last December with the south-east equatorial, and on December 30th a measure was obtained of an object supposed to be Deimos, the outer satellite. The sun's chromosphere has been examined with the half-prism spectroscope on 36 occasions, and each time prominences were seen. On one day, a detailed examination of the whole spectrum of the chromosphere was made at 24 points of the sun's limb. Several prominences have shown great changes in the course of two or three minutes, and large displacements or contortions of the bright lines have been noted. In particular, a prominence examined on May 13th was observed to rise through a space of about 30″ in less than two minutes, being at the rate of about 110 miles a second, while the C line showed a displacement towards the red, gradually increasing from 1¼ to 11·4 tenth-metres, corresponding to a motion of recession increasing in two minutes from 36 to 330 miles a second. A comparison of the successive determinations of the motion of Sirius indicates a progressive diminution from about 22 miles a second, in 1877 and 1878, to about seven miles a second, or less, this year, and, as other stars do not show anything similar, it appears likely that the change is due to the orbital motion of Sirius. Photographs of the sun have been taken on 200 days, and 352 have been selected for preservation. There were only two days out of 200 on which the sun's disc was observed to be free from spots. There has been a large increase in the number and size of spots and faculæ, the mean of the daily arrears for each in 1881 being nearly double those for the year preceding, and the increase is still continuing, though with well-marked fluctuations. A very remarkable outbreak of spots occurred in April last. The following are the principal results for magnetic elements for 1881:—Approximate mean westerly declination, 18° 27′; mean horizontal force, 3·915 in English units, 1·805 in metric units; mean dip, 67° 33′ 45″ by 9in. needles, 67° 34′ 54″ by 6in. needles, and 67° 35′ 5″ by 3in. needles. On September 12 and 13 and April 16 and 19 magnetic storms have occurred, the latter being of more marked character than any that have taken place since the great storms of the year 1872, and it is a significant fact that exceptionally large spots made their appearance on the sun shortly before. Smaller magnetic movements are now also much more frequent, exhibiting a marked constrast to their general appearance some two or three years ago. In regard to the long-period variation of about 11 years, it can now be stated definitely that the *minimum* as regards diurnal range of declination occurred at the commencement of 1879, while, as regards diurnal range of horizontal force, it occurred unmistakably earlier, about August, 1878. The mean temperature of the year 1881 was 48·7°, being 0·6° lower than the average of the preceding 40 years. The highest air temperature was 97·1° on July 15th, and the lowest 12·7° on January 17th. The mean temperature was below the average 6·7° in January and 4·8° in October; and above the average 5·9° in November. In other months the temperature differed little from the average. On four days in July the temperature rose above 90°. The mean daily motion of the air in 1881 was 291 miles, being 12 miles greater than the average. In January and September the mean daily motion was 70 miles and 72 miles below the average respectively; in April, August and November it was 70 miles, 60 and 71 above the average respectively. The greatest daily motion was 999 miles, on October 14th, the day of the great storm, and the least, 59 miles, on May 25th. A velocity of 61 miles an hour was recorded on October 14th, and one of 58 miles on April 29, these being both greater than any recorded in previous years. The greatest pressure was 53lb. on the square foot, on October 14; on April 29 a pressure of 49½lb. was recorded at a time when the hourly velocity was 50 miles. The number of hours of bright sunshine recorded by Campbell's sunshine instrument during 1881 was 1,301, which is more than 100 hours above the average of the four preceding years. There has been only one case of accidental failure in the automatic drop of the Greenwich time-ball. On four days the ball was not raised on account of the violence of the wind. The Deal ball has been dropped automatically at 1h. on every day throughout the year, with the exception of 15 days, on which there was either failure in the telegraphic connection or interruption from telegraphic signals continuing up to 1h., and of one day when the current was too weak to release the trigger without the attendant's assistance. On three days high wind made it imprudent to raise the ball. The Westminster clock has continued to perform well, its errors having been under one second on 40 per cent. of the days of observation; between one second and two seconds on 44 per cent.; between two seconds and three seconds on 14 per cent.; and between three seconds and four seconds on 2 per cent. Time-signals, originating in the Observatory, are distributed at 10 a.m. and 1 p.m. to all parts of the country by the Post-Office telegraphs.

ELEMENTARY LESSONS IN DRY-PLATE PHOTOGRAPHY.—XI.*

Varnishing the Negative—Printing.

THERE are many printing proceesses, all of which may be studied with advantage by the amateur. Each one has certain advantages, and some are especially suited for certain purposes; but the process which, on the whole, has held its own against all others, and which for general purposes seems not likely to be soon superseded, is that known as "silver printing on albumenised paper."

"Ready sensitised" albumenised paper is now an article of commerce, and its convenience is so great that we should recommend its adoption by the beginner, and shall here describe the manipulation of such paper before we give instructions in the sensitising of paper for immediate use. When the photographer has thoroughly mastered the process of printing, he will probably find that he can gain a higher degree of excellence by sensitising his own paper; but certainly at first the contrary will be the case.

It is advisable to take a trial print from every negative before the process of varnishing is performed, and, in fact, if ready sensitised paper, which is always quite dry, be used, varnishing is not absolutely necessary. It is very advisable, however, and we shall describe the process before entering on the subject of printing.

After the negative is thoroughly washed and quite dry, take it by that corner which, were it a printed page, would be the left-hand bottom corner. Let it be warmed gently over a gas-burner till it feels just warm enough to be pleasant to the touch. If a gas-burner fixed above the level of the operator's head be used, a good criterion of the proper temperature is gained by watching the moisture which condenses on the plate from the water formed by the gas-flame. When the moisture at first condensed is dispersed, and no more will condense on the plate, it is just at the right temperature. Let the plate be now held level by the corner mentioned between the finger and thumb of the left hand, whilst the varnish bottle is held in the right hand. Let a large pool of varnish be gently poured on to the centre of the plate. This pool should cover about half of the area of the plate. Let this plate be gently "tipped" so as to cause the varnish to flow first to one corner and then to another, beginning at that opposite to the one by which it is held. When the varnish comes round to the bottom right-hand corner, let the plate be tipped slowly up to a vertical position, so that all the excess of varnish may flow back into the bottle. The plate must be rocked from side to side during this part of the process to prevent the formation of crapey lines. When all the excess of varnish has flowed off, the plate must be again warmed—this time till it is about as hot as the hand can bear. When it is cold it is ready to be printed from. There is a vast difference between plates as to the ease with which the varnish will flow over them. The process is one which should in no case be performed over a choice carpet.

In printing with albumenised paper a printing frame is used. The apparatus is of various forms, but all these forms have the same object. They keep the paper in close contact with the negative, and are so constructed that one half of the print can be examined at any time, whilst the other is kept in contact with the negative to prevent it from slipping. In frames made at the present day the necessary pressure on the backs is gained by the use of springs. For small negatives, the frame is usually made exactly to fit the plate. In the case of large negatives—above whole-plate, for example—the frame is generally made somewhat larger than the negative for which it is intended, and is fitted with plate glass, against which the negative is placed. The pressure of the springs would be liable to break a large negative were it not thus protected. In the case of large negatives it is also necessary to use a pad of felt between the paper and the back of the frame to insure contact.

We shall suppose that our beginner has purchased a printing frame and a certain amount of ready sensitised paper. Let him cut the paper to about the size of the negative he has determined to print from. Now let him place a piece of paper under the negative in the frame, and place the whole outside in a bright diffused light. It is not generally advisable to print in full sunlight. After the operation has gone on for a short time—say five or ten minutes—the result may be ascertained by taking the frame into a weak light and examining the print, one half at a time. The print must be made considerably darker than is required finally. The exact amount of depth that is lost in the after processes can only be learned by experience, but we may roughly say that it is necessary to print for about twice as long a time as that required to give a pleasing result in the frame.

When the desired number of proofs have been printed, the paper should be trimmed to the correct size. This is generally done with scissors, using "cutting moulds," or thin plates of glass, which can be had of any size. Many prefer to trim their plates after they have gone through the various processes of toning, fixing, and washing; but there are various advantages in trimming before toning. The clippings, if kept, become, when a large quantity has accumulated, of value; there is a saving of toning solutions, and the trimming is far easier to do before washing, as the paper lies flat; whereas, afterwards, it curls up in a way which makes it difficult to manipulate.

The following solutions should be prepared for toning:—

Chloride of gold..........	15 grains
Acetate of soda	1 ounce
Water	15 ounces

The chloride of gold is purchased in small sealed tubes holding fifteen or thirty grains each. One of these tubes is placed in a bottle capable of holding the whole solutions; when there it is broken by striking it with a glass rod, due care being taken not to break the bottle, which is quite possible. The acetate of soda is then added, and the water being poured in, the whole is shaken till the acetate dissolves. The solutions must be kept at least twenty-four hours before being used, and must not be exposed to a strong light. It should be labelled, "Toning solution, one grain to the ounce." The other solution which is required is one of three ounces of hyposulphite of soda to each pint of water, and should be labelled "Fixing solutions for prints."

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* Condensed from the *Photographic News.*

USEFUL AND SCIENTIFIC NOTES.

M. PODEK, of Breslau, finds that the chief poisonous agent in illuminating gas is carbonic oxide.

M. DAUBREE, as president, and the members of the committee appointed by the French Government to consider the best means calculated to prevent accidents from explosions of fire-damp in collieries, have addressed to the Minister of Public Works a report. It will be found to be, in many respects, instructive, especially in pointing out the illusory character of many of the safety lamps and fire-damp indicators which have been recommended.

Balloon Experiments in Germany.—A new steerable balloon, the invention of Herr Baumgarten and Dr. Wölfert, was recently tried at Charlottenburg. It is of huge size, having a capacity of about 473 cubic yards, and is ellipsoid in form, the longer diameter about 58ft. It differs in principle from all other aërostats in that, although inflated with hydrogen, it has no ascensional force; its total weight is about 2 1-5lb. above that of the air it displaces. The means of displacement, in the horizontal or the vertical direction, are a helical system of vanes actuated by machinery in the car. Hence, in making land, the balloon does not requie to be partly emptied, and on reaching the ground it has nearly the same quantity of gas as when it rose. Another novelty consists in the mode of connection of the car. This is rigid. Thus the dangerous bounds or jerks to which the ordinary balloon-car is liable in landing are to some extent avoided. The car being usually suspended by ropes, the system is suddenly relieved of its weight when it touches the ground, so that the balloon shoots up again, giving a series of violent shocks. With a rigid connection the total weight cannot be thus temporarily diminished. The mechanism has a double action; one helix of vanes, or screw propeller, driven in one direction or the opposite, produces ascent or descent, while a couple of screws give horizontal propulsion; in a pretty calm atmosphere the horizontal direction may be modified by working one of the couple alone. The first experiments, it appears, were quite successful. The weather was exceptionally calm. In a second trial a slight accident ruptured the envelope of the balloon, and the car-mechanism was also injured. The experiments are soon to be resumed. The motor, it may be mentioned, has a force of four horse-power and weights 80lb. The cost of charging, each time the ballon is filled, is about £20.

SCIENTIFIC NEWS.

COMET WELLS makes its perihelion passage to-morrow, and may possibly be observed in full daylight with large refracting telescopes on the 10th and 11th inst. The comet seen by the eclipse observers, and photographed on their plates, has not, up to the time of writing, been again detected.

The death is announced of Mr. D. Campbell, the analytical chemist, who was at one time demonstrator to Prof. Graham.

The Midland Union of Natural History Societies holds its fifth annual meeting and conversazione at Nottingham on June 15, excursions being made to Castleton and Belvoir Castle on the following day. On the morning of the 15th parties will be made up for visits to the Hemlock Stone, near Nottingham, and others to visit the public buildings and factories of the "lace" district.

The council of the Society of Telegraph Engineers and Electricians have offered three prizes for the best original papers sent in on telegraphic or electrical subjects by any person not a member of the council. The prizes will consist of scientific books or apparatus, and will be called the Society's Premium (value £10), the Paris Electrical Exhibition Premium (value £5), and the Fahie Premium (value £5), the council reserving the right to withhold them if none of the papers are deemed worthy of the award. The first award will be made in 1883, for the best papers sent in between the present time and May next.

Mr. E. Berliner, of Boston, Mass., says he finds that a Planté battery is rapidly "formed" when 5 per cent. of alcohol is added to the ordinary acid solution. In practice he connects both lead-plates to the carbon-pole of several Fuller cells, and a carbon electrode to the zinc-pole, thereby developing both lead-plates simultaneously. The carbon electrode is subsequently removed and the lead-plates connected to different electrodes. One hour is sufficient to create a heavy oxide surface capable of taking a large charge.

A new lamp combining gas and electricity is said to have given good results. A small strip of platinum foil is so arranged in connection with the burner that when the gas is ignited the platinum becomes heated, and then offers so much resistance to a current of electricity that it becomes incandescent, and in turn heats the gas to a high temperature. It is stated that a light equal to 30 candles can be obtained from two cubic feet of gas per hour when a small current is used in aid.

From Mr. H. C. Russell, B.A., F.R.A.S., Government Astronomer, New South Wales, we have a paper on the Transit of Mercury, read recently before the Royal Society of that colony, and a copy of the Results of the Rain and River Observations during 1881. The latter is accompanied by a map, indicating the amount of rainfall, and by a chart showing in curves the heights of the rivers during the year. These observations are of very great importance to the colony.

From Mr. T. Fisher Unwin we have another of the "half-holiday handbooks—" "Round Bromley and Keston," a district which takes in a village rendered famous as the residence of Darwin. A neat little map shows the roads clearly, and the notes will be welcomed by the holiday rambler as well as by the naturalist.

Mr. Wragge has established a meteorological station at Stafford, under the charge of Mr. McCullum, the borough surveyor, and his brother. The station is supplied with standard instruments verified at Kew.

The Vienna Electrical Exhibition, which opens in the Autumn, will be held in the Rotunda in the Prater. Count Wilczek has accepted the office of president.

A subterranean forest has been exposed on Lord Normanton's estate near Crowland, Peterborough. It is about 10ft. beneath the surface, and some of the trees are in excellent preservation.

The Friday evening discourse at the forthcoming meeting of the British Association will be delivered by Sir W. Thomson, the subject being "Tides."

Mr. Ranyard, we hear, appears to have missed his ship from Egypt of the 25th ultimo, but is expected home by the next, which arrives about the 13th inst.

The phenomenon of the dark ligament is not peculiar to the transit of planets over the sun's surface. MM. Gonnessiat and Marchant have called attention to an example of it which they observed during the recent eclipse, when a ligament appeared between the indenting limb of the moon and each of three spots just before contact. It was less dark than that in the case of the Venus transit (but darker than the penumbræ round the spots). It did not sensibly affect observations. The dimensions and intensity vary with the aperture of the instruments employed. The authors hold that the phenomenon of the ligament, hitherto thought singular, is to be regarded as resulting from interference of luminous waves which form the focal image, and treated as such. They note the utility of the new case of ligament formation for observation of the Venus transit.

The Photographic Society of Berlin have announced the following subject of prize competition for 1882:—Communication of a method of preparing gelatine, uniform in all circumstances, for emulsion purposes, whether directly from raw materials or from ordinary commercial gelatine. The prize consists of a gold medal and premium. Foreigners may compete; and papers may be written in German, French, or English. They must be sent in before 1st Oct., 1882, to Dr. Franz Stolze, Schwerin-strasse No. 23, Berlin.

With the view of obviating the inconvenience experienced in Paris last year from the summer drought, the municipal authorities have taken measures to increase considerably, this year, the resources for watering, so as to economise the water indispensable for domestic use. Twenty pumps, worked by locomotive steam-engines, will be located at different points, chiefly on the banks of the Seine, and it is estimated that by working these fifteen hours a day, it will be possible, if required, to furnish a daily supply of 6,000 cubic metres, in addition to the normal quantity. The total expense of the new scheme, including purchase of 100 new water-carts, is about 500,000 francs.

Several French railways have adopted systems of electric intercommunication in trains. In that recently introduced on the Chemin de Fer de L'Est (described in *Annales Industrielles*), the general arrangement of circuits is the same as in the Prudhomme system. A special feature is the mode of junction between carriages. A cable bears a ring having the shape of a U with a cross bar. This ring engages in a hook having two jaws, the lower fixed and presenting a groove in which the cross bar catches, the other movable, but pressed down always on the lower and the bar of the ring by a strong spring. In case of rupture of the train, the ring raises the upper jaw of the hook. The alarm-bell is so arranged as not to be set in action by motion of the train. The passenger desiring to signal pulls out a knob on a box fixed to the ceiling (producing electric contact), and it cannot be replaced by him. The act informs the guard of the exact compartment whence his attention is called.

Most methods of determining the carbonic acid in the air require the slow passage of a pretty large volume of air (50 litres at least) over absorbents of carbonic acid; and to the traveller, the size of the apparatus and slowness of the process may be inconvenient. M. Mascart has lately proposed a method, based on direct measurement of the diminution of pressure in a mass of air, at constant temperature and pressure, when its carbonic acid is removed. By this method (of which some details are given in *Comptes Rendus*), the traveller may collect samples of air amounting to about 500 cubic centimetres in glass vessels sealed at a lamp, and afterwards make his analyses at leisure.

A crusade is now being carried on by the Citizens' Sanitary Society of Brooklyn, against the ailantus trees which shade many of the streets of Brooklyn and New York. The tree was introduced from China some forty years ago, heralded by extravagant praises, which led to its extensive use for tree-planting. It was popular for a time because of its hardiness and very rapid growth, but of late years it has been gradually disappearing; the blossoms in spring have a peculiarly unpleasant odour, which it is now reported, is unwholesome, besides causing "prostration of the nervous system," an "oppressive feeling in the throat," "swollen joints," and other afflictions. Under these circumstances, it is not surprising that twenty-two "eminent medical men" and over fifty householders, have signed petitions against the trees.

In a telephone-call which has been brought before the French Physical Society, an electric bell is liberated for action by the movements of the diaphragm. The apparatus is figured in *La Lumière Electrique*. The strong vibrations necessary are produced by means of an ordinary Siemens' whistle at the calling station. They let a plate fall, which acts on a lever and frees the bell. When the call signals have been exchanged, each interlocutor sets up his lever again by pressing a knob. The principle is the same as that of the Ader signal.

At Athens, during a recent congress of Greek medical men, the monuments of the Acropolis were brilliantly illuminated with the electric light.

In view of the Universal Exhibition to be held at Turin in 1884, application has been made by Signor Ivaldi and others to the Communal Council of that place, for the exclusive right to establish on the Po, between the Rocca mills and the ninth bridge, a service of electric boats, driven by special accumulators. They have also applied for gratuitous use, during the exhibition, of the hydraulic force of the river in the locality of the Rocca mills, where their motors will be set to charge the accumulators.

A horse-shoe is now supplied by Herr Schneider, in Berlin, which is claimed to afford horses an elastic and sure footing on stone and asphalte, while the price is not much higher than that of the ordinary kind. The calks, or prominences, are of caoutchouc, instead of iron or steel. The shoe itself is of malleable cast iron, and has pockets, into which the calks are compressed, and fixed by means of rods, which run parallel with the hoof-sole, through the pockets and the calks, and are nutted exteriorly. For horses that have heavy loads to draw, a less elastic material than caoutchouc may be used—*e.g.*, natural or artificial leather. Repeated and long trials have shown that the caoutchouc is worn out uniformly with the iron; but where it may be desired to substitute fresh calks, this can be easily done by the driver himself. A depression in the front part of the shoe serves to receive a short screw-calk when snow or frost sets in.

The progress of the electric light has given a healthy stimulus to the art of gas-illumination; and among recent developments of the latter may be noted a device of M. Clamond, the principle of which consists in burning gas with air raised to a temperature of 800° to 1000°C. The combustion takes place within a cone of magnesia, of special make, which, under the influence of the heat, becomes incandescent, and forms a light-centre of great fixity and remarkable brightness. With small burners, a luminous yield of 1 carcel per 33 litres of gas is obtained; with more powerful, 1 carcel per 27 litres. Certain burners of 4 carcel power require only 100 litres of gas, corresponding to 45 litres per carcel; the consumption of air is about 500 litres per carcel. The magnesia employed resists the excessive temperature about 52 hours; it is then necessary to replace it, but this is done with great ease.

After arriving at an exact method of quantitative analysis of fats, Herr Lebedeff recently experimented with reference to the deposition of fat in animal bodies. He first, it appears, starved two dogs for a month, so that they lost 40 per cent. of their weight, and as earlier observation proved, all their fat. Then they were fed with certain fats of foreign nature, together with small quantities of lean meat. Having in three weeks recovered their normal weight, they were killed. From the tissues of one of them, which had been fed with linseed oil, were obtained large quantities (more than 2½lb.) of a liquid oil, not solidifying at 0° C., and closely agreeing in chemical behaviour with linseed oil. In the fatty tissue of the other dog, which was fed with mutton-suet (melting point over 50° C.), was found, both in subcutaneous parts and the inner organs, and in the muscle fat, a fat almost identical with suet. The experiments are considered to prove a direct passage of foreign or food fat into the cells of fatty tissue of the animal system.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

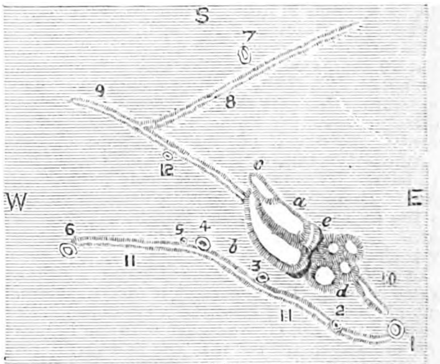
> "I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
> —*Montaigne's Essays.*

SELENOGRAPHICAL—PICO—HELICON—HEVELIUS.

[20120.]—IN No. 868 (Nov. 11, 1881) of the ENGLISH MECHANIC there is an interesting letter of Dr. G. W. Royston-Pigott, in which he refers to the remarkable mountain, Pico. Having, for some time of late, given a good deal of attention to this subject whenever opportunities offered, I am induced to send you the results I have obtained, hoping they will interest your selenographical readers, and induce them to make further observations. For their encouragement I may say that I have not found this to be a more "difficult object to define" than most others on the moon's surface. I am, therefore, inclined to believe that his disappointment with his 6¼in. refractor by Wray was caused more by an improper state of the atmosphere, than from difficulties inherent to this mountain, or from imperfections in his instrument. You will observe that the positions I give to the craterlets near Pico differ but little from those given by Nasmyth and Carpenter, though they agree more closely with the positions given by Dr. Schmidt.

I now copy from my observing-book:—

Pico.—March 30, 1882. 9h. p.m. Air rather unsteady, but clear. Pico is an agglomeration of large, elongated rocks, most of which are closely packed together. As a whole, they run in a N.E. and S.W. direction, with a slight curving southward. It is composed of at least eight mountains, three of which look like hillocks, stand quite isolated, lie on the east, and are of a greyish colour. Of the remaining five the largest is *b*, situated on the N.W. side, and looks like a high ridge about three times as long as it is wide. Its highest point is on the N.E. extremity, and from there it seems gradually to slope down to the plain as it runs south-westward. A round mountain, *d*, lies N.E. of this ridge, so close that at times it looks as if it was its continuation. But on the present occasion a depression between them with shadow was clearly seen. The round mountain *d* is perhaps higher than the highest part of the ridge *b*. Close to this ridge, and along its S.E. side, runs another ridge, *a*, perhaps somewhat higher than the first, but not so long. At the S.W. extremity of this last ridge an elongated hillock *c* lies also close to it. These three objects slope south-westward towards the plain. At the opposite extremity of ridge *a* there is another mountain *e*, forming a kind of step. Doubtless this is not so high as the ridges close to it. Several craterlets and very low ridges are to be found around Pico. Ridge 10, which is the highest, runs on the N.E., and at its extremity is crater 1, easily seen. A second, but very faint ridge, runs from crater 1 to crater 6, and on it are craterlets 2, 3, 4 and 5. They are very small, but chiefly the last. Another ridge, or perhaps only a

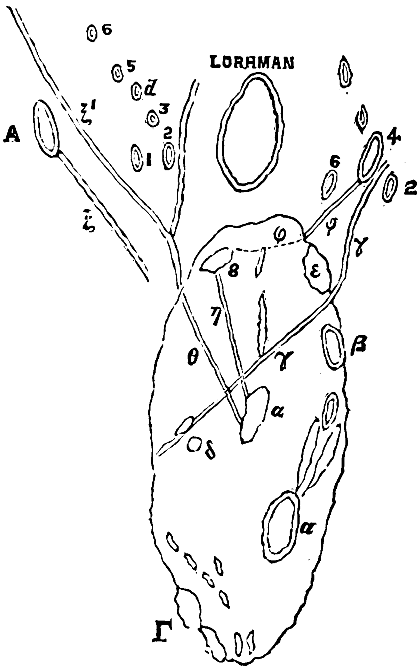


PICO. MAR. 30. 1882 9^{h} P.M. C. GAUDIBERT.

streak 9, runs from Pico south-westward, and on it is craterlet 12 exceedingly small. A last ridge 8 runs from 9 eastward, having crater 7 on its south side. This crater is easy.

Helicon.—E. of Helicon there is a small crater given by Beer and Mädler. On the 1st of April last I found a faint ridge connecting this small crater with Helicon, and on which about midway I found a very minute craterlet.

Hevelius.—As there has been much uncertainty about the positions of the various clefts situated on the floor of this formation, I send you an outline of the same, showing how they appeared to me on April 11, 1882, 11h. p.m., air fluttering. Cleft γ was seen first running from between craters 2 and 4 S.E. of Hevel. forming a curve and running across the floor of Hevel. in a S.E. and N.W. direction. It crosses first some hillocks on the S E. of the floor, passes a short distance from central mountain α, crosses what I took to be an expansion S. of craterlet δ, and reaches the W. side of Hevel. Cleft η was seen next. It runs in a N. and S. direction from the central mountain α to hillock 8 near the S.S.W. rampart. It therefore crosses the rill γ a short distance S.W. the central mountain α. Cleft θ runs in a straight direction from the N.W. side of crater 4 up to the rampart of Hevelius. This portion of the cleft was easy; but from the rampart of Hevelius to hillock 8 on its floor, its continuation was only suspected. It is shown by a dotted line, another cleft θ, only strongly suspected on the above date; but seen without doubt on a subsequent date, runs from the S.W. side of Hevelius, as if it were the continuation of cleft ζ', and reaches the W. side of the central mountain. As these objects have been seen by me only twice, the last time when the moon was very low and the air not satisfactory at all, their positions may require some slight alterations. I hope, therefore, observers will keep a look out on this formation, and report.



Astronomical.

I am sorry I have not been able to answer in time, on account of bad weather, (the question put to me by Mr. Mills (Eng. Mech., No. 891, p. 152), about the position angle of the companion to ζ Cancri. I have had only one occasion just to see this companion, and I estimated its position between 75° to 80°. The power used, when I split this double with 5in. and 5½in., was about 400.

I am sure every reader of the "E. M." interested in astronomy must have read with great interest the letter of Rev. Jevon J. Muschamp Perry in No. 896, p. 260. On May 31, 1882, I looked at some of the stars of his list to try what my mirror could do on some of his most difficult objects. The air was good, but might have been better. I first tried 42 Comæ Berenices, and with power about 300, the highest the air would bear, I recorded "a black division between the discs." Now, as my mirror is only 8½in. diameter, and this star is stated to be 0·4″, it ought to be quite out of its reach. Is it certain the distance is not greater than stated? I next tried 25 Canum Ven., taking care not to look at the position of the companion. After a good and steady gaze, I thought the companion was 160 +. On looking at Mr. Perry's position and distance, I did not believe my eyes. I again looked at the star, and there was the minute companion seen as an elongation of this difficult double. I hope Mr. Perry will continue to give other lists as occasions offer. My mirror is a With-Browning one.

June 2. **C. Gaudibert.**

WELLS'S COMET.

[20121.]—On several occasions during the visibility of this object, I have had some very interesting views with my 3·7in. achromatic, and have been particularly struck with the clearness and star-like brilliancy of the nucleus. The object seems to have steadily increased in brilliancy with its approach to the sun, at first of course slowly, but latterly in a very marked degree; and yesterday morning (5th), when I last had an opportunity of observing it, although at a rather low altitude, it was certainly fully equal in brilliance to an ordinary 2nd mag. star. I could see it distinctly with the naked eye in the strong morning twilight up to 2.40 a.m., having some minutes earlier lost all trace of β Aurigæ, with which I had previously compared it.

I think some of your correspondents who appear to have been rather disappointed with this object, were probably led to expect a more regular gradation in the increase of brilliancy, not sufficiently taking into consideration the close approach of the comet to the sun at perihelion, which accounts for the higher ratios manifested, the period of which is, however, very limited, and the benefits, so far as a general view is concerned, must inevitably be almost entirely lost to us.

London, June 6. **W. T. N.**

ζ HERCULIS — Σ 1884 AND Σ 1883 (BOÖTIS).

[20122.]—In looking over the XXXII. Vol. of your journal I remarked a letter from "F.R.A.S.," p. 59, in which he refers to "ζ" Herculis as a test for 3¼ telescope. I have been examining this star myself on several occasions lately with my 4in. Cooke achromatic, under extremely favourable atmospheric conditions, and found little difficulty in dividing it with powers 225 and 350. I should be inclined to conclude from this that the distance of the *comes* has increased since 1880. I am of opinion, however, that the distance now cannot be more than 1·3″; the *comes* is very close to the disc of the primary, and falls in my telescope on the first diffraction ring, which gives it an elongated and mis-shapen appearance. I asked a friend, quite unaccustomed to observing, to examine it a night or two ago, and he at once described the position of the *comes* without any previous knowledge of its whereabouts. The latest measure with which I am acquainted is by Burnham, epoch 1879·709 (see "E.M.," Vol. XXXII., p. 85). Will "F.R.A.S." please say whether he has examined this star lately, and if so, whether he has now been able to divide it? I cannot do anything with δ Cygni, and if I recollect aright, "F.R.A.S." has divided it with his Dallmeyer achromatic.

I would like to call the attention of your astronomical readers to the stars Σ 1884 and Σ 1883. Webb calls both distance 1·2″. The magnitude differs very little as given in "Celestial Objects," but I think anyone examining these stars cannot fail to notice that the components of the latter are *very decidedly* fainter and closer than in the former. Σ 1884 was easily divided last night, power 350, with perfectly round discs and a very decided dark interval between them; whereas Σ 1883 was not fairly divorced with this power; discs about in contact, but much fainter and generally more difficult. Of course, the latter object was not nearly so favourably placed as regards altitude as the former, but I think the difference in their appearance was greater than could be accounted for by this fact. The colours of Σ 1884 were well shown, A yellow, B blue. **David Simms.**

Limavady, Co. Derry, June 1, 1882.

P.S.—I have just now discovered that Mr. Burnham gives a measure of ζ Herculis, epoch 1880·47, p. = 114·3° D = 1·38″. See English Mechanic, Vol. XXXII., p. 233.

MERCURY.

[20123.]—Acting on the excellent instructions of Mr. Fleming (letter 20068, page 259), I, on the 27th May, caught Mercury very easily with a small telescope, and soon after with the naked eye. I brought a larger instrument to bear, to be certain I had the right object. A power of 120 on a 4in. Gregorian satisfied me on the point. I have read of the extreme difficulty of seeing Mercury, and that a celebrated astronomer, in his whole life, never once succeeded. If this is so, I think it worth recording that he was an easy naked-eye object in the smoky atmosphere of North London on May 27th. I saw him again still more plainly on Sunday, the 28th, and on the 29th a few miles from Birmingham, and caught him again on the 31st. I think the difficulty of seeing him consists in not knowing exactly where to look. Venus, at this time, forms a first-rate pointer; for, with a low-power opera-glass, both will be in the field at once. I am much obliged to Mr. Fleming for his thus enabling me to have a look at so interesting an object as the planet Mercury.

Edwin Holmes.

THE BLUE PROCESS FOR ASTRO. SKETCHES.

[20124.]—I send you some of my sketches. My plan for using the "blue process" for astronomical drawings is, I think, original. I append a short description. After preparing a rough sketch from the field of the telescope, noting magnitudes and other matters of importance, a tracing is made on tracing linen. Here I may say that it is difficult to get good tracing material. It must be free from specks, as they make white spots, which may be mistaken for small stars. Nebulæ and the tails of comets are made with fine plumbago and the point of the little finger. Having prepared the tracing, a stencil is made from some material entirely impervious to light. Mine is made of two pieces of white paper, with black shellac varnish between. The field is cut out, and the design for the name and date. The tracing is laid upon a piece of sensitive paper and the stencil on it, covering the whole with a piece of plate-glass, and exposing to the rays of the sun for about five minutes. I need not describe the "blue process," for, probably, your readers are familiar with it. (See p. 477, No. 774.) **Francis G. du Pont.**

Wilmington, Delaware, U.S.A.

ASTRONOMICAL EYEPIECES.

[20125.]—If "Paugul's" errors affected only himself and his pupils, I should not think it worth while to disturb his serenity; but as his statements may possibly mislead readers who have not the opportunity of testing their correctness by experiment, I will lay before them the result of a series of my own, and shall be glad at some future date to describe the simple means by which it was determined.

All rays cross in the object-glass, and are refracted to a focus at a distance from it, proportional to its curvature. At this focus an inverted image of the object is projected, from whence the rays proceed in diverging paths to infinity. The image forms a blunt apex to the cones thus formed on either side of it; but the formation of the second cone may be arrested, and its rays bent into a continuation of the first, by the interposition of another lens, such as, for example, the field lens of the Ramsden eyepiece. It then terminates in a second apex, as shown in my diagram (on page 259). This apex differs from the first, in that it is now no longer the point where the image is formed, but is a curious reproduction of the object-glass inverted in every particular—that is to say, it is not only upside down, but its convexity is rendered concave, and its effect in all respects appears to agree with a lens of that character.

In the Huyghenian eyepiece the apex proper is not reached until it is at the focus of the eye-lens. From this position the rays have, more or less,—according to the power of the field-lens—a tendency to run parallel. The difference is, however, so slight, that it can hardly be said to alter the form of the cone, which is continued to an apex as before.

As in the matter of "terrestrial eyepieces," lately under discussion, it would have spared our readers some rather unparliamentary language if "Paugul" had previously taken the trouble to assure the correctness of his position, so now I should advise him to obtain better practical information in "matters he is accustomed to teach" before he again asserts that the image must necessarily form the apex of the cone in a telescope eyepiece, or that apex and focus must always be convertible terms. **Aldebaran.**

ON THE ACTION OF EYEPIECES.

[20126.]—The action of an eyepiece does not seem to be well understood. Your correspondent "Ascalon," has elicited an interesting reply from "Aldebaran"; but I altogether fail to follow the reasoning of your esteemed correspondent. If I venture to criticise his letter adversely, I trust he will not take it amiss and think that I wish to set up my knowledge as superior to his. I want to arrive at the truth, and if he considers my conclusions wrong, I hope he will not spare them.

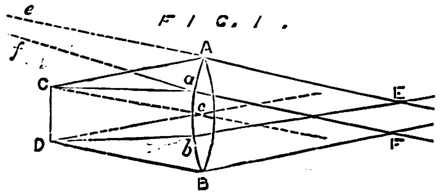
In his third paragraph (letter 20069), after alluding to the two sets of rays, he says:—"After the image has been projected, it matters little or nothing whether the cone that conveys it is refracted sooner or later to a focus." Now, if we both attach the same meaning to the words "cone of direct rays," this strikes me as being a rather glaring error. The apex of this cone is the focus of the object-glass—it is one point in the image; the aggregation of an infinite number of such apices forms a curved surface, which gives us the impression of an aërial image. The completion of this cone and the formation of the image are simultaneous, one cannot exist without the other; hence the "projection" alluded to cannot take place till the apex is reached.

Your correspondent represents the combination as *inverting* the image; but this, though literally correct, is not what occurs when the appliance is used as an eyepiece. It is usual to speak of the Ramsden and Huyghenian as inverting eyepieces; but this is incorrect if understood as applying to their *action*. The inversion is produced by the object-glass, and these eyepieces allow it to remain so, their effect being solely that of magnification. Of course, we can get a re-inverted or erect image by holding a screen at some distance in the rear; but the emerging rays are seized upon and modified by the eye before this image is formed.

In the telescope we have two essential parts—an image-producer and an image-magnifier. Rays diverging from an object pass through the object-glass, and form an inverted image at its focus, this focus being the apex of the cone of rays transmitted by it. Similarly, the eye is an image-producer; diverging rays are by it converged on the retina. It is usual to speak of rays entering the eye as parallel, because the distance of the object is generally very great compared with the diameter of the pupil. But, strictly speaking, they are divergent, and the point of greatest divergence is the least distance of distinct vision. It matters not whether the rays fall upon the eye naturally or are transmitted by a lens or eyepiece; they cannot have a greater amount of divergence than this in order to be utilised for purposes of vision. Evidently the difference between parallelism and this slight divergence is scarcely distinguishable; and as it simplifies matters, it is usual to say that to produce vision the incident rays must be parallel.

But it must be carefully remembered that *it is only those rays issuing from each point separately that are parallel among themselves.* All the rays entering the pupil are not parallel to the axis of the eye; most of them cut it, in the centre of the pupil. It is probably here that that the confusion arises, therefore I will try to make my meaning clear by means of a diagram. Let A B (Fig. 1) be a convex lens, and C D an object at its focus. Rays from the point C will fall upon every part of the lens, and all or any part of them, as A *a*, on emergence, will practically be parallel to the line C*c*. Similarly those from the point D will be parallel to the line D*c*. Now it is evident that the rays after their passage must intersect, yet as the individual members belonging to each point of the object have no vergency, the general condition is said to be that of parallelism.

FIG. 1.



If the eye were placed close behind the lens, the condition of vision would be such as to require the rays A E and *a* F to separate very slightly; so that their prolongations A *e* and *a f* would meet at a point about 10in. distant from the eye.

When a lens or combination of lenses is used in this way, magnification only without inversion is produced; they act upon a telescopic image in the same manner as they would upon a real object.

In the Ramsden eyepiece the image must be formed in front of the field-lens, the precise point being that which will give the requisite divergency to the final emergent rays. The apex of the objective cone is at this point, and not behind the eye-lens.

In the Huyghenian eyepiece the telescopic image would be formed just in front of the eye-lens, but the refraction of the field-lens brings it nearer to the latter, the precise point of adjustment being that which allows the eye-lens to give the necessary form to the emergent rays.

The four-lens pancratic eyepiece is, in reality, an inverting eyepiece; the inverted image formed by the object-glass is reinverted by a pair of lenses, and being thus brought into its natural position, it remains so when viewed through the second pair, which form a Huyghenian eyepiece.

In a telescope with a concave eye-lens a different action occurs. Convex combinations lengthen the telescope, more or less, because the rays from the objective must be brought to a focus before the eyepiece can be employed. But in this case the objective cone does not terminate—it is shortened by an amount equal, practically, to the focus of the eye-lens. Rays from the objective are converging, but being intercepted by the concave glass, they receive just so much divergency as fits them for the purposes of vision.

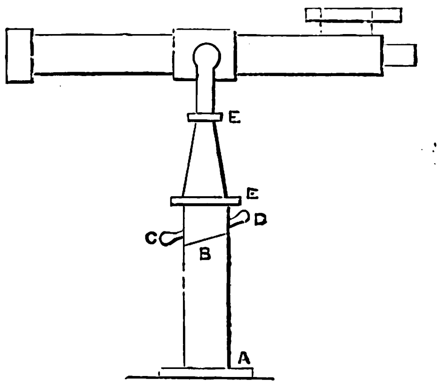
Hence it appears that whatever form of eyepiece we employ, its position or adjustment must be such as will allow the emerging rays to enter the eye naturally.

The acuteness of vision is in a great measure owing to the perfection of the definition of a very small image; and in practical optics, I think it would be advantageous if attention was devoted to this matter, rather than to mere enlargement.

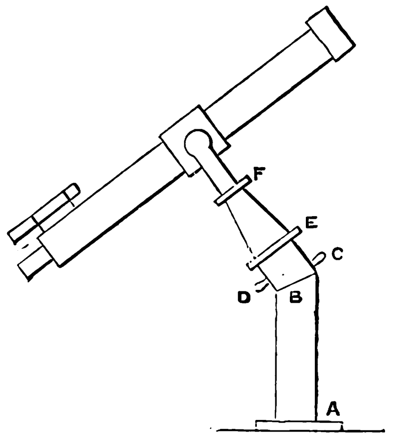
May 29th. **Orderic Vital.**

NEW COMBINATION OF ALTAZIMUTH AND EQUATORIAL MOUNTING.

[20127.]—Having been present at the last scientific meeting of the Royal Dublin Society, when Mr. Grubb, F.R.A.S., exhibited "a new form of combined altazimuth and equatorial mounting for small telescopes," I have thought a rough sketch from memory and a short description of the instrument might interest the readers of the "E.M."



The telescope, which is of about 5in. aperture, has been constructed for the Royal Irish Yacht Club, and intended primarily for viewing terrestrial objects, for which purpose the altazimuth is, of course, the most convenient mounting. To enable it, however, to be used astronomically whenever desired, with the maximum of comfort, Mr. Grubb has devised a most ingenious method by which the instrument can be converted into an equatorial, or vice versa, in two or three seconds. The lower half of the pillar (from A to E in sketch) is cylindrical, and at B contains a section making an angle with the horizon equal to half the co-latitude of the place. To effect the conversion, the portion of the pillar above B is turned round bodily by means of the handles C and D, which in the process change places. Thus the upper part of the pillar becomes either perpendicular or a polar axis. Of course, there is an arrangement at B to prevent the telescope from toppling over when an equatorial. The motion in R.A. or azimuth, as the case may be, takes place above F. The sketches show the telescope in its two characters, but I have omitted the declination circle for simplicity. It may be mentioned that the novelty in this telescope consists not in the upper part of its pillar being reversible, but in its being reversible by one movement, and with such facility.



More Light.

DIVISION-PLATE FOR A LATHE, THE CONSTRUCTION OF WHICH PREVENTS ONE BEING MADE ON THE PULLEY.

[20128.]—Some years ago, a gentleman was kind enough to show me his lathe and its addenda, made for him by the talented designer of the Saltair lathe. I was particularly pleased with a division-plate which he showed me, designed for use on an ordinary engineer's screw-cutting lathe, in which it would be difficult to fit a division-plate, as the front of the large cog-wheel must not be covered up, as doing so would interfere with the back-gearing arrangements.

I made a rough sketch of the arrangement, which I am sure would be appreciated by many of your readers, and I believe it is within the power of most amateurs to make it for themselves. It consists of a brass face-plate, having on its front surface a flange, or projecting ring, for the purpose of acting as a guide to a cast-iron plate which is fitted to the brass one.

FIG. 1.

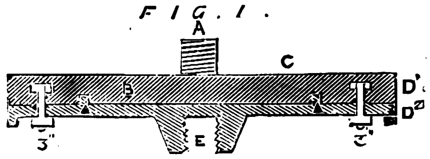


Fig. 1, which is a section of the complete arrangement, will, I think, make this clear to all.

FIG. 2.

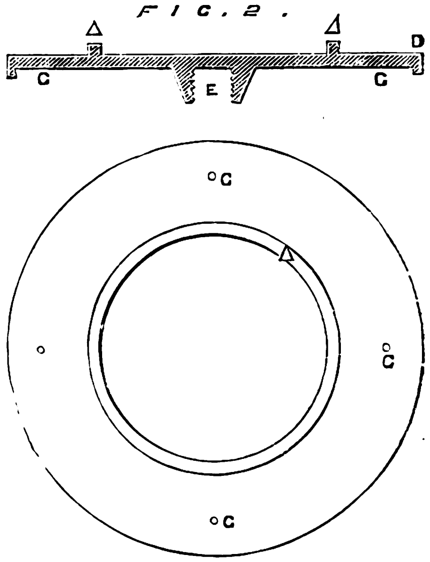


Fig. 2 is the brass face-plate in plan and section.

FIG. 3.

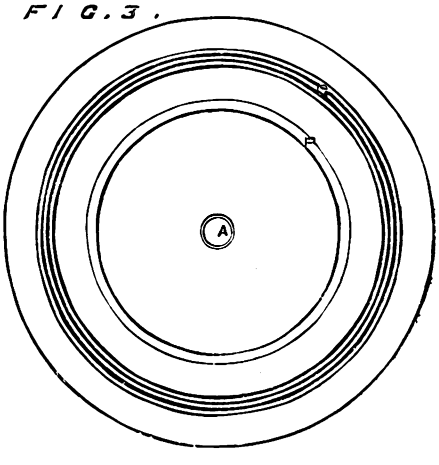


Fig. 3 is the cast-iron plate in plan. This plate, it will be observed, has a groove turned in it, into which the brass flange or ring fits easily, but without shake (A). It has also cast in it a T-slot, to enable it to be fixed firmly to the brass face-plate by bolts, the holes for which are shown in Fig. 2.

The edge of the brass plate in the chuck I saw was divided into 144, and that of the cast-iron plate into 8.

The nuts clamping the two plates together, and the screws with T-heads working in the dove-tail slots, are clearly shown in Fig. 1 at the back of the brass plate. By slacking these, the position of the two plates may be changed circumferentially without interfering with the work. The iron plate carries a false mandrel-nose, the counterpart of that on the nose of the mandrel, so that all the ordinary chucks can be screwed to it.

I am sure that for many pieces of work this chuck would be very useful.

Reference to Figures.—T is a section of the complete chuck, the upper half of cast iron, and the under half of gunmetal. A, false mandrel nose; B, section of iron plate, with undercut circular slot in it for the bands of the T bolts, *g*, which also pass through holes in the brass plate and are fixed by a nut; C is the plain surface of the chuck without break, but it may be tapped with holes to take shut-screws for fastening work to it directly; D^1, edge which is divided by straight lines across the face into 8; E, boss on lower gunmetal plate for screwing in lathe; △, raised ring which fits into upper plate to insure its being central; D^2, edge of gunmetal plate, divided at edge next the iron plate, by straight lines into 144, further back holes may be drilled as in other division plates; E shows the bolt and nut which fix both plates together. Fig. 2, Section and plan of gunmetal plate shown separate, same letters as in Fig 1. Fig 3, Iron plate in plan, showing G, the groove which is undercut, as shown by dotted lines; F, groove which takes the brass raised ring; A, false nose for taking chucks.

Gereb Admi.

CHIME CLOCK-MAKING—NO. I.

[20129.]—In fulfilment of my promise, I now send instructions for making a chime clock. The clock I propose describing chimes the quarters on either eight bells or the Westminster chimes, both sets of changes being on one barrel, so that you can have either set of changes at pleasure. The hours are struck on a gong; the clock has a dead-beat escapement, with a one-second pendulum; but if anyone prefers a gravity essapement, it can easily be made so by putting a cock above the frame to carry the pallet pivots.

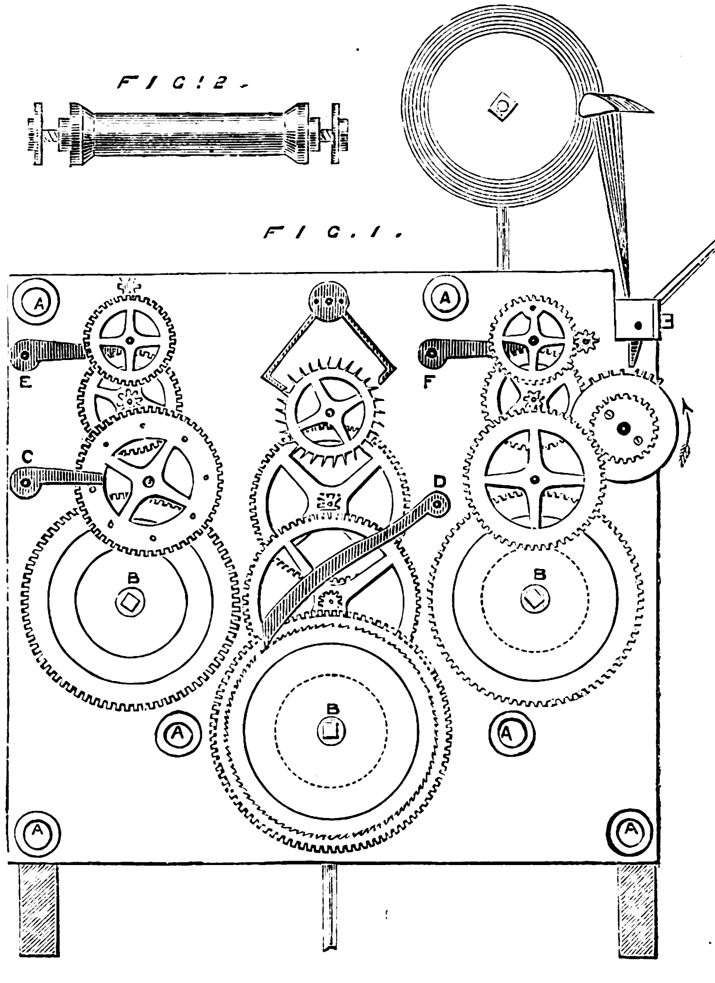

FIG! 2.

FIG. 1.

Fig. 1 is a view of the movement (half-size) with the front frame removed to show the positions of wheels, pinions, &c. In designing this movement I have adopted the locking-plate plan, it being very much simpler than the rack, and consequently easier to make.

We will now proceed to the construction of the clock. The first thing to engage our attention is the frames; these are of stout sheet brass, 11in. by 10in., No. 8 B.W.G.; they must be got perfectly flat by hammering on a smooth stake. Having done this, put the two plates together with the two edges matching one another as closely as possible, drill two small pinholes near the edge, drive pins into them to hold the frames together while the edges are filed up perfectly square, now mark off from the drawing the pillar holes A A A A A A, barrel holes B B B, hour hammer C, maintaining power click D, and locking arbor holes E and F, drill them right through the two frames with a small drill, keeping the frames pinned together while this is being done, drill out the pillar holes to the right size and turn the pillars up, leaving them 2½in. long between the shoulders (this of course will be the distance between the frames), drill them up at each end; tap and fit screws and washers, as in Fig. 2; fit them into the frames, numbering them and the holes they fit into, so that the same pillars may always be put into their proper places; fasten with the screws and washers. Care must be taken to make all the pillars the same length, or a great deal of trouble and annoyance will be the result. The frames being mounted, we are now ready for the wheels and pinions, but these I must leave for my next.

In giving these instructions it may happen that some small details may be omitted. I shall be most happy to remedy such omissions if anyone finding themselves in a dilemma will kindly communicate with me. I therefore append my address.

W. Baldwin (A Clerkenwell Clockmaker).
110, Richmond-road, Dalston, N.E.

CHEAP RESISTANCE COILS.

[20130.]—In accordance with my promise, I will now describe a method of making a set of resistance-coils which, though simple, are perfectly reliable, and are easily within the reach of any possessing the few tools necessary. 1st. As to the coils themselves. These consist of frames of wood as shown (Fig. 1) preferably of oak, or some other hard, strong wood. A and B are 6in. long, half an inch deep, and rather over ¼in. thick. Joining A and B are C and D, also of oak ½in. deep (the drawing shows them rather less), and rather thinner than A and B, so that they do not come up flush with A^1 and B^1. The tops of A and B are grooved, as shown at A^1 and B^1; then at intervals (varying with the size of wire to be used) are cut notches, as shown along A. These are for the wire to be wound into. If the size of wire is not larger than about 24 or 26 B.W.G., these may be about ⅛in. apart. The number of frames must be regulated by the number of ohms resistance it is required to make up; but of this more afterwards. On to these frames must next be wound uninsulated German silver wire. This may be bought at any ordinary metal warehouse. Fix one end by means of a screw to a point on C, and commence winding, keeping the wire tight, and taking care that the wire goes to the bottom of the notches cut for it. Where the coils are not likely to be subjected to very powerful currents, we may begin with No. 28 for the smaller resistances, and as the resistances get larger we may use wire as fine as No. 40 B.W.G., for, although this might be too fine for ordinary coils where the wire is massed together, in these the whole wire is exposed to the air, and thus keeps cool. When these frames are wound, they must be soaked in hot paraffin wax till thoroughly saturated, and then the excess drained off. The next thing to do is to give the coils their true value. To do this, some standard is, of course, absolutely necessary. I must, therefore, assume that such a standard can be got at. What we next need is a simple form of Wheatstone bridge. Perhaps the simplest and best for our purpose is made as follows:—Take a board, about 5ft. long, and fix a piece of wood about ½in. thick at each end. Now, from the tops of these

FIG. 1.

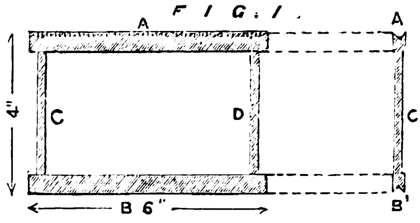


FIG. 2.

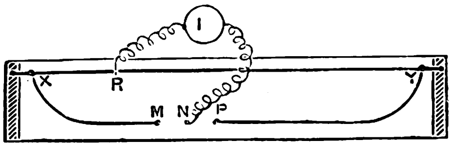


FIG. 3.

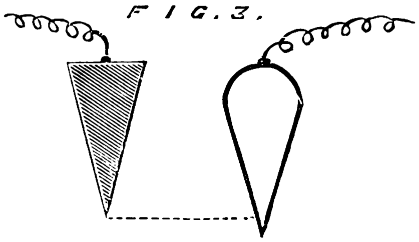


FIG. 4.

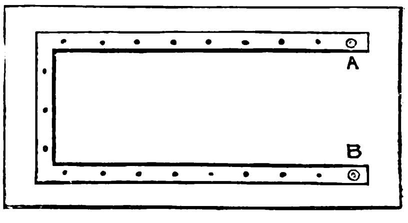
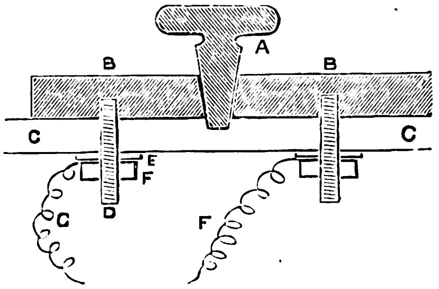


Fig. 5.



pieces of wood, stretch a piece of German-silver wire tightly, and fix firmly by means of screws. To two points, X Y, near the ends of the German-silver wire, solder two stout copper wires, leading to two binding-screws M P, at N between them is another screw; now make two clips of stout brass, as shown, Fig. 3, in elevation and section. To one of these solder any piece of copper wire, to the other solder a stout piece. Then place the clip with the thin wire, so that it clips the wire X Y at any point; let the wire connected with it go to one terminal of an astatic galvanometer, whilst the other terminal of the galvanometer is connected to N. Next let the standard, which may be a piece of wire, having a resistance of 1 ohm, be placed between M N, and to P connect the end of the wire on one of the coils we have wound. Let us suppose we wish to find what point of the wire on the coils gives 5 ohms: divide the wire X Y into six parts, and set the clip so that five parts are on one side, and one part on the other; then X R : R Y :: 1 : 5; also our 1 ohm standard is between M and N. (I should have said before connect a battery to X Y, say, about six Daniell cells, though less will do—it is better to have as many as possible.) Now, having P connected to one end of a coil, connect the end of the stout wire on the other clip to N, and put the clip on different points of the wire, wound on the coil, till no deflection is got on the galvanometer; this point shows the ends of the 5 ohms. To this point a stout copper wire is soldered. I have described this rather fully, so as to make it all clear, but it will be seen that I am only describing an ordinary Wheatstone bridge, so those who understand it may miss all this out. Similar trials, altering the ratio of X R to R Y, will enable us to get any number of ohms resistance accurately marked out. This being done, a box rather larger than the frames of the coils should be made; into this the coils are put, having pieces of cork fixed at the corners, so that no contact takes place between the coils. On the top of this box, as shown Fig. A in plan, a piece of stout brass ½in. by ¼in. is placed; at intervals of about 1in. a hole is bored, then this hole is made taper with a reamer; plugs of brass are then turned so that the taper corresponds with the taper of the hole. At A and B a binding screw is fixed; underneath, between every two holes, a small hole is bored, and a short piece of wire screwed in and fitted with a brass nut and washer; these serve both to bolt down the pieces of brass, and to fix the resistance coil wire to. Finally across the centre of each hole the brass is sawn right through. Fig. 5 shows a section through the plug A, the pieces of brass B, the top of the box C, the pieces of wire screwed into B, the nut and washer E and F, the wire G being clipped between them. Between each pair of pieces of brass is clipped some resistance; when all the plugs are in, the current will go from A B (Fig. 4) round by the thick brass at the top; if a plug is drawn, the current has to pass through the resistance that connects the two pieces of brass, thus left without a plug.

It is convenient to have things arranged so that we have plugs putting in the following resistances:—1 . 2 . 2. 5 . 10 . 10 . 20 . 50 . 100 . 100 . 200 . 500. By this arrangement we can get any integer between 1 and 1,000.

In conclusion, the drawings are not to scale, but are merely diagrams; also, if I have left anything not very clear, I shall be glad to answer queries on this subject. **Ll.B.A.**

ELECTRIC VERSUS GAS-LIGHTING.

[20131.]—Your correspondent, M. Jonson (20104), has adopted a very misleading method of comparing the relative cost of electric-lighting with gas-lighting. He takes the *selling* price of gas and compares it with the first cost of electricity. Instead of three shillings and four pence per thousand feet, he should have stated no shillings and no pence per thousand as the prime cost of gas *at the works*; seeing that, where there is no wasteful outlay, the by-products—coke, ammonia, naphtha, &c.—cover the cost of making the gas.

If gas-production were subject to ordinary competition, we should be supplied at one shilling per thousand cubic feet, which would pay the expenses of conveying the gas to our houses and fair interest on the capital outlay.

In some of the towns where the corporation has bought the gasworks, they are supplying at about half the price of London gas, and are able to make out of that a profit that is paying off the exorbitant price that was extorted for getting rid of the monopoly, and, in addition to this, are paying for municipal improvements.

My statement, as to the prime cost of gas, is based upon their experience of the working of the *extensions* of the gas-works made since they paid off the old company. The cost of these extensions being only equal to legitimate value, they alone supply fair data for estimating the fair cost of the gas.

I have had much and early experience in the electric light, and some experience in the distillation of coal, and have no hesitation in denouncing the present gambling in electric light joint-stock companies' shares as a miserable delusion, wherever it is not a deliberate swindle. When all the calls are paid up, and all the debentures are "floated," and all the devices of license granting to offshoot companies are played out, the justice of my denunciation will be understood by the public in general and the victims in particular.

W. Mattieu Williams.

ELECTRIC METERS.

[20132.]—The interesting account given in your last issue of the meters of Messrs. Sprague and Edison reminds me that I also have an idea on that subject.

It is well known that a current of electricity passed through acidulated water decomposes it, evolving hydrogen and oxygen. Why not utilise the gases to rotate a wheel, and so measure the quantity of electricity which has produced them? The motion of gas in and out of a chamber is made to do this in a coal gas-meter, and I do not see why the same could not be done to measure electricity. It would be a very simple matter to arrange a wheel so that the ascending gases would impart a circular motion to it which (by means of suitable wheels, &c.) could be made to actuate hands indicating units, tens, thousands of current. The quantity of gas evolved would be proportional to the strength of the current and the time during which it had passed, and for pretty powerful currents at least the resistance introduced by passing the current through acidulated water could not make much difference. The meter would be more sensitive than weight meters (if I may use the term), owing to the fact that the volume of gases evolved would be so much greater than the weight of the gases themselves, and consequently better able to overcome a resistance and move a wheel than the small weight of copper deposited would be to sink a float.

It would also be economical, as the mixed gases (oxygen and hydrogen) could be collected and utilised by limelight workers, &c., or even used to drive a motor by their explosions, somewhat as the gas-motors are driven by the explosions of coal-gas and air.

The value of any metal deposited from its solution is, on the other hand, comparatively very small, and the solution of the metallic salt costs something, whilst water is cheap enough. I hope some of our practical workers will discuss the idea, and tell us what they think of it, though candidly I do not think (theoretically at least) that any electric meter could surpass that of Mr. V. Boys, described some time ago before the Physical Society.

Dublin, June 2. **Clement J. Leaper.**

A BENNETT BATTERY.

[20133.]—Mr. Bennett's paper on a new form of battery, which appeared in the *Electrical Review* of the 24th of last February, a résumé of which you published shortly afterwards, contained so many points of interest, that I determined to give it a fair trial; and having a large number of Swiss-milk tins by me, I utilised them in its formation, and as it may interest some of your readers, I give you the details of construction with the cost.

The tins are 3in. diameter and 3in. high, the porous cells are 2in. diameter and 4½in. high, fitted with a cork bung ⅝in. thick; the zincs are stout-sheet, 3in. square, cut with a projecting strip 1¾in. long by ¾in. wide, which passes through the bung: these zincs are bent lengthwise into an S-shape, so as to pass inside the porous cell. The negative element is ordinary cast-iron borings, such as are used for making rust-joints. On the outside of the tin is soldered a piece of copper-wire cord 3½in. long, on the end of which is one of my clips, described in your paper of the 13th June, 1879; another of these clips is soldered to the projecting end of the zinc outside the cork bung; the connections from cell to cell being a piece of the same cord 3in. long, with a clip at each end at right angles to the cord. The exciting fluid is a saturated solution of American potash, its causticity improved by boiling in an iron pot until dissolved, and adding some air-slaked lime.

My battery consists of thirty cells, the tins for which having been opened according to the printed directions, the hole through which they were originally filled remains in the bottom, so, fearing that the potash might in time eat away the solder, I painted the bottom of each tin inside with paraffin—on which the potash seems to have no effect. About 1in. of the top of the porous cell is saturated with melting paraffin—the cell being previously heated in an oven: the bung is also well saturated with the same. The cell was nearly filled with the cold solution, and the bung pressed in while soft and warm; and then the outside of the top, and the joint of the bung painted over with the hot paraffin. (From some recent experience I think the sealing of the porous cells ought not to be perfectly hermetical, but as near to it as possible.) The bungs were all fitted to the cells beforehand, as were the zincs to the bungs; but had to be removed in order to soak the bungs, and were replaced while the latter were warm; the clips were soldered on afterwards. This completed the porous cell, which was then placed in the centre of the tin, and firmly packed thereinto with the iron borings, which were previously damped with the potash solution. As to the cost of this battery—the tins were valueless:—

	s.	d.
26lb. iron borings	3	0
30 porous cells	5	0
7lb. potash	3	6
4lb. zinc	2	0
30 bungs	1	3
½lb. paraffin	0	6
Lime, wire, gas, &c.	1	6
	16	9

or 6¾d. per cell.

The preparation of the potash solution is the most unpleasant part of the manufacture; the 7lb. of potash took over six quarts of water, and I used about 1lb. of lime; thoroughly dissolving the potash first, added the lime cautiously, and boiled it for a quarter of an hour; let it settle, and drew off the clear liquor with a siphon, filtering the muddy portion; the specific gravity of the saturated solution was 1270·5. When filling the cells I kept a basin of acidulated water by me to dip my fingers in, as the potash has a serious effect on the cuticle.

I think this battery is as well entitled to the name of its inventor as is a Daniell, a Grove, or a Bunsen; it is for many uses peculiarly handy and convenient; its durability has yet to be found out; mine has reduced little, if anything, in three weeks. There is no need of amalgamation, and there is not the ugly messing and crystallising of the copper attendant on the Daniell and some others; and, being entirely sealed up, it can be carried about without danger. As to its strength, Dr. Guthrie, of South Kensington, has most kindly tested two of my cells for E.M.F. One (A) gave 1·14 of a Daniell, (B) giving 1·19, the internal resistance being 0·838 of an ohm. The Daniell being taken as one volt, on leaving one cell in short circuit for some hours, whilst the E.M.F. was much reduced at the time, the internal resistance was increased to over one ohm; but the cell recovered its strength afterwards.

Prof. McLeod, of Cooper's Hill College, has also favoured me with the results of an extensive set of experiments he has made with a somewhat larger cell than mine. The tin was 5·4 diam., by 5in. high, and the porous cell 2½in. diam., by 6in. deep, charged with a solution of 4oz. caustic soda. At the commencement the E.M.F. was 1·005 volts; in 64 hours this had gradually increased to 1·213 volts, internal resistance being 1·007 ohms, and the deflection in a tangent galvanometer 56·0-1, which varied, according to length of time of connection, from 42° to 54°, the E.M.F., at time of disconnection, varying from ·647 volt to ·938; but when left standing for two days it rose to 1·045 volt, the internal resistance also varying from ·818 of an ohm to 2·606; but the law of its increase awaits some further experiments. It is too soon to draw a comparison between this form of cell and the Leclanché; but, so far as experiments go, they compare favourably as to E.M.F., and their relative recuperative powers, their cheapness, ease of construction, and of renovation, and their handiness, are much in their favour.

Robt. J. Lecky.

SOURCES OF ELECTRICITY.

[20134.]—Some years since, I recollect reading of an experiment in which a bar of iron was coiled round with a *small* pipe, through which high-pressure steam was allowed to pass, upon which the bar became magnetic, and would then attract a needle some inches away. Now, whether this is a great, or small force, it is uncertain to say; but if the pipe should be insulated from the bar, and also from adjoining coils, no doubt there would be an increase of power; but this is not all, for if the ends of the pipe were made to complete a circuit by means of a wire, the power would possibly be further increased, and made available for the electric light or other purposes.

Now, remembering the hydro-electric machine of Armstrong, a still further conservation of energy might be had by suitable arrangements. But before dealing with this fully, I will refer to the experience of engineers in respect to expansion of steam in the cylinder. In this case it is often found that much steam is condensed therein, and herewith also ensues a cooling of the cylinder. Now, taking into consideration the theory of latent heat which would be supposed to be given off to the cylinder; how, then, is the cooling accounted for? At the risk of much adverse criticism, I venture to put forward a theory of my own—namely, that when a certain degree of expansion occurs, the heat is isolated, and then exists as electricity, and passes away to the earth; and that this accounts for the apparent anomaly. Presuming this, another idea occurs—namely, that with a number of metallic points set within the condenser, and further communication with each other insured, all the water required for condensation might be saved through the escape of the said electricity. To avoid condensation in the cylinder (which is a great evil), it should be insulated, for, possibly, the opportunity for escape has an influence here in bringing about the condensation. To confirm this, observe how the rain forms and falls, just after a cloud has discharged its electricity as lightning.

To return, now, to the magnetic experiment: it is quite possible that the boiler and condenser are in opposite electric states. If this be so, by insulating the boiler, and the bar with its coil-pipe, which connect with a chamber for a condenser, also insulated, we may then have a shunt for using electricity for any purpose, between the boiler and the condenser, and, at the same time, the energy augmented by the interposition of the iron bar.

We here have dispensed with the steam-engine and the dynamo-machine, and, so far, with all visible motion (being steam internally); that is, if these premises turn out correct, and will only further observe that insulation may possibly account for obstinately-heated bearings; and conclude with hoping that my critics may be merciful.

Barry-road, S.E. **J. H. Huxley.**

REFRIGERATION—E. MAGNETIC MOTORS, &c.

[20135.]—"LL.B.A." (20080) says, referring to Refrigeration (20055), that no heat would be lost, as it "does no work in expanding," whatever that may mean. Possibly he means that no equivalent co-relative force is produced; but such is not the fact, for the expansion of the included air helps to work the pump.

Did "LL.B.A." never hear of a Dr. Black, who made experiments with heat, and found there was such a thing as latent heat; and does he not also know that expanding gases in air have "a greater capacity for latent heat" and consequently *sensible* heat is absorbed, and its absence proved by the falling thermometer, and hence cooling? I might, in my former letter, have used this illustration; but as it was intended for others beside B.A.'s, I preferred to use the more familiar fact of the snow-line.

Mr. Ponton (20016), as to my E. motor (19997), speaks of the "friction of the particles of iron," whatever that may mean. If he means the atoms, I must tell him that we absolutely know nothing about internal friction of atoms, although, judging by the free behaviour of electricity among them, we might conclude there is plenty of room. As the indicated construction of the E. motor is founded on fact, and there is no theory *assumed* to throw doubt on its feasibility, and the train of reasoning leading thereto, and as I still have no doubt of the force being *great* in proportion to the space in which it acts, I think Mr. Ponton's observations have no bearing on the matter.

As no one has noticed Mr. Buttershaw's assertion (19909) that he can, at one setting of the slide-rule, give the answer to $\sqrt{5 \cdot 5^3}/11 \times 53/37 \times 17$, perhaps he will kindly enlighten myself and others as to "how it's done." I can set three terms to find a 4th term, but am not clever enough to set more on at once.

Mr. Blanco (20083) gives me the credit of making a discovery in evolution (19898). I did not claim this. I only endeavoured to make the matter plain to ordinary readers, which I should hardly think is the case in the worked example *he* has given.

Barry-road, S.E. **J. H. Huxley.**

THE BERLINER VIOLIN.

[20136.]—I send you a violin, and trust it will arrive in good condition. It is one of a lot of cheap instruments which I bought last year in Germany for experimental purposes, and which cost me about 40 dollars a dozen. I selected this on purpose to show what my invention will do on such an instrument. It has been strung up for about a week, and is therefore a fair sample of a cheap and entirely new violin. The resonator is of metal (steel or iron), and weighs 4¼oz., but I have found that it can be reduced to 3¾oz. The inside is fixed similarly to the published drawings. I should like to have this violin submitted to some of your correspondents, and solicit criticism as the safest way to ultimate success. Mr. Julius Eichberg, Director of the Boston Conservatory of Music, has most favourably expressed himself on my invention, and has ordered an instrument for himself.

Boston, U.S.A. **E. Berliner.**

[If "Fiddler" and any other of our violin correspondents would like to try the violin and report, they are welcome to do so, if they will undertake to fetch it themselves and return it in good condition. —Ed.]

CANADA AND THE TRANSIT OF VENUS.

[20137.]—As a constant reader of your highly useful issue on this side of the Atlantic, I shall be much obliged if you will grant me a little space to allude shortly to the important geographical position of the Dominion of Canada at the approaching Transit of Venus. As the Dominion Parliament has made an appropriation to contribute its share to the numerous staff of observers placed by England, France, Germany, and the United States in different parts of the globe, the question at once arises, Where, in the Dominion, may be found the places most suitable for fixing the different instruments, so that the observations to be taken may be of the greatest use to future science? In looking at this important part of the subject, the great diversity of climate which prevails at the date of the approaching transit (6th December) has to be closely considered, for at some stations the transit may be entirely invisible from beginning to end. In this connection it may be noticed here that at the last transit in 1874, the Australian colonies organised four parties for the purpose of taking observations, and at some of their stations, owing to cloudy weather, the observations were not full and complete. Now, surely the Empire colony of Canada may be expected, on the approaching occasion, to do as much as Australia for this the sublimest of all the sciences.

At the last transit in 1874, the base-line lay greatly between stations in the southern part of Siberia and that region of the globe, with stations in Australia and New Zealand, an arc of over 6,000 miles. At the coming transit in December the circumstances are still more favourable for separating the chords of transit on the sun than any which have yet occurred; hence, action ought to be taken, so that the opportunity may not be lost. It may now be observed that, from a close examination of the terrestrial sun illumination at the instant of the first internal contact, it is only at some point or region on the eastern boundaries of the Dominion that sure and reliable results can be expected and obtained in this, the most essential and critical part of the work. Hence, we suggest that one of the best places in Canada to observe the first internal contact, and to follow the transit by photography, is at a place called *Nain*, on the eastern shores of Labrador, in latitude about 55° N., longitude 4h. 8m. slow of Greenwich time; and for safety, in case of unfavourable weather, another Equatoreal telescope might be used at Cape Breton or Halifax, which is considerably south of Nain, and not far west of the same meridian. For the last internal contact at egress, seen in Canada, which takes place in the afternoon, the Equatoreals in the colleges at Kingston and Woodstock may be of great use, provided they have the other instruments to obtain their absolute time and their true latitude and longitnde, for without that knowledge observing in this case is merely an eye gratification, and nothing more. Moreover, there is another feature connected with the transit observations in Canada which should not be overlooked, and which is worthy of the attention of the Dominion authorities—viz., when we take into account the great extent of the Dominion territory, which is known to be equal to the entire area of all Europe, and to the circumstance that as yet we have not a single meridian established through it which could be relied upon as a sure point of reference at this transit, it will appear obvious that in promoting our knowledge of astronomy, as in this case, we are also, at the same time, adding greatly to our geographical knowledge of the Dominion; and the value and importance of this fact soon appears when we look at what it has cost the United States within the last twenty years to complete their present great network of meridians for the determination of longitude over all the Union.

From a close inspection of the earth's sunlit hemisphere at the first internal contact, and at the last internal contact, as seen in Canada, it may be observed that a base-line can be formed with the Canadian observations above-mentioned, extending even to the Antarctic Circle, which is an arc in latitude of over 120°. We allude here to a place called Graham's Land, forming a base-line with Nain nearly equal to what Winnecke used to obtain the parallax of the planet Mars. At all events, we may be certain that many good observations will be taken as far south as Cape Horn, and on some of the surrounding islands, so that we have reason to hope that they will lead to improved results.

It may be added, in reference to the chances of having a clear sky along the western shores of Lake Ontario and the banks of the St. Lawrence on the 6th of December, and about the time of the first internal contact at ingress, that from a carefully-kept register of the morning weather since the last transit eight years ago, it has been found that only two out of the seven mornings could have furnished the scientific results sought for and required at the first internal contact of Venus.

M. Turnbull.

Toronto, Canada, May 18th.

GRINDING AND POLISHING GLASS SPECULA.

[20138.]—Mr. Wassell, in his very explicit description (letter 20032) of the use of the Foucault test, recommends the employment of a lamp-shade with a triangular aperture. I do not think this can give such accurate indications as a truly circular one. The mirror repeats the form of the radiant point, and if this be angular, it does not seem so easy to decide upon the accuracy of the convergence, as when a luminous disc is viewed, having a regular outline. I believe the circular luminous point is in general use in the optical trade for testing purposes: perhaps "Prismatique" will favour us with his opinion on this matter. Mr. Wassell is describing the shadow test, and doubtless the angular hole will show the general character of the surface; but I do not see how it can indicate the accurate convergence of rays from point to point. I may appear to attach too much importance to a small matter; but I think the form of the aperture is one of the chief points in optical tests.

In answer to your esteemed correspondent's query (letter 20044), the rule for aberration, if correct in one case, should be so in another, no matter what may be the particular aperture and focus of the mirror.

While thanking Mr. Calver for his reply (20019), I must say I am somewhat disappointed. My suggestion was not made with the object of inquiring whether he made use of diaphragms in working: as a matter of fact, it is of no interest to me what particular method he uses. All I and Mr. Wassell wished to know was, the difference between the central and marginal foci of a truly parabolic mirror when tested at the centre of curvature. This is a matter independent of any peculiar method of working; mirrors of equal perfection should give results in precise agreement. As the information is not forthcoming, I trust some reader will accede to the request of Mr. Wassell. **Orderic Vital.**

THE CONCENTRIC MICROSCOPE.

[20139.]—I must apologise to Mr. Moss, and withdraw my statement as to his being at the meeting (R.M.S.) on Nov. 10, 1880; but my having been misinformed as to this point is not material to the question. The question is, Who first published *the principle* of throwing the two axes of motion into one plane, so as to intersect at the object, and then concentre all the motions of the microscope round the intersection — thus enabling the centres of the object and of the lamp-flame to be converted into two points in an ecliptic plane, and superseding a host of swinging-sub-stages and other contrivances, which were complicated, expensive, and unmanageable? Now, Dr. Edmunds described this principle fully on Nov. 10, 1880, and the abstract of his remarks was published in the *Journal*, R.M.S., on Dec. 13, 1880. Mr. Moss filed his "provisional specification" on Dec. 22, 1880, and his "specification" on June 22, 1881. Mr. Wenham filed his "provisional specification" on Jan. 12, 1881, and the "specification" to which he refers on July 22, 1881. No amount of dust-throwing will alter these dates.

Will Dr. Edmunds at once publish his drawings in "ours," instead of keeping his designs in his cabinet until he finds leisure to make a model stand with his own hands?

Another F.R.M.S.

WENHAM'S NEW MICROSCOPE.

[20140.]—Dr. Edmunds having now come forward personally with some sort of claim to the new microscope, I have only to say, by all means let him grasp what credit he can. I shall not enter into any discussion with him, as matters of much more importance to me now engage my attention.

F. H. Wenham.

MICROSCOPE POWER.

[20141.]—Your correspondent, "Antares" (letter 20074, pp. 261-2) gives many valuable notes on the practical determination of the principal numerical data relating to the outfit of a moderately well-furnished microscope. It must of course be understood that his tabulation of data refers to the particular objectives and eyepieces specified, and therefore in itself is only of value to the possessor of the actual instrument. But the system of tabulation appears to me excellent and exhaustive, and I would cordially recommend its adoption by all in whom a love of accuracy is a factor in their microscopy. The careful working out of the needful measurements, and the due consideration of the why and wherefore of each operation, cannot fail to fix in the mind a comprehension of the instrument which will be a source of pleasure in itself, and which will assuredly give weight to any detailed account of special investigations the worker may engage upon.

"Antares" devotes paragraph (*d*) to the apertomer of Prof. Abbe.

He mentions an experiment with this apparatus which he has found somewhat perplexing. I quote the experiment:—

"Suppose an oil-immersion o.g. is tested by the apparatus, and in the first instance focussed *dry*, and the reading taken, then let a drop of pure water be interposed; the readings instantly increase considerably, and the field becomes brighter. Next, let the water be completely removed, and oil of cedar substituted. The readings generally increase again, to some extent; but not much; and oil-immersion o.g. are to be met with, and good ones too, which show no increase of aperture whatever, by this apparatus, with oil as compared with water."

The perplexing part of this experiment to "Antares" seems to be to account for the non-increase of the reading when he substitutes oil for water as the immersion medium in measuring the aperture of certain oil-immersion objectives.

It appears to me the matter can be thus explained:—

Assuming that the oil-immersion objective measured by "Antares" has a numerical aperture of 1·25 (say, 110° in crown-glass), let us follow the experiment with a running commentary.

On taking the measurement with the lens used dry on the apertometer-disc, the reading is of course limited to slightly less than 1·0 N.A., because 1·0 N.A. = twice the critical angle from glass to air. In this case the critical angle is, say, 41°. So long as the medium between the plane surface of the disc and the plane face of the objective is air, the effective critical angle must obviously be that between glass and air, and no measurement can be recorded greater than twice the critical angle.

On interposing a drop of water, the reading is 110° (= 1·25 N.A.) The former critical angle has vanished; the critical angle now effective is that between glass and water, say, 61°. Twice this figure would be 122°, which is 12° in excess of the aperture we are measuring, and hence presents no obstacle to the record. The substitution of oil for water in this case cannot increase the reading, because we have already measured the maximum aperture of the lens.

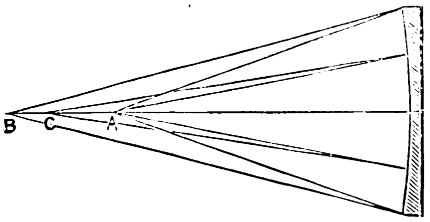
If instead of trying the experiment with an objective of 1·25 N.A., "Antares" could try it with one of, say, 1·4 N.A., the result would be as follows:—

Used dry the reading would be just less than 1·0 N.A. (= 82° in crown-glass); with water interposed it would be 1·33 N.A. (= 122° in crown-glass); with oil, 1·4 N.A. (= 134° in crown-glass). In this case, the objective has an aperture even exceeding twice the critical angle from glass to water, hence the water limits the measurement, and the true reading of the aperture requires a more highly refractive immersion medium to be used such as oil of cedar-wood. **Akakia.**

MR. WASSELL'S SPECULUM TESTING.

[20142.]—MR. WASSELL is at present engaged in the testing of specula, with the object of finding out, if possible, some definite rule or formula by means of which may be ascertained the correct distance of the focal point for parabolic rays from the centre of the spherical curvature when tested by the Foucault test. This is a line of research of the greatest importance, and I would urge upon all our readers who have the requisite mathematical knowledge to assist Mr. Wassell in his investigations.

Let the speculum, of which A is the centre of curvature, be converted into a parabola; the marginal rays will then be reflected back to a greater distance, B, and the intermediate ones will fill up the interval, as may be shown by C. The thing is to find out the rule which applies to the case, so that when testing, the amateur may know with absolute accuracy the exact fraction of an inch beyond A, at which not only each zone, but any point on the speculum, at any distance from the axis, should give a correct focal image.



I believe Mr. Wassell is at present testing the truth of the rule which he himself enunciated a week or two ago; but that rule appears to me rather empirical. I incline to the opinion that the case is one of pure mathematics, and that an absolutely accurate formula can be prepared which shall apply to specula of any focal length, and to rays of any angle of deviation, as, indeed his does; but what we want is a rule which can be proved to be mathematically exact. In a recent communication, Mr. Wassell requested owners of specula by good makers to send him some for experiment, and in reply to that I sent him one of 8in. diameter, and am pleased to hear from him that others have done the same. This is gratifying, and shows the interest which is being taken in the subject.

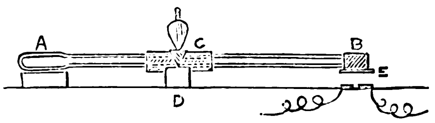
I have no doubt that if those of our readers who are equal to the task would investigate the theory and supply a formula, Mr. Wassell would willingly put it to the test. He has been supplied with some mirrors of undoubtedly good parabolic figures, so that we have now a capital opportunity of laying a firm foundation, upon which all aftercomers may build. We cannot be too much obliged to Mr. Wassell for his kindness in undertaking this investigation, as well as for the numerous and able letters which he has contributed to the ENGLISH MECHANIC on speculum matters.

In the diagram the distance between A and B is enormously exaggerated, and the cone of rays shortened for convenience of insertion.

Thos. K. Mellor.

A SIMPLE AND CHEAP FIRE DETECTOR.

[20143.]—A B is the thermometer sliding tightly in a brass tube, C, which is balanced on knife edges, on the block D, and having at E a small plate of platinum or other metal, fixed on, face downwards. Directly under this plate are the terminals of two wires leading to an electric bell. The thermometer is adjusted in the tube C, so that when the temperature rises to the desired point, the end B, overbalancing the end A, descends, completes the circuit, and rings the bell. This occurs, of course, by the mercury expanding and causing the end A to become lighter, and the end B to become heavier.



Broughty Ferry. **Robert S. Baxter.**

AMERICAN ORGAN.

[20144.]—I SHOULD like to help Mr. Floyd by any information I could give to his inquiries (20108, p. 285) concerning reed-voicing; but I am afraid I can tell him but little. The object sought in bending the reeds is to attain the diapason tone, and the man who can do this best is the one who could give the reeds any other tone that is possible under the conditions. If you take an ordinary tube-board, and bend and twist the reeds about in any and every way, you will not get any great variety, as they are all of the reed, reedy. The tubes in these boards, it may be assumed, are correctly proportioned to develop a diapason tone, and of sufficient area to make the most of the reed. When I set out my large board (page 219), I adopted this scale for the full-sounding sets; the others I got by experiment—that is, making a specimen tube, and trying it in a similar position to that it would occupy finally. I cannot give any scale for them, as I do not know of any: but some of the tubes are so small that there is only sufficient room for a small puller in the tube to withdraw the reed.

Then as to length. It is certainly an advantage in a soft stop to obtain a long tube, for it mellows the tone considerably; but how long they can be made with advantage is a question I cannot answer, as you would have to build your instrument without regard to space, if you carried this point very far. Judging by your letter, I should think you are not going to confine yourself to space; and, if such is the case, you will have a fine opportunity to test the efficacy of long tubes. Another point that demands attention is the windway, or mortise-hole, over which the reed is placed. Roughly speaking, you may not enlarge it, especially in the treble, but may contract it *ad libitum*. Do not forget that these long and narrow tubes are more troublesome to cut than the others, as the same tool will not do for them. In trying your hand at bending the reeds, I think you will find that the reed that has the most bend and twist is the soft windy one, the one that is so treated without being overdone—i.e., does not waste the wind, has the full round tone; from this to the straight tongue, are the different degrees of reediness; and the one that is bent only, has the string tone. Try a set of the latter in ordinary tubes; give a good bend and lift the heel portion of the tongue a little.

When you have decided to build an instrument with pedals, and provided a blowist, I suppose you may as well have a constant pressure in the bellows; but by so doing you destroy one of its best qualities—viz., expression. If I were to build such a one, I should not confine my pedal to one stop, but have two at least, as the extra labour would not be much. When you have settled on the specification, why not send it on for publication, as you may get a little advice and perhaps help.

Joiner.

MEDICAL REPLIES.

[20145.]—SKIN DISEASE (47047).—"Sunflower" probably suffers from a chronic and often infectious disease of the skin (Pityriasis versicolor), which will be cured by a borax lotion (1oz. of borax to a quart of water). Dab the lotion on to the part affected so as thoroughly to saturate the skin, every night on going to bed. This will probably erase it in a few weeks, and can do the skin no harm. Pityriasis versicolor is allied to sycosis, inasmuch as it depends upon the skin being infested with a cryptogamic growth. The vitality of the spores is destroyed by the borax.

KNEE-JOINT DISEASE (47068).—If rheumatism, treat locally and generally for rheumatism, which is a constitutional disease producing local manifestations in various joints. If joint disease, properly so called, from mechanical injury or scrofula, must be treated generally for scrofulous diathesis, and locally for the trouble in the joint. Read former replies on both subjects. Detailed advice and treatment cannot be prescribed for such cases in these columns, nor can such details be safely settled unless upon the results of skilled examination and accurate diagnosis.

FITS (47080.)—Querist is suffering from epilepsy. Must get carefully examined by a competent physician and undergo suitable treatment. Many of these cases are perfectly curable if taken in time. After long continuance, local changes are produced in the nervous system, which are too often irremediable, and the patient is then incurable.

DIABETES (47083.)—This is a disease in which probably some failure in assimilating starch and sugar occurs, and the sugar is treated as a foreign body in the blood and thrown out by the kidneys. With the sugar a vast quantity of water is also excreted as a vehicle for carrying off the sugar. Hence all the symptoms:—1. Intense thirst, in consequence of the continuous elimination of water by the kidneys. 2. Emaciation, because one of the main elements of the food, instead of being oxidised in the body as a source of power after being absorbed, is treated as a foreign body and excreted. 3. Wearing out of the kidneys from overwork of those organs, whose duty ought only to be that of eliminating waste salines and nitrogenous débris. 4. In the exhaustion of system and kidneys which thus arise other phenomena occur to usher in death. I cannot undertake to prescribe in detail for such a case without seeing it.

James Edmunds, M.D.

Grafton-street, Bond-street.

STEAM LAUNCH.

[20146.]—THERE are a few things in this specification (letter 20115), that are perhaps worth further consideration: *Keel.*—If she is to lie in a tideway and take the ground at times, she would be better without a keel; the same strength and stiffness can be got with a double kelson below and above the floors and checked into them. *Planking.*—Yellow pine is so soft that every dint and scratch shows, and elm or other hard wood of thinner scantling above the bilge would be, I think, better. *Coamings* of coach-roof would be better framed, say, of cedar, varnished—of top and bottom rail 4½in. and munnions 6in. long, sliding glass windows 12in. by 6in., alternating with panels. *Bulwark.*—A 3in. mahogany would be a nuisance. The deck, if laid flush with the coving board and well arched, would throw rain and spray over as fast as it came inboard. A half-round hard wood rubbing piece screwed to the outside edge of the coving-board would save sides from injury. *Engine.*—Willan's engine is a most compact and ingenious machine, but I should prefer a simpler type of engine in which the vital parts are all visible and comeatable. A single reversed cylinder with a good heavy balance-wheel, for instance.

Robinson Crusoe.

TRICYCLE.

[20147.]—SEEING my name mentioned on p. 210 in the last December part of "ours" in reference to a tricycle I described in the "E. M." about 1868 or 1869, I would like to say a word or two from this far-off land. At the time I made that vehicle I was very closely confined to business, and I thought the exercise would be conducive to health. I, therefore, about 1865 or 1866, planned and produced the tricycle spoken of, and with your permission I will describe it, as, if it had been fitted with rubber tires in the modern style, I think it would have equalled many later machines. The two driving-wheels, formed of 1¼in. by ¼in. half-round iron bar, with 5-16in. round spokes, 12 in number, screwed into cast-iron hubs, were 36in., on a crank shaft with 5½in. cranks, one wheel loose. The seat was cushioned, placed slightly in rear of cranks, with the steering-wheel (afterwards altered to two) about 24in. diam., was carried about 4ft. astern of the driving-wheels, and a connection made with a lever on the right hand; against this lever I put a segment on the frame, $\frac{3}{4}$in. by $\frac{1}{4}$in., and a small blade spring held the lever to the segment, with sufficient grip to enable the hand to be released from the steering during the greater part of a journey—in fact, it could be set to any angle required. I remember setting it to run round a circle, on its trial trip, in the Mile End-road, London, which it did in about half the width of the road without a hand on the lever.

It was also made to unship for doorways. The frame (of T-iron), seat, and steerage, was narrow enough to enter an ordinary street-door, the lower half of the crank-shaft was hinged at one end, and a clutch at the other, while the wheels were held to the crank-shaft by feather and nuts. I could separate it and take it indoors in four minutes. I had also a mile indicator on the frame, working from the driving-wheel. I would like to say that I think this was about the first attempt to place the feet direct on the cranks; at least I had never seen or heard of it before, and I certainly had a power over it that could not be had with any treadle. I did not run far from London at any time, about 10 or 12 miles in the morning before breakfast, or in the evening. One snowy, frosty morning, mounting Muswell-hill, the wheels slipped very much in the snow: but I did it, and returned by Highgate-hill. Brakes were not thought of then, and I came down to Holloway at a splendid pace. Although I was mounted rather high, I remember one spill only, and that was in the Mile End-road, through running carelessly in the gutter.

Perhaps you would like to know something about these things here. A few months ago, a few young men met, and formed the A. B. C. (Auckland Bicycle Club). There are two or three machines here, and others have been ordered. Two of my sons sent home for the parts of two bicycles to fit up themselves; and here is an instance of the way in which English manufacturers get a bad name. They were to be hollow steel forks, with Stanley heads. Now, would you credit it, that the sockets on the heads were so loose in the forks that a lap of 18 gauge iron scarcely made them tight? I suppose it was, "Oh, let them go: they are too far off to send them back"; but things like these don't improve England's foreign trade. The roads around here are somewhat hilly, and not in such good condition as near London; but the Great South-road, extending about 70 miles, has very good gradients. It was made as a military road; but it remains to be seen how the rubber tires will be affected by the road metal, it being scoria from the many extinct volcanoes—very hard and sharp.

If this somewhat discursive letter is deemed worthy of a place in the English Mechanic, I may report progress another time. I am a subscriber from the first number.

Wm. Service.

Karangahape-road, Auckland, N.Z.,
April 23, 1882.

SUPPOSED PHENOMENON WITH REGARD TO THE FLOW OF WATER FROM A PIPE.

[20148.]—Perhaps some of your readers can give me an explanation of the following phenomenon—or what appears to me to be such—which I observed whilst watching the flow of water from the mouth of the main drain-pipe here. The diameter of the pipe is about 2ft. 5in., and on the occasion in question the pipe was full of water to the depth of 7in. My attention was drawn to it by the circumstance that the flap of the pipe — which is capable of moving freely on its hinges—projected from the mouth of the pipe by about half an inch more than was absolutely necessary for the water to flow—7·8in. at water level, and 1·22in. at the bottom of the pipe. With the view of finding an explanation of the phenomenon I made the following observations:—(1) When the flap was moved to a certain small extent from the position above indicated, either by pushing back or pulling in, on the pressure being removed, it always returned to its original position. (2) When the flap was pushed in to such an extent that the opening between it and the pipe at water-level was just one half its original distance, or 7-16in. (the flap thereby coming into contact with the water), the pressure then being removed, the flap remained open to that extent. (3) When it was pushed close to the mouth of the pipe so that no water flowed, on the pressure being removed, though not quite instantaneously so to speak, the flap returned to the same position as in case (2), 7-16in. (4) Finally, when it was pulled back so that the distance between it and the pipe exceeded 7-16in., then it did not return to this position on the pressure being removed, but took up its original position 7·8in. at water-level.

The only explanation I could arrive at to account for the above phenomenon, was that of atmospheric pressure on the portion of the flap which is opposite the wetted part of the pipe; and this moment of atmospheric pressure may be estimated at about 5·70lb. **C. H. Romanes.**

THE CONTINUOUS BRAKES BILL, 1882.

[20149.]—The Continuous Brakes Bill was presented to the House of Lords by the Right Hon. Earl De-la-Warr, on the 24th of February, and read a "first time"; and on the 20th of March it was read a "second time" without a division.

The object of the measure was to compel the companies to fit their trains with brakes which fulfil the Board of Trade conditions; hence, it followed that all persons who have spent large sums of money in trying to "push" brakes which are inefficient, tried to the utmost to prevent a Bill becoming law which would require really good brakes to be used. A combination among the railway representatives in the House of Lords was formed, and two modes of attack decided upon. 1st. To move the "previous question" and thus quietly smother the subject. 2nd. To eliminate in committee the second or "automatic section," by which the Bill would be rendered perfectly useless.

On Monday, May 22nd, Lord De-la-Warr moved that the House go into committee on the Bill, upon which Lord Colville (chairman of the Great Northern) moved the "previous question."

Lord Sudeley, on behalf of the Board of Trade, expressed a hope that the House would go into Committee with the view to having it considered by a Select Committee; and after quoting the data given in the last return, he remarked:—

"The Board of Trade had up to the present time been in hope that the force of public opinion, and the moral pressure which they were able to bring to bear upon the companies, with these returns before them, would have induced them voluntarily to take up and deal thoroughly with this important question. Such a course was in every way far more desirable than to compel them by legislation to do so; but after the experience of the last five or six years it was difficult to maintain that anything short of legislative enactments would induce the companies thoroughly to grapple with it. In these circumstances, and while the Board of Trade would not, perhaps, have initiated a measure of the kind which was now before the House, they could not help thinking that the time had arrived, in the interests of the travelling public, when some pressure should be put on the companies."

Lord De-la-Warr said it was rather an unusual course to move the previous question on a motion to go into Committee on a Bill which had been read a second time without opposition. The only inference he could deduce was that the noble lord (Colville) did not wish that the Bill should be considered on its merits, as it might be in committee.

The previous question was carried without a division, and the matter is therefore delayed for the present. The *first* mode of attack having succeeded, the *second* was not required, but it will nevertheless be advantageous to consider the subject. Had the measure reached the committee stage, an amendment would have been moved "to throw out the automatic clause on the ground that automatic action is wrong because it is not used in other appliances on railways." This latter assertion has been so often made that some persons may begin to think it true: it will therefore be well to point out that an automatic brake which will not allow a train to proceed unless it is in safe condition, simply carries out the principle applied to all railway signals and the block system. When a signal-wire breaks, the signal flies automatically to "danger," and stops the traffic.

In working the block system, it is a rule that "in the event of any failure of the instruments or bells, no train must be allowed to pass a signal-box on that section of the line where the failure exists, without having been previously brought to a stand, and the driver and guard advised of the circumstance." Years ago all railway signals in their normal position were "off," and only put "on" to protect or stop a train when required; but at the present time every signal stands at "danger," and is only taken "off" for a train to pass when necessary. Now this is exactly the principle which applies to continuous brakes. A non-automatic brake is always "off," and requires to be put "on," and there is always the fear that this cannot be done when necessary.

An automatic brake may be considered as always "on," and requires to be taken "off," therefore it is certain to act when wanted; but like the signals and block system, when it fails it will cause slight delay to the traffic; but this is indeed a small matter compared with the very great safety obtained.

Clement E. Stretton.

Saxe Coburg-street, Leicester, June 3rd.

In Bulgaria a post-office has, on an average, to deal with about 16,000 letters annually, an English one has 107,000, a German one 85,000.

REPLIES TO QUERIES.

⁂ *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[20079.]—**Cheap Bunsen Battery.**—Will "H. T. B." kindly give necessary instructions for depositing the copper upon the carbons of battery, as offered?—Geo. Neville.

[45505.]—**Watch Jewels.**—In a former number a correspondent made a statement to the effect that watches with jewels for the pivots to work in required no oil; such is not the case. Such a watch would, in a few months, stop through the wear of the pivots or of the jewels.—Parkinson and Frodsham.

[46124.]—**Telegraphists' Paralysis.**—Speaking from experience, I would advise "M. G. N." and others who are troubled with a similar complaint, to try rubbing well with camphorated oil every night over the joints and tendons affected Of course, change of employment, as suggested by our valued friend, Dr. Edmunds, would be preferable, but, for many, very inconvenient.—Colleague, Monte Video.

[46427.]—**Electric Engine.**—There is no difficulty in making a large engine to drive a lathe-overhead motion; but the cost of battery power for an 8-horse engine would be too much to suit any amateur, and a description of one would be no use. I do not think such an engine could be worked with satisfaction unless by a secondary battery charged by a dynamo, in which case the first cost would be very great. The power of an electromotor to work by a common galvanic battery should not be over 600lb.—1ft. per minute. This would be big and heavy enough, if properly made, to be called a $\frac{1}{4}$-horse engine, and could do three or four times more work by increased battery and cost when required. I will describe an engine that will do this if the Editor thinks it worth while.—J. Sutcliffe.

[46598.] — **Half-Chronometer.** — Although your correspondent, "T. M.," is not altogether wrong in stating that the above term is a misleading one, as it frequently induces the purchaser to believe that a watch so named partakes of the character of the chronometer as a timekeeper, still the word has a value and a definite use, as when not used to palm off inferior timekeepers, it designates, and that without possible error of description, a watch that is so far a chronometer that it keeps time without any greater variation from Mean Time than one minute per month. To describe such a watch as a "best lever," or even "compensated lever," only, would not be giving a sufficiently correct idea of its value and quality. —Parkinson and Frodsham, 4, Change-alley, London.

[46598.] — **Half-Chronometer.**—"T. M." would do well to study Saunier's work, and particularly the detent escapement, described on p. 515, and drawn on plate 10, Fig. 11, of that work. "T. M." is wrong in stating this to be a drawing of the escapement known as Morton's patent; he will see his mistake if he refers to my description (in my reply to "Chronos") of the last-named escapement, which has *two* locking pallets, and are unlocked by every vibration of the balance, whereas the one he refers to in Saunier is a single-beat escapement with only one locking pallet, and unlocked by one vibration of the balance, the return vibration being dumb; in fact, the only difference between this escapement and an ordinary pivoted detent chronometer, is that instead of it having a coiled spring for the recovery of the detent, it has a supplementary pallet known as the recovering pallet, and quite a different thing to what Morton's patent lever chronometer is. "T. M." also says Morton's escapement is never used. I have had some very fine watches through my hands for repairs, fitted with this escapement, and the term "half-chronometer" is as often used in speaking of it as any other name, and I must disagree with "T. M." when he says "half-chronometer" is shopkeepers' "clap-trap" to hoodwink customers, and is only a lever watch with a compensation balance. I admit that a "cheap-jack," or some dishonest shopkeeper, might try to palm off such a watch as a half-chronometer; but that is not the question.—G. K., Stockton.

[46598.] — **Half-Chronometer.** — I have not seen any answer that properly explains this question. "G. K." is quite in error in putting forward Morton's patent 14, which, by the way, is an unknown affair, comparatively speaking, to the practical watchmaker. The principle is very old, and "Saunier" says that "escapements of this class have always been unsatisfactory, and for evident reasons," which reasons he gives. Again, "T. M." does not help inquirers at all out of the difficulty, and certainly uses the "claptrap" with which he saddles the shopkeeper by trying to "hoodwink" the reader. This he does when he leads the reader astray by saying that "a verge watch or a Yankee clock is as much a chronometer as any kind of timekeeper; but, as a trade term, it is only applied to a watch with a detent escapement and a compensation balance." And that is all the explanation we get about the "half-chronometer," out of some five-and-forty lines of real, spread-eagle scribbling!. All the rest that he says the "trade" already know, and have long known; whilst for those who move outside of the horological orbit it need never have been said, for the good and sufficient reason that they cannot comprehend it. But we are not going to be "clap-trapped" and "hoodwinked" in that way, and "T. M." deserves to be cauterised for attempting to pass off upon the ENGLISH MECHANIC such pitiful, logical cheap-jackery. I make bold to affirm that there is not a sentient human being anywhere, who has anything whatever to do with a watch, but is perfectly aware that a chronometer is a distinct form of instrument standing by itself alone; and that it has no more connection with a verge watch or Yankee clock than "T. M." seems to have with the common-sense of the argument; and that is saying a good deal. And now about the half-chronometer. The term "half-chronometer," in its clearly-understood meaning, is the expression for the highest possible development of the lever watch. It consists of a chronometer-balance and an isochronal-spring, whether flat, breguet, or cylindric; in other words, of two-thirds of the movement of a full chronometer, the only difference between it and the chronometer proper being in the lever-escapement instead of the detent. Take the lever out, and put the detent into the movement, and then the "half" becomes the "whole," and *vice versâ*, if you choose. Of course, the "half" is "adjusted" and "timed," as well as the "whole." If "T. M." is in the trade, and happens to send his verge watch or Yankee clock to a customer who has ordered a chronometer, I am very strongly of opinion that a judge and jury will soon "scarify" him out of his foolery. Let "T. M." repent forthwith, and determine not to so insult the readers of the ENGLISH MECHANIC again. One word more. The name "half-chronometer" is very much abused by "pushing tradesmen," just as many things are abused; but the respectable maker will always, at once, explain to you in what it consists. Trust in no other.—C. S. M.

[46642.]—**Drilling Fluid.**—Bateman, East Greenwich, sells some salt which, dissolved in water, is the best stuff I ever saw for lubrication of drills and turning-tools. I have not any idea of what it is composed.—J. K. P.

[46694.]—**Brick Kiln with Down-draught.**—This should be about 12ft. wide, 7ft. to spring of arch, and 21ft. or 22ft. is plenty long enough for a kiln of this sort: fire-holes 11in. wide, lined with fire-brick and slake a little towards bottom of kiln, same as bars, 2ft. 9in. between holes, flue down the centre from one end to the other, 2ft. wide by 2ft. deep, to be covered over with strong fireclay slabs set apart for draught. I should suggest a stack at each end of kiln, as it allows the steam to escape better, to stand about 10ft. or 12ft. above top of kiln, not too narrow to throttle steam, as this is a great matter in these sort of kilns. Should be able to tell you more about it if I knew the clay. Entrance at each end suitable for a brick barrow to enter easily; should be three strong baulks each side, set in the ground and pinned together at top; also a screw cramp at each end to be screwed up when it is ready for burning. Further information if desired.—BRICK-BURNER.

[46702.]—**Drills.**—I think "A. F. W." might have let "Beetle Crusher" alone with the answer he gave to 46702 query. Any experienced mechanic will corroborate "Beetle Crusher's" statement "that a drill for cutting brass ought to be ground to a sharper angle than a drill for iron," and I may add, a drill for brass ought to be made a little harder and driven a good deal faster than one for iron. It is quite the reverse with a turning tool: for brass it ought to have a more obtuse angle.—D. D. M. L.

[46709.]—**Mildew on Composition Statues.**—If "Blackwater" gave some idea of the composition of his statues, and also of what he means by mildew, he might obtain a useful reply. As his query stands, it is doubtful if anyone can do more than guess at an answer.—NUN. DOR.

[46710.]—**Depositing-Trough.**—The best thing to line troughs with is pure sheet-lead, in which the joints have been burned, not soldered; but perhaps you will find pitch answer, if applied as a paint in turpentine. For copper solutions the trough can be lined with a cement made of six parts Burgundy pitch and one part guttapercha, or the latter can be used alone; but when silver solutions are in question, guttapercha will not do, as the cyanide of potassium acts on the joints. The tanks used in large silver-plating works are now made of iron, sometimes with a thin lining of wood or a coat of cement. I have not tried the experiment, but I think, if you soaked your wood trough inside with melted paraffin, it would answer well, provided you do not work with hot solutions.—W. E. G. M.

[46711.]—**Terra-Cotta.**—Do not the replies given pp. 73, 141, of the last volume answer this query?—T. P.

[46719.]—**Reading-Lamp.**—If the oil, wick, and especially the "&c.," are always precisely the same, it follows that someone must cause the oil to overflow. It is probable that the conditions are not always precisely the same; but I do not see how the action can be explained without examining the lamp.—E. P. B.

[46720.]—**Pitch of Cogs.**—This query has been answered many times in back volumes. Let "Jeff" look on p. 539, No. 437, and refer to the indices since then.—T. P.

[46728.]—**Ferrules.**—They are coloured either with lacquers or with stains. A bronze can be produced by brushing over a mixture of sal-ammoniac, common salt, and strong vinegar, or by exposing the metal to fumes of hydrochloric acid or chloride of lime. In fact, there are many ways of doing them which you will find described in back volumes.—ESSAR.

[46729.]—**Vegetable Ivory.**—What is it querist wishes to know? I don't understand what he means by preparing vegetable ivory, which is known as Coquilla nuts in commerce. If he wishes to make a pigment of them, I suppose that would be done by burning them in air-tight boxes and grinding.—NUN. DOR.

[46730.]—**Cheap Oils.**—Anyone who knows how to make a "good lubricating oil" at twopence per gallon, must be in possession of a secret of some commercial importance, and will scarcely be likely to impart it to others, except for a consideration.—NUN. DOR.

[46745.]—**Stopping Decayed Teeth.**—Many thanks to all. I was afraid a mass of metal pressing against a nerve would cause much trouble. A druggist told me that there were several qualities of carbolic acid (nine or ten I think), and that the pure was 9d. per ounce, and was in the form of a white crystal like oxalic acid. It appears to me that a really perfect stopping for teeth is still unknown. It ought to be white, as hard as ivory, not easily friable, placeable in the cavity of the tooth, in the form of a paste, not poisonous, and strongly adhesive to bone. It has often occurred to me (and it may not be a new idea), that a small cavity left in the stopping (internal) over a nerve, would preserve the latter, and prevent pain being caused by the plug. Like Mr. Ollard, I am a vegetarian, and have been for ten years. I do not smoke, except three or four times a year, as a cure for the toothache, and I seldom find it fail to do so in half an hour or so, but if it does fail, camphorated spirits of wine generally succeeds.—MURANO.

[46758.]—**Bicycle Varnish.**—There are some special preparations advertised, but probably ordinary pale lacquer will answer as well. Make the wheel as hot as you can bear it, and apply with rapid strokes.—T. P.

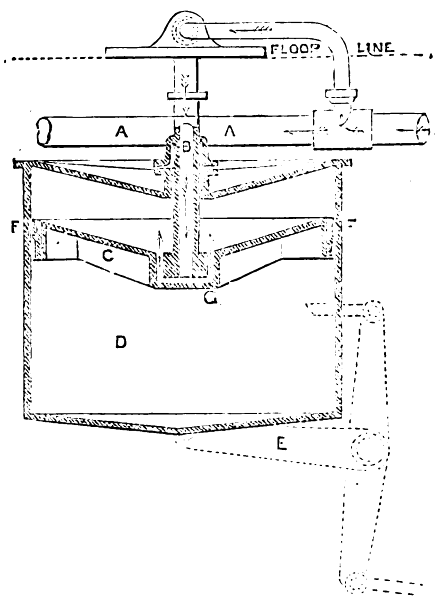
[46761.]—**Compensated Watch.**—I may tell "M. F." that finding my watch sometimes gaining and sometimes losing, I had it "adjusted" through a local watchmaker. It was sent to London, and examined by one who makes it a part of his business, and a contract was given that it should be done for 50s. It was declared to be a good watch and worth adjusting. I had it done, and it is vastly improved.—GIMEL.

[46761.]—**Compensated Watch.**—"M. F.," before buying his watch, should have exacted a written guarantee from the seller as to the amount of time that his watch should be allowed to vary in different temperatures. Some watchmakers are so conscientious that they will only use the term "compensation balance" when speaking of watches that are sufficiently well compensated to be spoken of as watches having "compensated balances"; but they reserve this term for their pet watches of a superior standard of timekeeping.—PARKINSON and FRODSHAM, 4, Change-alley, London.

[46767.]—**Repolishing Ebonised Pianos.**—It requires re-polishing with clear French polish, and if you have never tried your hand at the work it would be advisable to get a polisher to do it. There is nothing better than the polish, unless you have it varnished like a carriage, and that would cost rather too much.—T. P.

[46793.]—**Glueing Belt-Splicings.**—Get some good glue, melt it in the ordinary way, and then add tannin, leaving it to digest until the whole becomes what is called "ropy." Clean by skiving the ends of the belt to be spliced, and anoint both with the glue; place between two iron plates and clamp up until dry. Properly done, a very few stitches will suffice to keep the splice firm.—E. G. M.

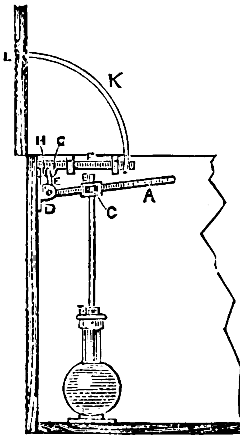
[46828.]—**G.W.R. Vacuum-Brake.**—The inclosed sketch of the cylinder of this brake will no doubt be acceptable, showing the brake on. A, continuous brake; B, hollow piston-rod connected by branch pipe to continuous pipe; C, piston; D, cylinder capable of moving freely up and down on the fixed piston, and connected at the bottom with brake-levers E. The piston is packed with an indiarubber packing-ring F, so arranged that air can pass freely from the bottom to the top of the cylinder; but not from the top to the bottom. The piston-rod is also packed with an indiarubber ring. Brake on.—Air is admitted into the continuous pipe and down the hollow piston-rod into the upper part of the cylinder, which pressing the indiarubber packing-ring against the sides of the cylinder, seals the vacuum on the under side of the piston, so that the pressure of air in the upper part of the cylinder, having nothing to balance it on the other side of the piston, thrusts up the cylinder and presses the brake-blocks against the wheels. The air then slowly leaks through a small hole G, into the lower part of the cylinder, and gradually releases the brake. The driver can take off the brake by creating a vacuum with the ejector, the air is then exhausted from the pipes and cylinder, and the vacuum being equal on both sides of the piston, the cylinder falls of its own weight, and holds the brake off the wheels.—NORTH STAR.



[46847.]—**Equation.**—A decisive proof that Mr. Lane Davies' solution (p. 226) is founded on a fallacy, as pointed out by "M.I.C.E." (p. 289), is the fact that the *three* unknowns are determined entirely from the *two* equations (3) and (a), the equations (1) and (2) being not used except in deducing (a). The fallacy is an old one, and it may be shortly expressed thus: if $a = b$, then $a^2 = b^2$, whence, on taking square roots, $-a = b$, so that $a = -a$. As "M.I.C.E." suggests, there is absolutely no reason for expecting a quadratic solution; there is, on the contrary, every reason for expecting the solution to be biquadratic, i.e., giving *four* values for each unknown, as *two* of the given equations are of the *second* degree. "A Medical Student's" artifice (p. 267) is perfectly legitimate; since, however, β is found by equating (A) and (B), x must be determined from either (A) or (B), and not from (V), which, being derived only from (a) and (b), can be satisfied by values that will not satisfy (c). Thus the second values given for the unknowns—independently of those for y and z being accidentally interchanged—are wrong. A direct solution is as follows:—Mr. Lane Davies' equations (b) and (1) give $2z - y = 18x^{-1}$ and $z + y = 11 - x$ respectively, whence $y = \frac{1}{3}(22 - 2x - 18x^{-1})$ and $z = \frac{1}{3}(11 - x + 18x^{-1})$, and these values, substituted in either (2) or (3), give on reduction $7x^4 - 55x^3 + 100x^2 - 198x + 324 = 0$, the four roots of which must be determined in the usual way. Of these one is a 2, second 6·062640 very nearly, and the others imaginary. The corresponding real values of y, z are 3, 6 and 2·301905, 2·635455 very nearly respectively.—R. E. B.

[46847.]—**Equation.**—The spirit in which "M.I.C.E." criticises my solution is quite refreshing after the style which "A Medical Student" thought proper to indulge in. Neither of them, however, has proved a fallacy in my solution. I do not see how it can be correctly said that the terms which I multiplied together to form a quadratic are identical simply because they can be reduced to an identity, any more than it can be said that equations (C) and (d) are identical, which manifestly are not; but they are the same equations in another form as those multiplied together, and not, as your correspondents say—$xy/2 - 3 = -xy/3 - 6$, a form into which they can be reduced. I quite agree with "M.I.C.E." that casting out a factor, found by trial, as "A Medical Student" has done, is not a quadratic solution. This can, and has been done, in various ways, better and shorter than the cumbrous process given by "A Medical Student." "M.I.C.E." asks—"Why should we expect to be able to solve the equation as a quadratic?" It is simply because it was given to be solved as such. Herein lies the difficulty. It is easily enough solved as a bi-quadratic.—J. LANE DAVIES.

[46854.]—**Mechanical Action.**—In the hope that I have understood your query, I venture to suggest the following mechanism:—The zinc rods are raised and lowered by means of the handle A, which having a slot B, acts at the centre of a horizontal bar C, connecting the zinc-rods of the cells. The object of the slot is to give to the ends of the rods play, so as not to interfere with their vertical motion. The whole lever is a bell-crank lever, turning on pivots D D¹. When A is depressed the rods will be lowered; at the same time the short lever E will move to the right, and together with it, for a short distance, the "belt" F, with the projections G and H. When A is raised, the zincs are raised, and as soon as they are lifted to the top, H is pushed to the left. Every time that F moves to the right it enters a hole in the quadrant K, which is fixed to the lid; L thus fixing it. H may be made as long as you like; G only long enough to be acted upon by E, till K is properly locked. If required, you could also easily arrange matters so that the handle A is outside the chest.—R. KANTHACK.



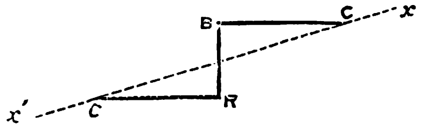
[46874.]—**Australian Railway Prospects.**—The prospects for any competent railway men in Australia are good in either New South Wales or Victoria; but, if possible, it would be advisable to get an appointment before starting, unless you can land with a little spare cash. The wages are good, but clothes and house-rent are dear.—S. M.

[46879.]—**Telephone Transmitter.**—To MR. TOLMAN.—Will you kindly send description of coil and how to make it, also should the carbon be plunged into mercury or not, and whether the primary wire should be wound next to core or not? Should the core be a solid rod, or composed of wires? A sketch of the connections, &c., will greatly oblige.—BEGINNER.

[46883.]—**Bleaching Straw Hats.**—These can be bleached by exposing them to the vapour of burning sulphur, which is about the best and cheapest method. It is usual to steam them first, and then put them into a chamber filled with sulphur vapour.—E. G. M.

[46884.]—**Varnishing.**—The best varnish for the purpose is, I think, the best hard copal, but, as a rule, it is a spirit varnish that is generally used, such as brown hard. If the chairs are painted it is cheaper to mix the final coat with some varnish such as copal.—T. P.

[46901.]—**Watt's Parallel Motion.**—I have to thank Mr. Fred. Walker for his reply to my query relative to the above. I think, however, that on consideration, he will see that he has not really met the point of my query. I assumed that the beam and the radius bar were equal and of given length, that their centres of motion were at a fixed distance apart, and that the point of attachment of the piston-rod was the middle point of the link; and what I wanted was the length of the link to make the motion most nearly rectilinear. To put the thing in a more mathematical form—Let b = length of beam C B, or of radius-bar C′ R; $2c$ = distance between centres of motion C C′; $2a$ = lengths of link B R. Then the locus of the middle point of the link (when C C′ is taken as axis of x, and its middle point as origin), is $x^2 (x^2 + y^2 + a^2 - b^2 - c^2)^2 + y^2 (x^2 + y^2 + a^2 - b^2 + c^2)^2 = 4a^2 c^2 y^2$. Now b and c being given, what must a be that this equation may represent most nearly a straight line? Will $a^2 = c^2 - b^2$ suffice? This relation would permit of the following position being taken up:—Where C B R and C′ R B are right angles.—A. J. SMITH.



[46954.]—**Dividing Apparatus.**—In my reply on p. 290, line 16, strike out the words "in order."—J. K. P.

[46956.]—**Chronometer and Watch-Rating.**—The rating of instruments to tenths of seconds is entirely a "faculty" of practice with both eye and ear; indeed, hardly any two raters can tenth the time alike. A ship, or box, chronometer beats half-seconds; and in rating it, the eye must be on the seconds-hand, whilst the ear must be on the tick of the regulator. But a good deal must be approximate guess-work until long practice has educated both ear and eye. An electric arrangement is possible to make the pendulum record the tenths of itself.—C. S. M.

[46963.]—**Astronomical.**—I am much obliged to "F.R.A.S." for his lucid explanation of my difficulties, and to the Editor for engraving wood blocks for the same. I hope it has been useful to others besides myself. May I further ask if the principle involved in the second question holds good in all pairs of bodies; for instance, between the earth and the sun, does the sun "in a sense" revolve round the earth—that is, round the centre of gravity between the two? And if so, would the sun be similarly affected by each and all the planets?—GIMEL.

[46975.]—**Gravel.**—A few days sea-voyage is an excellent cure. Sickness stirs up the acids in the body, and they reform healthily.—N.O.

[46983.]—**Cost of Concrete.**—There is evidently some error in the calculations of "W. S.," given in your last number. The mass of concrete is given as 38ft. by 14ft. by 5ft., or 2,660 cubic feet = 98·5 cubic yards. The cost for cement is £17 4s. = 2s. 10d., and not 3s. 4d. as given. The cost of slag, £14 = 3s. 6d., and not 4s. as given. Assuming the labour to be 1s. 8d. a yard, as stated, the total cost per yard would be 8s., instead of 9s., as given by "W. S." I also notice an error in the statement that "ashlar, at 2s. 6d. per cubic foot = £1 2s. 6d. per yard." As there are 27 cubic feet in a cube yard, 2s. 6d. per foot = £3 7s. 6d. a yard. I wish to add that the estimate for concrete is extremely low, and is to be accounted for by the very small quantity of cement used. Taking the weight of cement at 107lb. per bushel (the usual specification is 112lb.), and the ton is equal to 1 cube yard, as only 8 tons of cement were used to 98·5 cubic yards, the cement was less than one-twelfth of the mass instead of one-sixth, as is generally specified. The cost, then, on the prices given by "W. S." would be per yard.

	s.	d.
Slag	2	10
Cement	7	0
Labour	1	8
	11	6 per yard concrete.

Even this is a very low cost. A friend of mine, a harbour engineer, who has great experience in concrete work, estimates the cost at about 15s. a yard.—DENNY LANE.

[47004.]—**Bread.**—"Disgusted Foreigner" begs the question. Less than six hours ago, I remarked to some friends with whom I am staying that during the past two years I have never tasted any bread in the United States equal to that on their table. There is much bad bread in this country as well as elsewhere; but in my opinion the highest perfection is reached here. English bread that is really "semi-dried dough" may owe its faultiness to badness of flour, or ignorance of the proper method of making, or lack of proper oven-heat in the baking. The bread that pleases me so much is undoubtedly made of good material, is well manipulated, and well baked. To abuse English bread is what a Yankee would call "too thin."—R. M. TUTTLE, Haddenham, Ely.

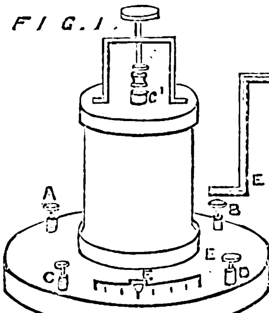
[47022.]—**Shafting.**—If "J. A." would strip the brasses both of the footstep and the top of the shaft, it would make it all right. It is the shaft having too much play, and therefore, although it gets ever so much oil, it does not retain it.—D. D. M. L.

[47022.]—**Vertical Shaft.**—The screaming noise you refer to is probably caused by the fact that when you oil your upper bearing the oil passes from between your bearings by gravity. I should recommend you to shrink a collar on the shaft immediately below the bearing, and make a circular grease-cup of tin to go on top of bearing. I may say that I had once a vertical shaft that screamed perpetually, but the fault lay in the step. I kept putting in new brasses, to no good effect, till I put a hard wood bearing in, and filled it up with powdered plumbago; that is eighteen months ago, and it has not screamed nor cut since.—FRED. WALKER.

[47023.]—**Sea-Sickness.**—Having crossed the Atlantic twice (my second voyage ending four days ago), let me give "A Rechabite" some practical advice. The sea-sick passenger meets with a variety of advice when on shipboard. The passenger who is never sick, and who eats a good deal, will urge the sufferer to eat freely, if even he vomits directly afterwards. Others will tell him to eat little or nothing. My plan is to eat nothing whatever during the first three days of the voyage. I am always very sick for two days; but if I were to eat at such times, the food would only serve to irritate the stomach, and keep me ill for a longer period. It is well while the *mal de mer* prevails to drink plain soda or Appollinaris water, avoiding all drinks that are sweet. Dr. Beard, of New York, who is thought by some to be an authority on such matters, advocates the use of bromides; but in my opinion the remedy is worse than the disease. Brandy, which is recommended by some persons, always makes me worse. Sea-sickness makes one feel very miserable; but the philosopher accepts it as the inevitable penalty of the traveller.—R. M. TUTTLE, Haddenham, Ely.

[47025.]—**Medical Coil.**—To MR. FRED. WALKER.—I have a reel, $2\frac{3}{4}$in. in diameter and 3in. high, and a stand 8in. in diameter, standing upon three wooden feet. In the centre of the reel I have a $\frac{1}{2}$in. clearing hole, not reaching the bottom by a $\frac{1}{4}$in.; into this is dropped a piece of $\frac{1}{2}$in. iron, softened in the fire and allowed to cool gradually. This is long enough to project $\frac{3}{4}$in. above the top. I have a small upright A in Fig. 2, of brass, screwed at both ends, one end to screw through the top of the reel and project a little below to allow of attachment, the other to fit a brass milled nut D. B is a slip of thin copper sheet, $\frac{1}{2}$in. by 2in., to which is riveted a small soft iron cone C, and a hole at b has a small piece of platinum riveted through it. E is a slip of brass sheet $\frac{1}{8}$ thick and $\frac{1}{4}$ wide, bent in form shown, with two wood screw holes in feet to fix by. A milled-headed screw F passes through this, to which a piece of platinum wire has been soldered. This fitting is placed athwart the contact-breaker, so that the platinum point of F is immediately over the platinum at b; when fixed up, the iron cone C should be 3-16in. above the soft iron core. Now as to wire, I had $\frac{1}{2}$lb. of No. 22 at 3s. the pound, cotton covered, and commenced to wind from the top of the cylinder, first boring a hole so as to pass the end down and connect to binding-screw A, Fig. 1. I then wound right-handed, and at each third coil soaked with melted paraffin, first baring the wire alternately at top and bottom of each third helix, soldering thereunto a short wire to each, which passes down under the stand and comes up in front of the coil. To each short wire is soldered a piece of brass wire $\frac{1}{8}$in. diameter, standing in a semicircle, and $\frac{1}{4}$in. high; the end of the wire itself, when all is wound on, is fixed to the last of these wire uprights, and called the strongest power. This power is also connected by a short wire to upright A, Fig. 2. The bent brass

FIG. 1.



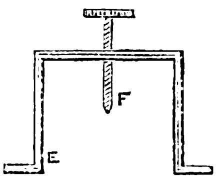


FIG. 2.

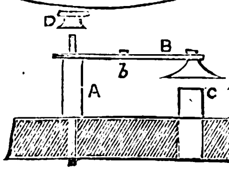


FIG. 2.

E is connected to binding-screw B, which, with A, is for battery connections. The wire which is connected with E and B is also connected with binding-screw D. Between the reel and the brass powers there is a brass wire bent, as shown at E, Fig. 1, having on it a slip of brass long enough to rest on the powers, and moving easily enough to rest on any at pleasure. This brass wire is connected to binding-screw C, which, with D, is for patients. Two brass tubes, 1¼in. by 6in., should have ends and binding-screws soldered to them for handles; also there should be a circular piece of brass sheet, hammered concave, and soldered to wire for a spine attachment. This completes the coil. Its cost is about 6s., and one Daniell cell will give a fair shock; two will render the manipulation of the powers necessary, It should be remembered that what renders medical galvanism futile in many cases is that the application of the current is not understood. The positive and negative binding-screws are those opposite the corresponding battery connections. For rheumatism the positive pole should be placed on the spine, and the negative on the hands or part affected; indigestion the reverse; and so on.—Fred. Walker.

[47027.]—**Electric Current.**—The current is produced from all the coils at once, though in a less degree from some than others (see Fig. 1).

FIG. 1.

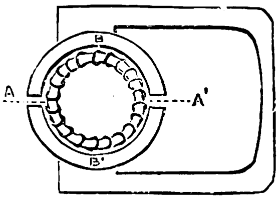
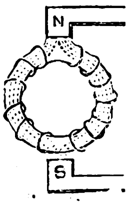
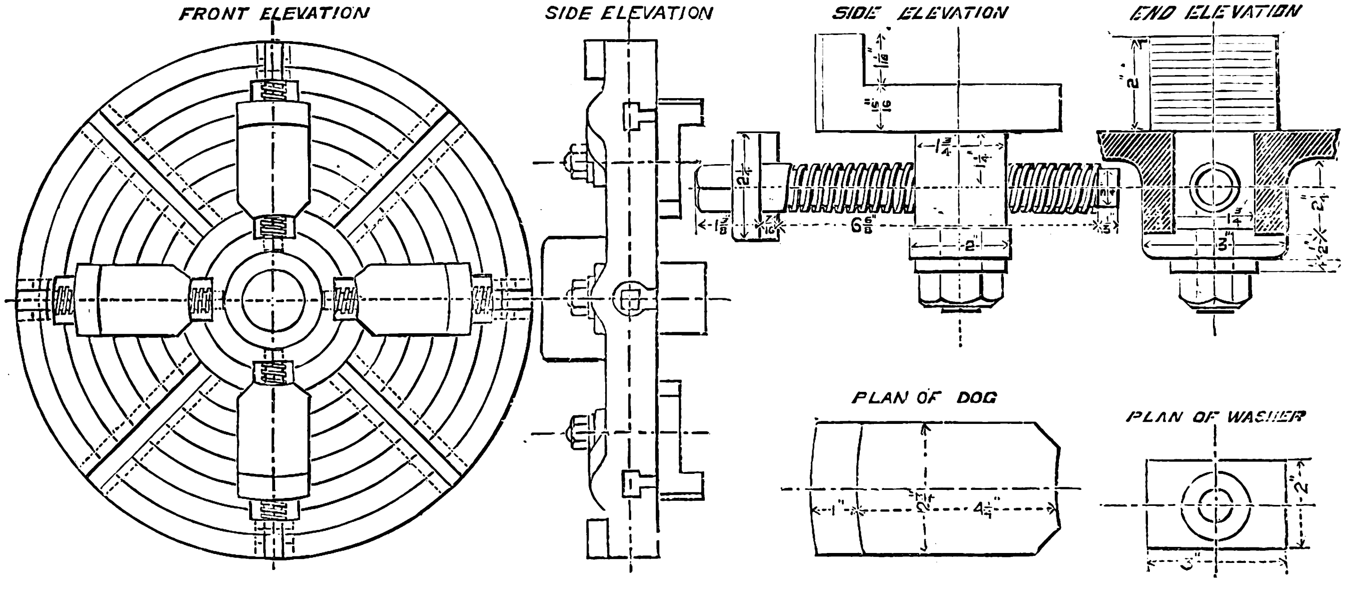


FIG. 2.



The greatest current is produced from coils at A and A'—the least, in those at B and B'. If there were no iron ring the current would be very small. The ring has the effect of so placing the lines of force that they are in the best condition for being cut by the coils in their rotation. If ring were not there, lines of force would go straight from pole to pole, and no coils would cut them. I do not think there is any other better than the Gramme.—W. H. L. H.

[47034.]—**Dog Chuck for Lathe.**—I beg to hand "E. D." a tracing of a 4-screw dog-chuck, which is self-explanatory and fully dimensioned. Front and side elevations are 1½in. to the foot; details ¼ size.—H. L. Crate.



[47032.]—**Stonehenge and Sun-Worship.**—It is stated there are two gnomons and stations at Stonehenge for observing sunrise 21st June and sunset 21st Dec., but there are none existing for sunrise at the winter solstice or for sunset at the summer solstice, unless the same gnomons were used.—W. B. P.

[47032.]—**Stonehenge.**—As "Neo" is so very interested in Stonehenge, he could not do better than read the chapter which is devoted to the subject in "English Traits," by the American philosopher who has so recently passed away, Ralph Waldo Emerson.—W. Henly Richmond.

[47032.]—**Stonehenge.**—I have to thank "Diamond" and "F.R.A.S." for assistance given and promise of further. The reputed cromlech I refer to is situate at Clun, in the S.W. corner of Shropshire, 52° 25′ N. latitude. If any correction is necessary for the fraction of a degree difference in latitude between Beaumaris and Clun, I should be obliged if "F.R.A.S." would give it at once. The plantation is not a complete circle. There would appear to have been two angles, and the boulder (10ft. long) lies opposite the southernmost one, and pointing towards latest sun rising. Is there anything unusual in this? I am extremely interested in the matter, and hope to report further to the English Mechanic.—Neo.

[47033.]—**Mining Questions.**—The way to proceed to rebar an oblong shaft depends a great deal upon the circumstances. If the size of the shaft must be kept at 14ft. by 6ft., it will necessitate the removal of some of the old wood; to do which, it would be best to commence at the top, and secure the sides by temporary supports, the number of which and the way of fixing will altogether depend upon circumstances. If there is room for the bars to be fixed inside the old casing, there will be no difficulty whatever in re-barring the shaft. Column pipes for pumping should be fixed perfectly plumb, by means of a line and stays, put in every 6ft. at least. Wooden guides for cages should also be put in perpendicular and secure. In most cases two will suffice, one at each end of cage, with four receiving guides at top and bottom. The two guides should be in a right line with the winding rope.—G. Worland.

[47035.]—**Safety-Valve for Kitchen Boiler.**—In my opinion, and most of the plumbing trade, the best valve for kitchen boilers is the one manufactured by Messrs. John Warner and Sons, and sold by all plumbers—the Randall's Patent Safety-Valve.—Chas. Hosken.

[47037.]—**Watchmakers and Jewellers.**—Yes, there is. Kelly's people publish "The Watch and Clock, Goldsmiths' and Jewellers' Directory." Price 20s.—C. S. M.

[47053.]—**Conservatory.—A Question for Spectrum Analysis.**—Using ground-glass for a conservatory is certainly a drawback. Ordinary plain glass transmits only the luminous rays of the sun, and is opaque to the non-luminous heat rays. The only heat-giving power of the sun's rays in a conservatory made of plain glass is therefore due to the luminous rays of the sun. Now, in the case of ground-glass, owing to repeated reflection and the dispersion of light, the number of luminous rays entering the conservatery is reduced, and therefore also the amount of heat. Anyone may notice these differences of light and heat by going into a room with plain glass windows, and then into one with windows of ground-glass. But it is just possible that the flowers would thrive better by a more careful attention to the conservatory. The latter should be so constructed as to admit abundance of air; and, in summer-time, the roof (and better still, the glazed sides as well, except the north side), should be removed, as the rain, dew, and the *direct* rays of the sun produce a richness of foliage and vividness of colour in plants that cannot be brought about by any artificial means. Without this, the plants in a few years become long-stemmed, naked, and almost, or quite, destitute of colour, except white, and are anything but beautiful.—J. Jones.

[47056.]—**Bacteria.**—It seems to me, who pass much of my life studying and fighting these beings, that "Cygnet's" difficulty is due to not boiling the wort after straining from the rye and malt meal. Unless this is done it is not possible to keep the barm free from the germs of bacteria—lactic, acetic, butyric—because, in spite of scientific theory to the contrary, practical men who have only observation and experience as their guides irresistibly conclude that these germs have their origin in the albuminoids of the cereals employed in brewing. The albuminous matter or endosperm of cereals, such as barley and rye, is composed of a mass of cells united into a tissue, and it is the contents of these tissue cells that are called endosperm and carbo-hydrates. This endosperm consists of three, if not four, distinct albuminoids or proteids—soluble albumen, soluble casein, fibrine (organised nuclei), and aleurone—which there is reason to believe are of different chemical or molecular constitution; judged to be so not from chemical analysis, but because they are coagulated and rendered inert in water at different temperatures. The lactic ferments which "Cygnet" encourages, by leaving aside the mash or wort for twenty-four hours before the alcoholic torulæ are added, is, as was pointed out by M. Mège-Mouries, transformed soluble vegetable casein. This lactic ferment, which I have no difficulty in controlling in flour barm at temperatures below 80° Fahr., has a decomposing action on vegetable fibrine cells; their normal development in a fermentable fluid into torulæ by endogenous division is arrested; they dissolve, and the granular protoplasm, in the presence of excess of acid, develops into butyric and acetic germs. The practical brewer and baker, with knowledge born of experience, while they may not reason as above, act on the assumption that it is true, and the brewer will not linger in bringing the wort to a boil after straining, boiling briskly and thoroughly, till he sees the albuminous matter coagulated and in flocks. The lactic producing soluble casein is not killed by merely raising the heat of the wort to 212° Fahr. That is why milk boiled at that temperature will not keep, even although atmospheric germs are excluded; but, prolonged boiling of the wort, aided by the astringent tannin of the hop, will coagulate the casein, and that, I believe, is the reason for the almost total absence of lactic organisms from British beers. And that is also why "Cygnet" finds skimmings from a back attenuated with pure yeast contain few bacteria. The brewer coagulates the casein and fibrine from which they arise, and renders these substances soluble and assimilable to the alcoholic torulæ. "Cygnet's" difficulty to coax the "old mother" to send her offsprings to the surface as skimmings after the first broust is doubtless due, not so much to the presence of bacteria, but to the not boiling of the wort. If pure malt, and not more pure sound rye is used than the malt diastase can invert, and the wort resulting from their proper mashing is thoroughly boiled, cooled rapidly, and fermentation started (according to quantity), between 51° Fahr. and 70° Fahr., and the proper saline elements are present necessary for healthy cell-life, then no power in nature, that I know of, except an atmosphere chemically altered by electricity, will prevent the yeast rising to the surface. But "Cygnet" would, there can be no doubt, produce a purer and stronger yeast with a bottom rather than a surface fermentation, whether the wort is boiled or unboiled; his aim being yeast rather than a high alcoholic and rapidly fermented beer. And it is advisable to start each new fermentation with a "store" or "mother" from malt beer skimmings. I find, in my experiments with yeast, the best and purest food for the cells is the ash of carbonised figs, raisins, and malt grains. Unfortunately the ash is black, and the fluid is a porter-colour in proportion to quantity of ash. The ferment tubs should be covered till fermentation is in full force, and carbonic acid is being rapidly evolved. As to keeping the yeast covered or uncovered, it is of more consequence to keep it cool, but, if covered, it should be in a barrel, full, and made air-tight; if kept in open tubs, leave them open and uncovered, so as to allow the cells free oxygen for respiration, instead of compelling them to obtain this necessary oxygen from any unaltered sugar, or from the protoplasm and cellulose of weak cells, which the stronger cells kill by excreting an acid inversive ferment.—W. A. THOMS, F.R.M.S.

[47061.]—**Mixing Brass for Melting.**—Put 5oz. copper into a small crucible, melt it, and then throw in 2oz. melted zinc; stir it with a stick of wood, and pour it out into a hole in your moulding sand. When cold, try the metal with a file for colour. Then remelt, and when melted add ½oz. lead, and, if the colour is too deep, ½oz. to 1oz. zinc, according to judgment, as experience is the only guide. Do not use any tin, solder, antimony, or gunmetal to mix with the brass, or it will be hard. The lead used should be quite pure. For larger quantity use proportionate weights; but judgment is required, as copper is very variable.—J. SUTCLIFFE.

[47064.]—**Flight of Rifle-Bullet.**—The problems proposed by "A Rifleman" are indeterminate for want of sufficient data. The following equation will show this and may interest him. If d be the lateral deviation of the bullet in feet, caused by the wind; t the time of flight in seconds; v the velocity of the wind in ft. per sec.; a the lateral acceleration of the bullet in ft. per sec. for unit velocity of wind (1ft. per sec.); then we have this equation—viz., $d = t\,v - 1/a \log (t\,a\,v + 1)$. The constants v and a must be given or ascertained by experiment. The datum of "A Rifleman" that $d = \cdot 5$ft. for the first 100 yards, combined with the others, would enable us to find t for the first 100 yards; but mathematics will not enable us to deduce thence the time of describing the next 100 yards, which time must be known in order to get the lateral deviation at 200 yards. For the high velocity of a projectile, the relation between it and the resistance of the air can only be given by an empirical and but approximate formula. The above equation depends on the fact that, for a low velocity, such as that of a moderate breeze, the pressure of the air is sensibly proportional to the square of that velocity. The equation enables us to see this much, that for a gentle breeze in which v is small, the deviation is nearly proportional to v and to the time of flight; also that as the time of describing each successive 100 yards increases very rapidly from the resistance of the air, the deviation increases very much more rapidly than the distance traversed by the ball. For further information it is necessary to consult empirically-constructed tables.—DUBLINIENSIS.

[47068.]—**Swelling and Pain about the Knees.**—Homœopathic remedy for young gent.: Aconite, two pilules every four hours for two or three days. For young lady, arnica pilules two every three hours for two days; at first arnica lotion for the knees, every day kept moist with soft linen.—A SYMPATHISER.

[47069.]—**Fruit-Growing.**—Books on this subject seem to be rather scarce. There is a work entitled "Our Common Fruits," by Mrs. Bayle Bernard, which will most probably give "Highlander" all the information he requires.—W. HENLY RICHMOND.

[47077.]—**Casehardening.**—The most simple method by which "Cycle" can caseharden his collars is to take a small cast-iron box, close at one end, fill it with coal-dust, the collars being in the midst of the dust, cement up the open end of box with clay to exclude all air, heat the box in a bright fire for four hours. Quench them in water containing a small quantity of salt. A small quantity of yellow prussiate of potash will greatly facilitate the hardening.—K. PAXTON.

[47079.]—**Regulator.**—The index-plate at the bottom of the pendulum of a regulator is for the purpose of showing through how many degrees of a circle the pendulum is swinging. This is useful to the clockmaker when adjusting the amount of weight necessary to drive the clock. It is also useful as giving an indication by the diminished arc of vibration of the pendulum of the effect of cold on the oil of the clock, as also to indicate when it is positively necessary that the clock should be cleaned.—PARKINSON and FRODSHAM, 4, Change-alley, London.

[47079.]—**Regulator.** — The index-plate over which the regulator pendulum swings, is to indicate the degrees of arc on each side of zero. Its proper name is "degree-plate," and its use is to show, or point, by means of the pointer at the end of the pendulum, whether the same arc of the swing—to use a home-made expression—is being kept, whether it varies, and in what sum the variation consists. The degree-plate is marked 1°, 2°, 3°, 4° on each side of zero, or the line which the pendulum covers when hanging in a state of rest. It may be interesting to mention that the first clock with a pendulum that was made in England was by a horologist named Richard Harris, in 1641, and was set going in St. Paul's Church, Covent-garden.—C. S. M.

[47080.]—**Fits.**—I believe all fits are caused by worms. Take cina, three pilules, night and morning for a week or two: then china for a week, &c.—HOMŒOPATHY.

[47083.]—**Diabetes.**—Consult a good homœopathic doctor. Common unsweetened gin with cold water, taken night and morning, might be tried first.—A SYMPATHISER.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

46495.	Silicate Paint, p. 90.
46502.	Proportioning Slide Valves, 91.
46505.	Movable Stage for Theatrical Performances, 91.
46508.	Lime-burning, 91.
46521.	Emigration—South Africa, 91.
46522.	Oil-Extraction by Carbon Disulphide, 91.
46523.	L. and N.W. Engines, 91.
46527.	Memorandum Tablets, 91.
46545.	Purification of Water, 92.
46546.	Moulds for Glass, 92.
46549.	Science Questions, 92.

46701.	Moment of Inertia, p. 183.
46705.	Cart Axle Grease, 183.
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USEFUL AND SCIENTIFIC NOTES.

Fossils uniting the Characters of Pigs and of Monkeys.—Some time ago M. P. Gervais discovered in Upper Eocene strata, near Apt, in France, a portion of an upper jaw with teeth which exhibited an analogy to those of certain omnivorous pachyderms allied to the *Suidæ*, and yet resembled in other respects those of the monkeys. For this fossil (*singe-cochon*) he suggested the appropriate name of *Cebocherus*. In studying the mammalian remains found in the phosphorite deposits of Quercy, M. H. Filhol detected several specimens of *Cebocherus*, which enabled him more fully to describe the dentition, our knowledge of which was previously very imperfect. But he also discovered other somewhat similar remains, which approached yet more nearly to the monkeys, and to these he gave the generic name of *Doliocherus*. Quite lately he has obtained an almost complete head, with lower jaw in place. This unique fossil he described before the Académie des Sciences at their meeting on May 1. It is, therefore, now proved beyond all doubt that there existed during the late Eocene period a group of mammals (*Pachysimians*) which united many of the characteristics of the pigs on the one hand with those of the monkeys on the other—an association of characters which naturally gives to these fossils a peculiar interest to the student of evolution.

OF the 400,000 tons of Bessemer ingots which were used for other purposes than rails in 1881, a large part took the form of blooms for export to the United States. The production of blooms in 1881 was about 100,000 tons in excess of that of any former year. About 50,000 tons of ingots were manufactured into tires, axles, and general forgings; and 15,000 tons were made into angles for shipbuilding purposes, and so forth.

THE Census Bureau revised report of the United States population statistics shows an area of 2,900,170 square miles. The population is 50,155,783, the number of families 9,945,916, and of dwellings 895,512, being an average of 17¼ persons to each square mile.

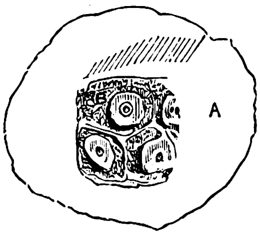
QUERIES.

[47086.]—**Picture Frames.**—Are there any rules of the material, colour, breadth, depth, and section of these? I am a perfect novice in this matter, and picture-frame makers I find cannot help one in it. They can only say such and such a kind of frame usually goes with water-colours, engravings, or photographs, as the case may be; which, being interpreted, means that such and such is the present fashion. I have been led into asking these questions through endeavouring to find a substitute for gilt mouldings for framing—a detail in household decoration not surpassed by any other, in my opinion, for vulgarity and pretentiousness; and I have thought the various woods offer a desirable field for the necessary variety required, and where their natural colour is not suitable it might be treated in some unobjectionable manner to make it so. I should esteem it a favour if any of your readers (and I should think there are many who could) give me a few hints or refer me to any published information on the subject. I do not want expensive frames.—SALT.

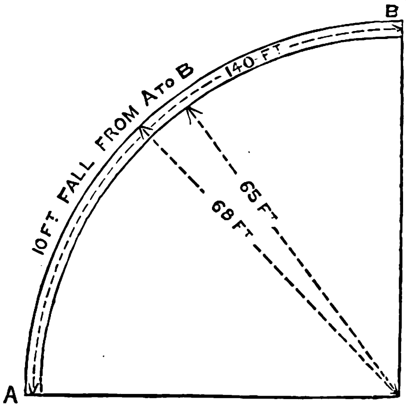
[47087.]—**Small Launch.**—I am thinking of building a small launch. Will some practical reader of the "E. M." kindly give me the benefit of his advice on a few points? It is to be 18ft. long and 5ft. beam—at least, so far as at present decided. I want to get a good speed, and light draught of water; the lines will be tolerably fine for the sake of speed. I want to know whether a steam cylinder 3in. by 5in. will be sufficient to give a good speed, worked at, say, 80lb. pressure, what kind of boiler to get—whether vertical or horizontal—and dimensions of it? What would be the best kind of screw, what size must it be, where could I get it from, and approximate cost? I suppose, for a river launch, that twin screws would really be the best. But I am afraid that in a small boat the machinery would be too complicated;—I should be glad of advice on this point. I am of course, aware that it will be impossible to get all my requirements in a small boat. If great speed is required, a great deal of space must be given up to machinery. But I shall be extremely obliged if some reader will kindly proportion all the principal parts for me, so as to get the best effect. One naturally does not like to be passed by every small tug on a river, and, therefore, wants some degree of speed. I shall be glad, therefore, if anyone, in giving me advice, will also estimate the speed.—MARINER.

[47088.]—**To Dr. Edmunds.**—I have a child 16 months old very backward in every respect; has not yet a single tooth through, no strength in her legs to make any attempt at walking, and is very small. It seems to me she does not assimilate all the food she takes (milk and bread, sago pudding, oatmeal, &c.), as, notwithstanding her being tolerably hearty for so small a child, she does not make flesh, and is really very poorly. Born a little prematurely, owing to a fall a fortnight before birth.—J. N. W.

[47089.]—**Fossil.**—Can anyone tell me the name of the fossil of which I send a sketch? It is in a depression in a stone which my dog brought me out of a hedge. The sketch is natural size, the part a being light brown, b very small cellular formation, and the rest of the stone apparently flint.—W. E. K.



[47090.]—**Tramway into Gravel-pit.**—I am now about laying down the metals. How much higher the outer rail ought to be than the inner one, the outer one laid to a 68ft. radius, the inner one about 65ft. radius; the incline of the line is 10ft. in 140ft. Note.—The horse will only walk with truck-load of gravel.—H. BOOKER, Sidcup, Kent.



[47091.]—**Inhabited House Duty.** — To MR. FRED WETHERFIELD.—I have built a house and shop, the domestic apartments of which are not completed, and the shop is occupied only in the daytime for business, no one sleeping on the premises at night; but I find I have to pay inhabited house duty, rates, and income tax. Will you tell me what rates and taxes can legally be demanded? and oblige—JIMBO.

[47092.]—**Optical Illusion.**—To DR. EDMUNDS.—I have for some time, when looking at a bright light backed with a dark ground, observed a halo strongly tinged with prismatic colours, the red rays outside the circle, the violet inside, the inclosed space filled with radial lines or rays. Please say to what cause this optical illusion is due, and whether it could be got rid of? I may add that I am well up in years, but enjoy a good state of health.—P. M.

[47093.]—**Double Steam-chest.**—I have a model steam-engine of two cylinders, each 1¾in. by 2¼in., worked of course, on the same shaft, and the two "throws" or cranks of the latter are only 2in. apart (inside), thus making the faces of the cylinders (against which the slides work) 1⅝in. apart. Now, I want some of your kind correspondents or readers to say if I can introduce a slide-valve of such dimensions and shape as can be conveniently fixed between the two cylinders. The engine has hitherto been worked by the slide-valves being outside the cylinder; but as this necessitated two steam-pipes and two exhausts, I am anxious to change. How can I manage to get the two eccentrics on the inside of the crank-shaft, also?—J. M. L.

[47094.]—**Combustion of Coal.**—Will any of your numerous chemical experts tell me how to work out in plain figures the quantity of atmospheric air required to form CO^2? or, in other words, suppose the analysis of coal was—

Carbon	88·42
Hydrogen	5·61
Oxygen	5·97

Calculate the weight of air required to burn 20cwt.—ATMOSPHERIC AIR.

[47095.]—**Paint for Loco. Engines.**—Will anyone inform me what ingredients to use in mixing paint for loco. engine, so as to stand heat, the finishing coats to be green and brown? Also, what varnish to use?—CYMRY.

[47096.]—**Legal.**—To MR. FRED. WETHERFIELD, Solicitor.—Last January I fell out of work, and my wife, instead of stopping with me and earning what she could as a tailoress, went home to her father, and now she will not come back, though I have sent repeatedly and asked her. I sent her money when I got in work again, but have now discontinued sending money, as she will not come back. Now she has put it into a solicitor's hands, and he has sent me a letter to say unless I maintain my wife, he is instructed to issue proceedings against me. My wife and her mother came to my place when I was out, and removed several articles of furniture which have been bought with my money, as well as a sewing-machine which I bought for her. Will you kindly tell me whether she was acting right in doing this, and whether they can compel me to keep her while she is away against my wish?—AN UNFORTUNATE BENEDICT.

[47097.]—**Loss of Smell.**—To DR. EDMUNDS.—I should feel very grateful for advice on the following case:—I have been subject to a cold in the head, more or less, for the last seven years, and for the last four years my sense of smell has almost gone. Sometimes in the morning I can smell a little, but towards the afternoon or evening I cannot smell at all. Otherwise, I enjoy very good health. I am engaged out of doors; age 25. Any doctors I have consulted, say that the affection of the nose has become chronic, but that a change of air might do me good—which I have tried, but without success.—T. H.

[47098.]—**Engine Queries.**—Will any reader give me information on the following questions?—1. To find the angular advance of an engine? 2. To find the angle of the crank, and position of the piston at any part of the stroke? 3. How I may find the pressure of water in a tank when full, which has an incline base?—PHENIX.

[47099.]—**Sunrise and Sunset.**—Would "F.R.A.S." kindly state at what point of the horizon the sun rises and sets 21 June and 21 Dec., respectively, in latitude 51° 2′ 45″ N.?—W. B. P.

[47100.]—**Loco.-valve Setting.**—Will someone kindly inform me how to try over a pair of valves to get correct length of eccentric rods, &c., and the use of the circles that I have seen valve-setters make on a piece of brass when getting length of rods?—DOME-JOINT.

[47101.]—**Polypus.**—To DR. EDMUNDS.—I suffer from this ailment, and have it cut every few months, but there seems no prospect of a cure. I see in No. 326 of "ours," replies 7763, p. 340, two correspondents give remedies. One advises a few drops of "Dutch drops" to be put in a spoon and applied with a camel-hair brush as far up the nostril as possible every few hours, when the polypus will wither away in a few weeks at most. Another states that "after paying numerous guineas to the doctors to no purpose, he was cured of polypus by taking tannin as a snuff." On p. 416, No. 329, another writer says: "Use fox-glove leaves dried and powdered, and take it as snuff." On p. 516, reply 10496, No. 358, another writer gives the following, taken from "Dr. Skelton's Science and Practice of Medicine": Gallic acid, two drachms; male fern root powdered, two drachms; sanguinaria, one drachm; triturate finely and use freely as snuff. Said to be an excellent remedy if the nasal bones are not affected. Does Dr. Edmunds think either of these remedies likely to be of use, and if he has not much opinion of them, would their application be injurious in any way?—D. L.

[47102.]—**Astronomy.**—Prof. R. S. Ball, in his lecture "A Glimpse through the Corridors of Time" (*vide* "E. M.," Nov. 4, 1881, pp. 204), affirms that the day is becoming longer and longer as the moon becomes more remote, and at some period of the moon's proximity the duration of the day was not more than three hours, with a tide flowing over the whole of England. With diminishing tide, the friction, surely, will diminish also—the day, therefore, diminishing too, as the moon is more remote—as, admitting the likelihood or truth of this almost uncommon "beautiful" tidal hypothesis, with the loss of friction, the earth's velocity will gain. Oppositely, then, the day will be longer in proportion to flow of tide, or three days, possibly, might be more like the globe's rotation period with the tide so mighty as described. Thinking it a little odd the professor should so seem to transpose the conditions, some astronomer might kindly throw light on the question, and oblige—INTEREST.

[47103.]—**Explosions in Collieries.**—Possibly some one of the erudite chemical contributors to the columns of the "E. M.," &c., would kindly inform me if conceivably is to be entertained the admission of a flow of non-explosive or neutralising gas into the coal-pit, either with the air-current or otherwise, for the object of destroying the explosive properties of the igniting hydrogen or carburetted gas; and either by combining with it or diluting it, carry it off, innocuous, or materially modify its risks and repetitions of fatalities. Such, say, nitrogenic gas, if not in itself too seriously injurious to life in the pit, to be contained in gas-holders below in the workings, or at the pit mouth, for service if occasion required, for purifying or, if possible, rendering more secure the mine.—ANTI-RISK.

[47104.]—**Light Punt.**—Will someone who knows all about it, kindly give me full instructions, with measurements, prices, &c., for making a miniature punt, having canvas sides and ends, very light, narrow, and swift, but capable of carrying two persons? Also, instructions for an amateur to make a pair of oars or paddles for the above, to be used when necessary.—MEDWAY.

[47105.]—**Enamel for Silver Prints.**—Will someone kindly give me instructions for making and using an enamel for photographs? Is there any kind of varnish ever used to give them a bright and even surface? If so, what is the formula? I have a small bottle of Newman's enamel-paste, which is very thick and stiff. Ought it to be so, or ought I to dilute it with anything? It is so thick that I can hardly wipe it off the print, as the directions say it should be done.—JOHN HALE.

[47106.]—**Dry-plate Photography.**—Will any reader please answer the following queries?—1. In "Easy Lessons in Dry-plate Photography," a few numbers back, is mentioned a "simple lens" among the lenses used in photography. Am I to understand that this is simply an ordinary meniscus, with the convex side towards the prepared plate. I have used such a lens but did not get the picture properly distinct, from the plate being out of focus. I assign this to one of two causes, either that the ground-glass and plate were not in the same position, or that the luminous and actinic foci of the lens did not coincide. Can anyone tell me is the latter the most likely? 2. What does "emulsify" mean, and what changes does the gelatine undergo in the process? 3. Will soaking a gelatine film in alum solution render it hard, so that it cannot be washed away by running water?—F. J. N., Liverpool.

[47107.]—**Bleaching Oats.**—Can any of your readers inform me of any other means of bleaching oats, except by drying on kiln and using sulphur?—NOVICE.

[47108.]—**Spring Blind.**—I want to make some outside blinds for room-windows. Will some reader of the "E. M." tell me how to make the spring to fit on the roller, so when a cord is pulled the blind will go up? A sketch will greatly assist.—ONE IN A FIX.

[47109.]—**Gymnastics.**—Could any of the readers of this paper inform me what are the best movements with dumb-bells to cure a high shoulder caused by working the hammer with the right hand?—D. D. M. L.

[47110.]—**Template.**—Will some reader describe the process of straightening a buckled template with a hand hammer?—D. D. M. L.

[47111.]—**To Mr. Lancaster.**—I wish to store up enough energy in a Sutton's secondary battery to work a small Swan incandescent lamp of about 3 or 4-candle power to light a small room with. Can you inform me as to the necessary size and number of copper and lead plates to be able to depend upon its working the lamp for about three hours or so every day? Can you give me particulars as to the making of a small dynamo to be able to charge it in about five hours or so by working it from the lathe when the lathe is in ordinary use? Or if you are not able, can you tell me where I shall be able to get a description of the general construction of dynamos? and oblige—ATELIER.

[47112.]—**Welding Cast Steel.**—Can any reader kindly tell me what I could use to weld cast-steel?—VULCAN.

[47113.]—**Bronzing Moderator Lamp.**—I have a bronzed brass moderator lamp which has worn bright. How can I rebronze it? How can I get at the interior? The oil seems to be supplied too fast to the wick. In fact, the pump requires to be wound up every four or five hours. Is this as it should be?—MURANO.

[47114.]—**Wood-chopping Machine.**—Will any reader of the "E. M." kindly oblige by giving me instructions and sketch for making the above for chopping cord or hard wood—to work by hand or steam-power?—FIREWOOD CHOPPER.

[47115.]—**Boiler.**—I have a boiler 32ft. long by 7ft., two furnaces 2½ft. each, six Galloway tubes in each flue. I have considerably improved it from reading the valuable information so freely given by *practical* correspondents in this paper; but I doubt my having arrived at perfection yet. I would feel much obliged if anyone who understands the subject would inform me the approximate number of horse-power it is capable of supplying steam for to a single high-pressure engine expanding from about one-third of stroke? Also, how many pounds of coal should be consumed per horse per hour? I am aware there is a difference in coal. We use Newcastle steam coal.—MANUFACTURER.

[47116.]—"**Livadia.**"—Can any reader kindly say what has become of the Czar's yacht, *Livadia*? Having gone on her trial trip, I would like to know what has become of her. I heard she was to be incased in wood, and then sheathed with copper.—ERIN-GO-BRAGH.

[47117.]—**Tinning Steel Wires.**—I should be glad if some of your readers would tell me the most ready means of tinning a number of steel wires about ⅛in. thick—especially the means of preparation previous to dipping.—G. C. T.

[47118.]—**Medical.**—Will Dr. Edmunds kindly tell "J. W." what to do, and what liniment to use to alleviate a most distressing pain in the forehead over the right eye, which now comes on, and continues for the night after a day's sick-headache, to which he has been subject all his life; but now, very often and very prostrating—the head, stomach, and back causing great suffering. I am in my 66th year. I think my case would be well-described by the word "megrims," and, without doubt, derived from my mother, who was a great sufferer for years before she died.—J. W.

[47119.]—**Speeds.**—I am fitting up a lathe for myself, and have driving-wheel for crank-shaft with four speeds; smallest is 14½in. in diam.; each of the other three is 1⅛in. larger. I want four-speed pulley for headstock to match, not to alter the strap, when I want to use the other speeds. Will "Sunlight," or some kind reader, give the size of the four speeds I require on coned pulley strap?—BICYCLE MAKER.

[47120.]—**Enamelled Bowls.**—Will anyone kindly tell me how to enamel iron bowls? and oblige—ENAMEL.

[47121.]—**Indian Locomotives.**—Can Mr. Gobert, or any correspondent of the "E. M.," give me a sketch of the engines on the Indian, Australian, and New Zealand lines, with dimensions and details? Also, those of the North and South American Railroads. Please show tenders, if possible.—RUSSELL.

[47122.]—**Size of Battery.**—I am desirous of changing the motive-power of a pump by which water is supplied to the fountain (pipe ⅜in. diam.) of an aquarium, and raised 3ft. by using a battery in place of a small steam-engine. Would you inquire for me what kind of battery would be best, and what size necessary, and if I could use a Leclanché or bichromate, and if I could, what size would be best? I wish it to work about an hour a day.—THOS. LEES.

[47123.]—**Electro-plating.**—Will someone kindly inform me if it is proper for the silver anode to become coated with a dark substance when plating? Also, what is the cause of gold solution yielding its gold very tardily after being in use a few weeks? I should mention that there is plenty of gold in solution, and that I have tried adding fresh cyanide, different battery powers, and temperatures.—ELECTRO-PLATER.

[47124.]—**Medical.**—I have about every five weeks a swelling in the right side of my nose, swells for about three days, and then breaks out into whitish-yellow scabs, and is very painful. I should be thankful to any reader who would point out the cause and remedy.—SUFFERER.

[47125.]—**Transmitter.**—I have a Blake's transmitter with switch, all in one case, on which the royalty has been paid. Can I alter the same by putting the transmitter in one box and the switch in another, like the instruments now used by the Telephone Co., without infringing on the patent?—E. T. C.

[47126.]—**Electrical.**—I intend to fit up a galvanic battery for medical purposes, and the only available space for cells (Leclanché) is an old outhouse. Will the frost in winter affect working, or in any way damage cells?—MEDICUS.

[47127.]—**Legal.**—About four years ago I lent some models to a tradesman on the verbal condition that if they were not returned when I sent for them they should be paid for. The said tradesman has not yet returned them, though I have sent for them two or three times. Can I legally send him a bill for them, and if he does not notice that, can I send him a County Court summons? I must remark, however, that no price was agreed upon between us, only what they cost working.—EPSILON.

[47128.]—**Chinese Cement**—Can anyone give me any information, or tell me where I can get information, as to the composition of a Chinese cement? I think that it is partly composed of quicklime and blood. Some time ago there was something about it in one of the scientific journals, but I cannot remember which.—T. D. HOLLICK.

[47129.]—**Organ Pedals to Piano.**—Wishing to connect a set of pedals to a piano, I should be glad if any correspondent will show me the easiest way to do so, and also describe the proper action, so as not to injure the piano-case.—J. E. B.

[47130.]—**Decorating Organ-Pipes.**—My show-pipes having become very dirty, I am anxious to recolour them. Before painting, must I remove all the old gilt and colour, or can I colour over? Can anyone give me a design for a small front—mahogany case? Pipes being small makes it difficult to stencil. Any suggestions will oblige—J. E. B.

[47131.]—**Pedal Pipes.**—Scales, lengths, &c., wanted for an octave of 16ft. bourdons CCC. to CC., smallest size possible. Will anyone oblige?—J. E. B.

[47132.]—**Hæmorrhoids.**—To DR. EDMUNDS.—Will Dr. Edmunds kindly give his advice in the following?—For some months past I have been troubled with blind piles. I have been recommended vegetable charcoal, and taken a good deal of it, but find little or no benefit from it. The piles do not inconvenience me much, as it is only occasionally I feel any pain from them; but I am afraid they may get worse, and so be harder to cure than they would be now. I fancied they were better when I had a good deal of sea-bathing. I should feel extremely obliged for any advice as to their treatment both from Dr. Edmunds or any others who may have received benefit from any particular remedy.—GRATEFUL.

[47133.]—**Gold.**—Would some of your metallurgical correspondents kindly inform me as to whether the gold in an auriferous iron ore passes into the slag or metal when the ore is smelted, and whether gold is ever found in refining slag, as I am unable to find the information in our ordinary textbooks?—K. A. G.

[47134.]—**Bicycle-making.**—Cannot we get some able correspondent to give us some practical articles on bicycle-making, with dimensions and sketches of any tools or parts where required to be understood? I think it would be conferring a great boon on many amateurs who, not going into ornamental turning, wish to make something useful.—A. B. R.

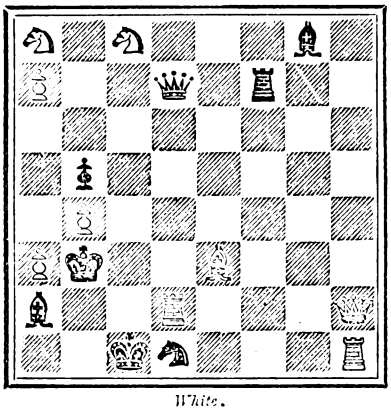
[47135.]—**Compressed Gas.**—I think of making in my spare time this summer a pair of condensed gas bottles for the limelight; but as I have never seen any of them, I would like some information how to proceed, the size they would need to be to hold about 8ft., and the construction of the valve. I was thinking of making them out of good Lowmoor boiler-plate ¼in. thick, making the tube first, and then welding in the ends. I am a blacksmith by trade, and I can get the use of a forge and a lathe in the evenings. I should like to have them ready by the coming winter season. Also, what like a thing is the pump for pressing the gas? We have in the works where I am employed, a hydraulic pump, used for testing boilers. It is used with water, but I think it would pump air or gas quite as well. I took this pump all to pieces to see how it was constructed. Would a pump of this kind do? If not, please to say of what style it would need to be, as the above would, I am sure, interest many other readers besides myself who take pleasure in exhibiting the magic-lantern, and would be willing to try their hand in making the above—the best and most portable of all forms of the limelight. I hope that someone who can give the information will do so.—Limelight.

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCLIII.—By H. E. Kidson.

Black.

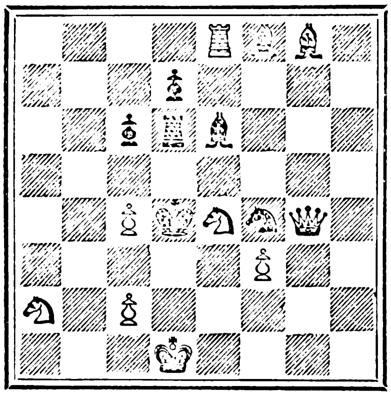


White.

White to play and sui-mate in three moves.

PROBLEM DCCLIV.—By T. B. Rowland, Dublin.

Black.



White.

White to play and mate in two moves.

Solution to 749.

White.	*Black.*
1. Kt to B 4	1. Kt to K 5 (a)
2. Q to K 5 (ch)	2. K takes Q
3. Kt mates	
	(a) 1. B or P moves
2. Q to K 5 (ch)	2. K takes Kt
3. P mates	

Solution to 750.

White.	*Black.*
1. R to K B sq	1. P takes R (a)
2. Kt to K B 3	2. Anything
3. Mates	
	(a) 1. Q to B 4 (b)
2. P to K B 3 (ch)	2. K moves
3. Mates	
	(b) 1. B to K B 6
2. R to K Kt sq	2. Anything
3. R mates	

NOTICES TO CORRESPONDENTS.

F. C. Collins.—Many thanks for the problem. No doubt it will prove sound.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, June 7, and unacknowledged elsewhere:—

Westinghouse Brake Co.—H. H. Holt.—J. Bateman.—C. W. Wilson.—Bausch and Lomb Optical Co.—C. J. Stock.—J. Devey and Co.—T. Dockray.—Quod Dixi Dixi.—Tyro.—Enquirer.—M. H. C.—W. H., Hoyland.—H. A. Wassell.—J. C., Liverpool.—Spot Lens.—Electric.—A. Hallett.—G. J. H.—F. C.—Zelia Naien.—Brickwall.—Novice.—Mc—One who Wants to Excel.—Musical.—A Constant Reader.—Everton.—Core Boy.—W. M. Gardner.—J. H. Huxley.—Russell.—E. Gobert.—E. Martin.

A Defendant. (No; the defence would fail.)—Thomas Jones. (No.)—C. H. Domaille. (Yes, if not too long.)—W. Mayer. (If you can tell our readers anything that "Foundry" did not, or if you can usefully criticise the methods of working he described, do so by all means; but we can't waste two columns in discussing the relative importance of green sand and loam moulders.)—Chemistiana. (The last instalment appeared on p. 212, No. 895. We have received nothing from you since.)—Isle of Wight. (Yes, and most properly.)—Success. (Your best plan would be to read up some of the lectures on the subject, and utilise the papers we have given in back volumes.)—John Hale. (There is one on p. 269, and another on p. 424, No. 876.)—Festina Lente. (See p. 504, No. 879, for the solution, or p. 268, May 26.)—M. J. (Ivory black 1 cwt., treacle 28lb., rape oil 1 gal Mix to a paste. Dilute 21lb. of oil of vitriol with 2 gals. of water. Add to the paste by stirring forcibly. Cover up whilst still fuming, and it will be ready for picking up next day.)—Thos. Lees. (Yes, many; but you must refer to the indices, unless you specify what kind of motor you require.)—Alpha. (The Bunsen battery is the best for the electric light when it is required for more than a few minutes; but any battery is very expensive. Read what has been said in recent vols. and numbers.)—W. Henly Richmond. (There is nothing but emery and oil; but it would probably be advantageous to wet all parts thoroughly with paraffin oil some hours before starting. Use rather fine emery.)—Diet. (By referring to p. 451, No. 877, we find that one of the letters mentioned appeared in the *Echo* of Jan. 7 last, so that if you consult the file of that paper for the month of January you will probably find what you require.)—Nemo. (The preparation is a secret, but it is understood that they are compounded of hops, buchu, mandrake, and dandelion.)—Star Light. (Directions for making small air-pumps have been given many times. See p. 516, No. 775, for illustrations of two; p. 521, No. 802; and Nos. 818, 819, and 824 for details of parts.)—Humanity. (They eat only during the summer months; lettuce is a favourite food and bread soaked in milk. See p. 619, No. 467.)—Electrician. (The incandescent lamp mentioned is in all probability supplied by a bichromate battery.)—S. Williams. (Try vegetable charcoal in the shape of powder or biscuits; but it would be advisable to consult a medical man.)—Stain. (The cause is evidently constitutional, and no one can advise without personal examination.)—Ploughman. (See the indices of the last two volumes. The cost of the lenses can be ascertained by consulting the catalogues of the opticians.)—Gasalier. (Directions for constructing Leclanché batteries have been given over and over again. You will find the new form described on p. 541, No. 803. Two quart cells; line wire No. 18 or 20. 2. We know of no process of taking copies from pencil drawings; but if you draw them with violet aniline ink you can obtain 50 copies by means of the "graph" process.)—Steward. (If you are acquainted with the duties, you stand as much chance as others. Make application at some of the steamship offices, or to the masters on board the vessels.)—A Workman. (It is the scurf from the retorts at the gasworks, and is cut with much labour by means of iron blades and sand, or with good hard saws.)—Signed Tinsmith. (Full instructions on p. 238, No. 868. See also No. 860, p. 36, "Japans and Japanning.")—Mc. (Are we to understand that the engine is actually at work? There is nothing novel in the two pistons; but your explanation is wanting in clearness. If the explosion takes place inside chamber, it is not clear what prevents the gas being driven through the valve without the ram being brought down. We are afraid you are not likely to get the information asked for, because the data can only be ascertained by experiment. 2. If you get one of Messrs. Barnett and Foster's catalogues you will find illustrations of bottle-washing machines.)—Yoshi. (In the specifications of the patent, and also, we think, in some of the technical papers.)—Pimlico, S.W. (Use one of the cements advertised, or marine glue. To repair the cuts, fill up with rubber solution.)—Landscape View. (Cannot you try whether it makes any difference? As to the stand, see p. 445, No. 877.)—A. J. F. (It is constitutional, and if it continually recurs you should consult a medical man. 2. Do you mean a bicycle or tricycle? Any of the makers who advertise in our columns can supply you with one, and if you read up the discussion in the last volume you will be able to make up your mind. 3. This query must be put in some other form. What is it you wish to know?)—Electrician. (Make up your cell as directed on p. 5, using caustic soda as cheaper than caustic potash, or make up a cell like the Leclanché. See recent back numbers.)—Charles Davies. (Your battery is a modification, but not an improvement, of the Daniell.)—An Amateur Electrician. (About 30 Bunsen cells.)—Clayton. (See p. 284, last week, and many other places in recent back numbers. You could use lead jars if you prefer them, but not in lieu of porous pots.)—Amateur Photographer. (Have you read the papers on dry-plate photography, now appearing, and many replies in recent volumes?)—Otter. (Rough the tube, and glue the leather on.)—S. Murray. (There are two works on "Dyeing and Calico Printing," one by Crace Calvert, the other by Crookes. Perhaps the latter will suit; but we are afraid you require too much technical information. Get Calvert's catalogue of books, Great Jackson-street, Hulme, Manchester.)—Beginner. (Hunter's "Manual of Beekeeping," D. Bogue. See for an answer to your question p. 517, No. 488, and pp. 171, 195, 244, Vol. XVI. If you can look through Vols. XV. to XX., you will find a great deal of useful information about beekeeping.)—A Would-be Astronomer. (Your question was answered on p. 8, March 10. A 4in. telescope is needed.)—Theo. Mechan. (Mere examination questions, for which we can only occasionally find room.)—Malleable. (See p. 559, No. 777. The castings are packed in red hæmatite, and subjected to a red heat for a long time.)—C. A. (Has been fully explained many times, the last so recently as p. 156.)—North Pole. (The principle is not patented, but the methods of carrying it out are in the shape of the machines. It consists in supplying intensely cold dry air to the room, and is applicable to such a space as you mention, but in that case would be rather expensive. See p. 240, No. 264.)—W. Styles. (See the indices.)—Sunshine. (There are two kinds—summer freckles, produced by the action of the sun and heat, and cold freckles, due to some disordered condition of the system. A good lotion is said to be sal-ammoniac 1 drachm, spring water a pint; but most druggists make up suitable applications.)

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*** It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions; and in cases where the amount sent exceeds One Shilling the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

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Equatorial **Telescope,** 9¼in., With-Browning mirror, at Stevens' Auction Rooms, King-street, Covent Garden.

Equatorial **Telescope,** 9¼in., cost nearly £100, by Auction, June 16th (Friday).—Stevens, King street, Covent Garden.

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Bicycles.—Britannia Company are appointing agents for the sale of their bicycles, which, quality and durability considered, are the cheapest in the trade.

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Gas-Engine Drawings. Indispensable to engineers inventing or using gas-engines.—Neal, 48, Junction-road, London, N.

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Readers of the "**Mechanic**" will do well to send for François' list and compare with others.

A. François, while thanking those who have honoured him with their patronage, beg to say he will forward list to them.

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One new **Vertical Tubular,** 4ft. 6in. by 2ft. diameter, highly finished and cheap.

One new **Vertical Tubular,** 4ft. high and 1ft. 9in. diameter, with or without fittings. Cheap.

One second-hand **Launch Boiler,** 3ft. 9in. high and 2ft. diameter. All fittings complete. A bargain.

Launch Boilers of every description are manufactured by Dickinson, Osborne, and Shaw, 219, West Ferry-road, Millwall, E.

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Tinman's **Jenny,** very little used, equal to new, 20s.—F. Hodges, 186, St. James-crescent, Gloucester.

Bicycle, 52in. Challenge, by Singer, in good order, front wheel brake, sale, cheap.—Sydney Evershed.

Horizontal Engine, 1-3rd horse-power, complete, in working order; quite new, cheap.—Sydney Evershed, Wonersh, Guildford.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, JUNE 16, 1882.

SCREW PROPULSION.

THE somewhat heterodox views of Mr. J. B. Root on the problem of the screw-propeller, a notice of which we gave on p. 294 of our last volume, attracted some attention in this country, as they did in the United States; but, so far, no really practical result has followed the expression of the various opinions enunciated. Lately, we have had a lecture from no less orthodox a propeller-man than Mr. Griffiths, the inventor of the screw that bears his name, who, at the commencement of his remarks, made the statement that, although nearly half a century has elapsed since the introduction of the propeller, very little real improvement has been effected, notwithstanding the attention the subject has received. Such a statement, made, as it was, in the lecture-room of the Naval and Submarine Exhibition, might have taken the visitor by surprise; but it is nevertheless a fact that we are still a very long way off even that approach to perfection which alone can satisfy the engineer. The problem is acknowledged to be a difficult one, and there can be no doubt that to a certain extent progress has been delayed, as Mr. Griffiths suggested, by the prevalence of erroneous ideas respecting the loss of power which appertains to the propeller—one of the greatest difficulties in the path of improvement being the uncertainty as to the cause of the loss, many believing that it is due to the form of the screw, whereas Mr. Griffiths and others hold that the position of the screw as regards the hull of the vessel is by far the more important factor. The actual power required to force a vessel through the water is less than one-third of that which must be applied through the propeller to obtain the same speed, so that if we could but approach to the minimum by means of the screw, a great reduction in the weight and strength of the machinery would be possible. It is some years ago since Mr. Griffiths determined that the slip of the screw was by no means a measure of the loss of power; but although many experiments have been made since, it is not yet clear what becomes of the wasted power. In 1875 Mr. Griffiths made some tests on one of the steam launches in the Navy, which was towed at the speed her own engines would have given her, with the view of ascertaining the velocity of the water through the screw's disc. It was found that while the velocity through the bottom-half of the disc, and at the outside for some distance above the shaft was approximately that at which the launch was being towed, the speed of the water at the upper part of the disc was only about half. Therefore, as the screw propels the vessel by pushing the water back, there must be an unequal distribution of power, the blades as they approach the top of the disc meeting with greatly increased resistance, and giving rise to a series of jerks, which are recognised in the shape of vibration. Dynamometer diagrams show clearly the great increase of resistance met with by the blades when vertical, and this increase must fall entirely to the share of the upper blade. At those parts of the screw's disc where the water is being dragged with the ship, the greater part of the power is exerted, and as the tendency of the propeller is to force water away from the ship, much less pressure is given to the stern by the closing in of the water behind the vessel. To avoid this drawback Mr. Griffiths placed the propeller further away from the wedge of the run, and found an increase of speed until the screw was more than two-thirds of its diameter from the end of the wedge formed by the immersed lines of the stern. Beyond that distance a decrease of speed was experienced, for then the propeller was behind the meeting line of the water coming from each side of the stern, and the flowing together of those two streams offers, as may be readily imagined, considerable resistance to the screw. In carrying his plan out in practice, either a different form of rudder is used, or the old form is placed on a new frame, the object being to put the propeller in such a position that it is so far clear of the run as not to retard the progress of the vessel. The increase of speed claimed for so comparatively simple an operation is about 12 per cent.—in some cases as much as 15 per cent.—to attain which, by engine power, would involve an increase of somewhere about 40 per cent., an enormous augmentation in the money value of the machinery of a vessel. Several ships have been fitted with propellers on the plan proposed with satisfactory results—in two cases where measured mile trials were made, the gain was a knot and a knot and a half respectively. If the greater portion of the power is expended at the upper part of the screw's disc, it follows that a reduction in the diameter should within limits lead to some improvement, and in the case of three Atlantic steamers a slight increase of speed (about half a knot) was effected by reducing the diameter in two by as much as 30in., and in the other by 16in. The experiments with the *Iris*, which was fitted with four-bladed screws of 18ft. 6in. diameter, and subsequently with Griffiths' screws—four-bladed, 16ft. 3in., and two-bladed, 18ft. 1½in. in diameter, which, owing to their narrower points, meet with less resistance at the upper part of the disc—conclusively proved the advantage, as a gain of nearly two knots was the result.

The dragging back of the water at the upper part of the disc increases the resistance of the ship very considerably; but Mr. Griffiths proposes to remedy that by fitting plates in such a manner as to increase the current of water through the upper part of the disc formed by the screw. At present the plan has been tried only in model, but it seems that it is sufficiently successful to warrant experiments on the scale of 12in. to the foot. The idea of placing cylindrical covers over screw-propellers is not by any means a new one, but whenever it has been tried, a loss of speed resulted. Mr. Griffiths came to the conclusion that the loss was occasioned by the propeller not having sufficient water to act upon, and from some experiments he made he was induced to give the cylindrical casing a sort of funnel mouth, with the view of gathering in water into the casing. About seven years ago this casing was tried on the *Bruiser*, a gunboat having a propeller 6ft. in diameter. The casing was 6ft. 1in. over the propeller, and 7ft. at the funnel-mouth. When tried at the measured mile the gunboat showed an increased speed of about a quarter of a knot, and also answered the helm more quickly, while vibration was much reduced. There is another reason why a casing over the propeller is advantageous, which is especially applicable in the case of men-of-war, and that is the protection afforded against the fouling of the screw by ropes or wreckage. Consequently, if an increase of speed can be obtained, and at the same time the propeller can be protected, there will be every inducement to adopt the invention, especially in its latest form. The casing, as fitted to the *Bruiser*, though perfectly successful so far as it went, did not altogether satisfy Mr. Griffiths, and further experiments led him to adopt a casing in two pieces of different diameters. One of these, just large enough for the propeller to work in, extends from the rudder-post to the middle line of the screw, where it is overlapped by a ring of greater diameter (about one-eighth), which extends forward, and is supported by bars reaching from the "run" of the vessel to the outer rim of the casing. These bars, it will be understood, serve to prevent the entrance of substances which might foul the screw, while the annular space left between the two rings forming the casing provides an escape if more water is taken in than the screw requires. The arrangement is based on the theory that the screw draws in water opposite the forward part of the periphery for about half the width of the points of the blades, and opposite the after half drives it out. By fixing a ring case over that part of the propeller, this latter action is prevented, and more thrust is obtained; but it is necessary to increase the size of the ring forward, in order that the drawing-in action of the forward part of the periphery may have full play. A practical demonstration of the value of the device will be given shortly, as some steam-trawlers which are being constructed for one of the fishing companies, are being fitted with these propeller casings. The plates above mentioned represent casings cut away in parts, and are certainly simple and inexpensive additions. The upper one, which covers about two-thirds of the diameter of the propeller, extends from the rudder-post to some distance in front of the screw, and is kept at a distance from it of one inch for every foot of the screw's diameter; the lower one extends from the rudder-post to the middle-line of the blades, and while covering as large a diameter as the upper, is placed as close as possible to the points of the blades. In the case of twin screws, the position is altered, the upper plates being fixed more to one side rather than directly over the top of the screw's disc. It is stated that a simple addition such as we have here briefly described, promises, according to the experiments with models, to give an increase of speed of 7 per cent., while the cost can be only a few pounds in the largest vessel.

THE RHEOLYSER.

THIS name has been given by Prof. Wartmann to an apparatus (described by him to a scientific society in Geneva) which enables one to make the intensity of a derived current vary rapidly from zero to a maximum, and which indicates, in an exact way, the relations of these variations (see *Archives des Sciences*, May).

On a tripod, adjustable with screws, rises a column, to which six radii—all in the same horizontal plane—connect a graduated metallic ring rising above the plane. Each of the quadrants is numbered to 90° right and left of a diameter which is the line of zero. This ring surrounds a thick disc of glass or ebonite, resting on the radii, and having a circular canal, filled with mercury, near its outer border. At the top of the column is a diametral bar, terminated by two verniers, which acts like a movable Wheatstone-bridge, turning about the common centre of the canal and the ring. It carries two copper screws with amalgamated points, fixed near the ends of the diameter which form the line of zero of the verniers. These screws dip in the mercury at an interval of 180° from each other. Insulated electrically, they communicate with two binding-screws, placed near the centre of rotation, to which are

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joined the circuit ends of a mirror-galvanometer. Two orifices made in the bottom of the canal, at the interval of a half-circumference, admit copper conductors into the mercury. These latter are connected with binding-screws, in which are fixed the electrodes of the battery, and which are isolated on the tripod.

To use the rheolyser, one commences by making the zeros of the verniers coincide with those of the graduated circle. A tangent-screw regulates the small displacements of the bridge, and enables one to appreciate them easily with an exactness exceeding a minute of arc. The battery circuit is closed; and if the galvanometer shows a deflection, this is counteracted by the play of a second tangent-screw, which turns the disc in its place. Then the diameter which joins the points of bifurcation of the circuit is exactly perpendicular to that which passes through the dipping screws. When the bridge traverses equal arcs right and left of the line of zeros, the deflections of the galvanometer needle are equal and of opposite sign. Two of the mercurial arcs gain precisely what the supplementary ones lose—a circumstance which increases the sensibility of the apparatus.

Mercury has an electric resistance at once superior to that of the other usual methods, and less affected by variations of temperature. No more perfect or uniform contact is known than that which it gives with amalgamated copper. When it is pure, its liquidity insures complete homogeneity. These properties justify its use in the present case.

But it is indispensable that the conductivity of the mercurial ring should be and remain the same throughout. Local capillary influences, or a possible imperfection in the support of the disc, might prevent this condition being fulfilled. To obviate this, the author covers the canal with a plate of glass which is held by springs, and turns with the bridge. The mercury, whose convex surface is flattened by this plate, fills the whole annular cavity; moreover, it is sheltered from dust and other impurities.

That the apparatus may be transportable, one of the small orifices in the bottom of the canal allows the mercury to flow into a glass cylinder under the disc. This reservoir is closed below by an iron piston moved by a screw. Thus the canal may be easily emptied, or a liquid ring of desired section introduced. One of the electrodes is then in communication with a plate of copper inserted between the disc and the metallic top of the reservoir. This plate is pierced with a central hole at that part of the canal.

The rheolyser may be used:—

1. To obtain a current of a given intensity.

2. To maintain this intensity with rigorous constancy.

3. To verify, by an operation similar to that of a commutator, the construction and installation of apparatuses based on electromagnetic reactions, such as sine and tangent compasses, electrodynamometers, galvanometers, &c. The mobile system is in its true position of equilibrium, and free from perturbating causes, when it deflects through equal arcs, under the action of currents equal and successively opposite, produced by displacements of the bridge on either side of zero.

4. To determine directly the value of the co-efficient of reduction which renders comparable evaluations made with two of these apparatuses not identical. This coefficient is equal to the ratio of the lengths of the mercurial arcs, reckoned from the zero of compensation, for which the deflection of the mobile system is the same in both instruments.

5. To form a table of correspondence between the intensities of different currents and the galvanometric deflections measuring them.

6. To form a table of corrections necessary for indications of ordinary tangent compasses.

7. To find the relations of intensity of electro-motive forces obtained from different sources. These intensities are to each other in the inverse ratio of arcs of the rheolyser which produce the same deflection in the galvanometer.

8. To estimate the ratios of the resistances of various conductors, as also variations of resistance in the same conductor.

9. To assure oneself of the good construction of shunts, resistance-coils, and other apparatus of the kind.

10. To express, in absolute measure, the intensity of derived currents, when one knows the value of I, as also that of the resistances R and ρ.

IMPROVEMENTS IN SAFETY-LAMPS.

THE proposal to employ electric lamps in coal-mines does not appear to meet with much attention from practical miners, although the safety-lamps at present used are confessedly not everything that could be wished. It is tolerably well-known that numerous as are the devices already seeking for patronage, there is no real safety-lamp amongst them, and it is difficult to conceive a design which in all circumstances could be fairly regarded as safe. There is a natural reluctance to adopt a comparatively untried system like the electric lamps, which, moreover, may introduce an element of danger from which the existing devices are free, for miners prefer the risks with which they are acquainted to others of which they know practically nothing. The question of the safe-lighting of coal-mines has been recently debated at some length by the Manchester Geological Society; but, although many practical workers have taken part in it, none of them have even suggested the electric lamp—perhaps because they are unacquainted with it, but more probably because they are not inclined to trust it, from a vague but not ill-grounded fear that it would introduce elements of danger from which the present lamps are free. It is certain that sparking between severed connections would inevitably fire an explosive atmosphere, and there might be some risk from lightning flashes if a system of electric "leads" were carried through a mine. At a recent meeting of the Manchester Geological Society, Mr. Jas. Cunliffe, of the Bridgewater collieries, submitted an improvement of the Davy, the principal object of which is apparently to secure a better light. He urged that as it was impossible to construct useful lamps which would not be liable to be broken by ordinary accidents in the mine, it would be better to seek for improved lighting power, which would diminish the risk of injury to the lamp, and trust to the indication supplied by the flame for the detection of dangerous atmospheres. Lately, several ingenious devices for ascertaining the dangerous character of the gases have been devised; but as they must needs be under the control of overmen, they would scarcely meet all the accidental conditions which sometimes arise in fiery mines. What the miner requires is a lamp that will give the best possible light, indicate unmistakably the presence of foul-air, be proof against tampering, and while resisting the effects of "shots," be strong enough to resist any accidental blows it may receive. It is not very difficult to devise a lamp which shall be so inclosed that a sudden blast of air, such as may be given by the firing of a shot, shall have no effect on it, in the shape of driving the air through or sucking the flame out; but it is not so easy to give sufficient light and avoid all danger from the accidental blow of a pick. The members of the Society above named do not appear to have been able to arrive at any conclusion, although many experienced mining engineers were present at the meeting; the discussion in the end being adjourned to a special meeting to be held at Wigan at the end of this month. Mr. J. Ashworth, of Derby, exhibited his modification of the Museler lamp, the principal improvement being the addition of a light copper or tin shield above the gauze, which touches the chimney at six equidistant points and prevents any current passing through the gauze on one side of the chimney and out again on the other, as it may do in the ordinary Museler. An appendage called a "chimney pot," consisting of a cylinder containing three wings which commence a little above the top of the chimney, and extending to a little below the bottom of the cylinder, divide the pot into three compartments, is another improvement. With these additions it is claimed that a continuous and steady current is maintained in the lamp with no more air entering than is required to supply the flame, whilst the air so entering is highly heated by direct contact with the chimney, and thus assists in producing perfect combustion. Mr. Ashworth prefers mineral oil, and so far as his own experience goes, he considers it safer than any other. He admits that it is useless expecting Government to make the use of any particular lamp compulsory, but thinks they might insist on the employment of lamps of standard types only, and that all new lamps introduced from time to time should receive the authorisation of the Home Office before they could be used in any mine. Mr. J. S. Martin, Inspector of Mines, said there could be no doubt that the lamp which was required was one which would go out when it came in contact with an explosive mixture, because so long as the flame continued inside the lamp when in the midst of an explosive mixture something must ultimately give way, and the result in all probability would be an explosion. The chief use of a safety-lamp should be considered as an indicator for detecting the presence of gas, and not for working in the midst of an explosive mixture.

IMPROVEMENTS IN VELOCIPEDES.

AMONGST recent "improvements" in velocipedes, whether bicycles or tricycles, are several devices to obviate the rotary action of the feet, and to replace it by an up and down motion in which the length of the stroke is at the rider's pleasure. Those who visited the Stanley Exhibition at the Agricultural Hall did not fail to note as one of the novelties the Merlin bicycle and tricycle, which we briefly described on p. 558 of the last volume. In that machine, it will be remembered, the pedals are at the ends of two levers pivoted to forward extensions of the framing, and connected, about the centre of their length, to loose pulleys carried on the axle. The connection is a leather band, and inside each pulley is a spring, which reverses the motion of the pulley, coils up the leather band, and so raises the pedal lever for the next down stroke. Motion is imparted to the axle through a pawl carried by the crank arm, which engages with the ratchet teeth on the side of the loose pulley. A somewhat similar method of imparting motion to the driving wheel has been recently patented in this country on behalf of S. N. Silver and C. E. Page, of Maine, in the United States. Their invention consists in a tricycle having two pivoted foot levers connected with arms loosely mounted on the driving axle, and provided at their outer ends with pivoted pawls engaging in notches in discs loosely mounted on the axle, the discs being provided with friction clutch dogs catching on the inner surface of the circumferential flange of a disc fast on the axle, whereby when the foot levers are depressed springs on the axle connected with the loose discs, and other springs, also connected with these discs, will be brought in tension, and when the pawls are released from the discs the springs revolve the loose discs which catch on the fast disc, thereby rotating the axle and propelling the vehicle forward. The tricycle is provided with a brake operated by means of a handle sliding on a squared rod surrounded by a spiral spring, and the front guide or steering wheel is connected with a like square rod, provided with a handle and spring, these handles and springs being also used to increase the power for propelling the vehicle. The frame is in form of a right-angled triangle, and is bent upwards at its rear end to form bearings for the axle. The driving wheels may either be fast on the axle or provided with boxes having internal ratchet teeth with which pawls on the axle engage only when the axle turns in the one direction and not in the other. The foot levers are pivoted at their front ends to the frame in front of the axle, and their rear ends extend behind the axle, and are respectively connected by links with arms loose on the axle and carrying pawls engaging with notches in the edges of discs also loose on the axle. Between the loose discs is another disc fast on the axle and having a broad rim, against the internal periphery of which bear two opposite friction clutch dogs pivoted to the inner face of each loose disc, and resting against and connected by springs to a diametral rib on the inner face. The arms and loose discs are held close up to the fast disc by a coiled spring. Powerful springs are coiled upon the axle at either side of this double friction clutch box, and are attached to the loose discs thereof, and strong springs are also attached to the frame and to the loose discs. Either or both of these springs may be used. By depressing the treadle levers alternately the arm and pawl are drawn down and the corresponding loose disc is turned backwards a portion of a revolution (its movement being limited by a stop), and the springs connected to it are thereby put in tension. When the pawl reaches the end of its stroke it strikes a fixed cam block and is thrown off, thereby releasing the loose disc, which is thereupon turned by the springs in the forward direction. In this forward movement the friction clutch dogs engage with the rim of the fast disc on the axle, which will then be rotated, the vehicle being propelled forward by the power of the springs. The treadles have a socket at the underside resting on a ball on the treadle lever and held thereon by a stirrup embracing the lever. A steering wheel is loosely mounted on a short shaft in the front forked end of the frame in line with one of the driving wheels, and an arm on this short shaft is connected by a rod with a crank arm at the lower end of an upright rod, turning at its upper and lower ends in the frame. This rod is of square section, and upon it slides the lower bent end of a guided rod, having a handle at its upper end by which the square rod can be turned at the same time that the handle is free to slide up and down thereon. The handle is pressed down by a strong spring on the square rod, but may be locked in the raised position when the action of the springs is not required. A similar arrangement at the opposite side of the vehicle is connected with a cross bar carrying brake shoes to be applied to the driving wheels. The action of the springs applied to these two handles is by drawing the handles downward against the upward pull of the rider's hands, to draw the rider's body downwards, and so increase the power applied to the treadle levers. It is not necessary to give illustrations of this device (the specification is No. 4434, 1881), as the application of the principle will be readily understood; nor are diagrams necessary in the case of another invention patented here on behalf of M. A. Mange, of Lonchamp, France. This patent, which is No. 650, 1882, is for devices by which the weight of the rider's body is utilised as motive power. The rider sits on a saddle about midway between the driving and the steering wheel, so that the former carries only such part of the weight as is transmitted through the frame. The saddle is connected to a rocking bar in the frame, and the pedals are also attached to the ends of the bar by links. The driving wheel has one crank only, which is attached to the rocking bar by a connecting rod, and the weight of the parts of the mechanism is "equilibrated" by a flywheel at the other end of the driving axle. The inventor has provided an ingenious arrangement of bevel wheels and a pinion by which the throw of the crank can be altered without dismounting. The rider can, if he so desires, touch the ground with his feet—that is, if anyone cares to ride such a machine when made. It is a good problem for young mechanics to find out how much of the weight of the body is utilised when the saddle and one of the pedals rise and fall together.

PRACTICAL NOTES ON PLUMBING.—XXXVI.*

By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page* 299.)

FIG. 211a, referred to in the last line, last week, but not shown, is here given. I.J.H. illustrates the pull, and G the fly-nut; Fig. 212 illustrates the lavatory basin-waste, and which will also work for the supply valve as fixed upon a bracket, also illustrated, but fixed at M L (Fig. 203). In Fig. 212 the adjusting holes can be seen at S W H R; the rocking standard G, and the stopping-box on the top, are also plainly shown. To take this valve to pieces, first take out the cotter-pin from the spindle at X, then the rocking standard cotter-pin at G; if you take out the cotter-pin at G first, you will most likely bend the spindle, and so cause the valve to jump or work irregularly when closing, &c.

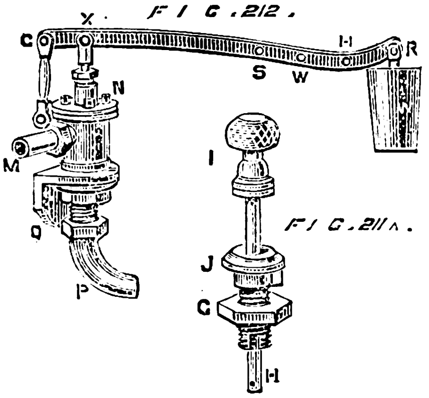


FIG. 212.

FIG. 211A.

Pillar Lavatories.

Fig. 213 illustrates a pillar lavatory, suitable for schools, &c. The inlet supply-pipe A may be brought up within a length of cast iron or up the inside of the column B, with the waste-pipe W; D is the lever to work the outlet valve; E the overflow; F the basin; this may be of cast iron, as also the top G. Of course the basin and top may be had in one casting, enamelled or galvanised, or in one piece of porcelain. For school-work I cannot recommend the washer and plug being fitted to the bottom of the basin, because the plugs get lost, and corks used in their places, that not unfrequently are found pushed down the waste-pipe; but with the lever arrangement D, all this nuisance is obviated.

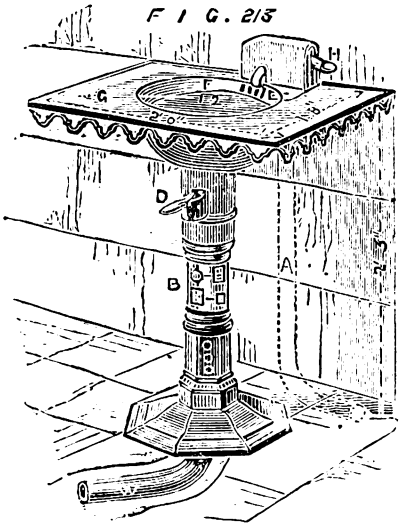
FIG. 213


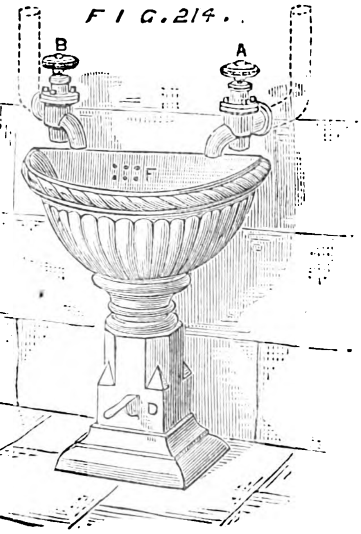
FIG. 214.


Fig. 214 is a similar pillar lavatory arrangement, but fitted with hot and cold water cocks for giving a constant stream whilst washing. I like the outlet of the two cocks to be branched into one pipe, then the temperature of the water can be regulated; the lever D for the outlet valve may be worked by the foot. One of the best kinds of inlet-cocks for this lavatory basin is illustrated at Fig. 215. A is a long screw to go through a wall, or to screw to a skirting, and makes a thoroughly good fixing; Fig. 216 illustrates a suitable horizontal cock for such work and such places where an ordinary bib-cock cannot be used, of course the bend C can be fitted to the cock (Fig. 215).

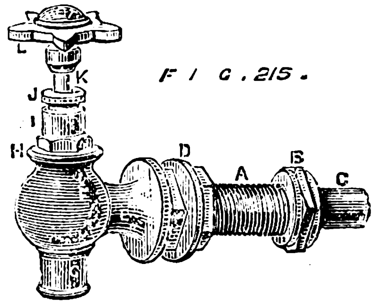


FIG. 215.

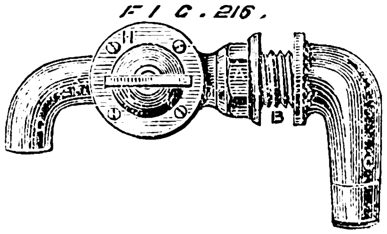
FIG. 216.


Fig. 217 illustrates a section of an upright basin valve-cock for fixing through the lavatory top: D is the fly-nut for screwing the valve to the top or slab. This may be had with plain brass or porcelain knob.

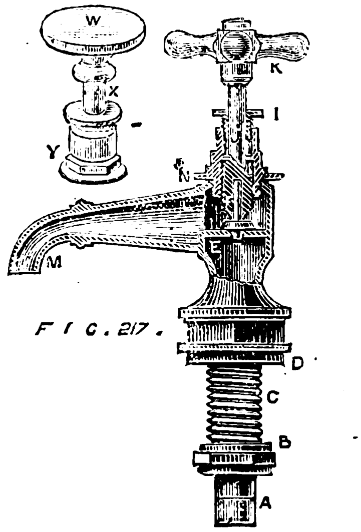


FIG. 217.

Fig. 218 illustrates a very useful kind of lavatory basin valve-cock, embracing all the good qualities of an ordinary Chrimes' screw-down valve-cock, with the additional valve J to shut off the water, whilst the ordinary shut-off valve E is taken out for releathering, &c., this addition valve being closed from the pressure of water from behind, or it may be had with

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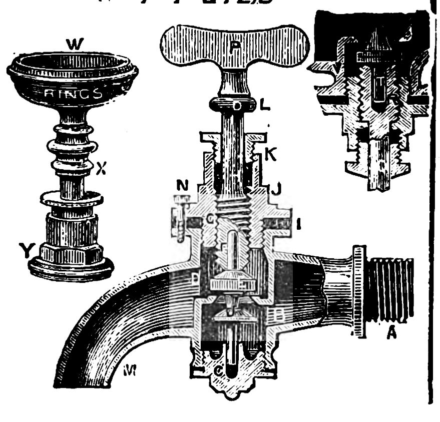
FIG. 218



the extra screwed spindle with stuffing-box Q R T V fixed at the bottom of the shed at C; but in this case the bottom of the cock should be let through the slab, or otherwise kept high enough to turn. This cock may be fitted with the ring-cup W, or with any kind of fancy knob.

Fig. 219 illustrates an upright basin valve, for fixing flush with the top of the slab. The

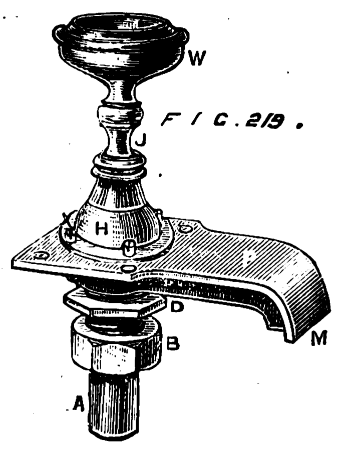


FIG. 219.

snout of this cock is made flat to give a good water-way, which will take off the pressure from the rubber diaphragm, which does not stand long together in these small valve-cocks.

MEAT TRANSPORT FROM THE ANTIPODES.*

WHAT may be regarded as a "new departure" of a very important character has just been made in the importation of refrigerated fresh meat from the antipodean colony of New Zealand. In the particular case of which we are about to give some details, there is involved a very great deal of scientific interest, for the consignment of the meat itself is the first cargo that has yet been brought to this country from New Zealand in a sailing ship. The vessel in question is the iron ship Dunedin, 1,250 tons register, built by Messrs. Robert Duncan and Co., Port-Glasgow, in the year 1874, and owned by the Albion Shipping Company, of which Mr. Peter Denny, of Dumbarton, is the chairman.

The enterprise in which that vessel has just been engaged, and is likely to be further engaged, has arisen in some measure out of the disastrous failure of the City of Glasgow Bank, one of the assets of which is a great extent of land held in the name of the New Zealand and Australian Land Company of Edinburgh and Glasgow. Being desirous of turning that property to the best account, the directors of the Land Company about a twelvemonth ago consulted Mr. J. J. Coleman, of the Bell-Coleman Mechanical Refrigeration Company, Glasgow, in reference to the possibility of bringing home a cargo of fresh meat from New Zealand by sailing ship, on the supposition that it would be necessary to have a refrigerating machine on shore for freezing the meat and one on board the vessel for maintaining it in the frozen condition during the voyage. Considering the fact that in New Zealand alone there are somewhere about 13,000,000 or 14,000,000 sheep, such an experiment was certainly one of far-reaching importance, alike to the colonists and to the people at home, who are dependent on other countries for at least 33 per cent. of the meat which they consume.

It was feared by the directors of the Land Company that if the experiment required two refrigerating machines, one at the port of shipment and the other on board the vessel, the cost would be too great to admit of the enterprise being made a successful one from a pecuniary point of view. Mr. Coleman found, however, that he was able eventually to suggest to them that under certain conditions one machine might be made that would be sufficient to overtake all the refrigerating work. The suggestion was that all previous practice in meat refrigeration should in a measure be set aside, and that a very powerful machine should be fitted into the vessel, one capable of producing refrigerated dry air at the rate of 70,000 cubic feet per hour. He argued thus: As the freezing of fresh meat involves the abstraction of about 145 deg. of latent heat in addition to the 40 deg. required to reduce the meat from a temperature of, say, 72 deg. (that of the meat cooled naturally) to 32 deg., a machine of the power just mentioned would, theoretically, be required for freezing meat at the rate of 20 tons per day. It was assumed that, in actual practice, about 10 tons of dead meat per day could easily be obtained by the facilities on shore for killing, dressing, &c.; and in order to avoid having to go to the expense of purchasing and fitting up two machines, the Albion Shipping Company agreed to allow their vessel to remain in port during the time necessary for the meat to be put on board in small daily instalments of 10 tons or so, assuming, of course, that the cargo of wool would be stowed away before the meat could all be got on board in a satisfactory manner.

In carrying out this interesting and important experiment, the principle adopted was in the first place to freeze each day's supply of carcases while hanging in the 'tween decks space, and then, after each of the carcases had been sewn in a coarse calico bag, to take them into the hold amidships, where they were packed, "head and tail," as closely as they could be stowed. The depth of the hold was nearly 18ft. Eventually the cold chamber in the hold was completely filled with frozen carcases in the way mentioned, and then the 'tween decks space was packed in a similar manner, until at last nearly 5,000 sheep and some 400 lambs were aboard in the refrigerating chambers.

The principle observed in providing for the distribution of the cold air was to bring it first into contact with the carcases that were already frozen, and then to bring under its influence those requiring to be frozen in the 'tween decks chamber. In adopting this mode of distributing the cold dry air, the object aimed at was not to maintain a uniform temperature throughout the meat chambers, but rather to make it absolutely certain that the air passing through the mass of meat in the 'tween decks was always at a temperature somewhat under 32 deg. Fahr., under which circumstances the lower hold, which first received the air from the refrigerating apparatus. must necessarily have been very much colder. That was most desirable, so as to insure the perfect rigidity of the carcases; for had the meat not been thoroughly frozen before being packed away in the lower chamber and still kept in that condition, the mere dead-weight of the superincumbent portion would have crushed the carcases forming the lower layers into a shapeless mass. As it was, however, the carcases of mutton and lamb forming this experimental shipment arrived in the Thames, after a passage of ninety-eight days, in their naturally rounded condition, and as faultless in shape as those that may be seen hanging in any butcher's shop. In the case of shipments of fresh mutton from Australia it has not unfrequently happened that the carcases have arrived quite misshapened, evidently in consequence of the ineffectual freezing power applied to the carcases before stowing them away even in the comparatively shallow space of the 'tween decks.

This shipment by the *Dunedin* is highly important from the fact that it has afforded accurate scientific data in regard to the refrigerating power really required, as the operations both of freezing and carrying have been entirely under one control. Hitherto the shipments of fresh meat from Australia have only been partially successful, owing in some measure, doubtless, to the fact that the carcases have not been frozen on shore by the same sort of machine as that used in the ship carrying the meat; and there is good reason to suppose that the freezing power employed on shore has not been at all adequate for the work to be done.

The Bell-Coleman machine on board the *Dunedin* occupies, together with the ship's linings and the upper and lower meat chambers, about 600 tons gross of carrying capacity, calculated at the rate of 40 cubic feet per ton; and the total internal capacity of the meat chambers was about 400 tons, calculated at the same rate. In that amount of space there were packed about 175 tons of meat; but as the refrigerating machine was only worked to about half its power during the voyage it is proposed to increase the internal capacity of the meat chambers about 50 per cent. for the next voyage, The machine is provided with a surface condenser, and it has a pair of compressing cylinders each of 21in. diameter, with a piston stroke of 24in. in length. Steam was generated by a pair of vertical and multitubular boilers, each having about 400 square feet of heating surface. The average number of revolutions was 60 per minute, and the average air pressure was 34lb per square inch, while the daily average number of hours that the steaming was maintained during the voyage was 15, and the consumption an average of 3lb per indicated horse-power. While the refrigerating air was delivered from the apparatus at a temperature of about 80deg. below zero, the average temperature of the lower hold was 5deg Fahr., and that of the upper hold, or 'tween deck space, was about 22deg.

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[*] Condensed from *Engineering*.

IMPROVEMENTS IN ICE-MACHINES.

THE so-called binary absorption system, the device of Tessié Du Motay and August J. Rossi, obviated some of the difficulties encountered in the manufacture of ice. This plan consisted in the use of two volatile liquids and substituting the chemical affinity of absorption for the mechanical efforts of compression generally used in returning a gas to a liquid state. In this method, sulphurous acid was absorbed in ether, forming a binary liquid. This, by the action of a gas-pump, was vaporised, producing cold, and, on passing into a condenser, the ether became condensed and absorbed the sulphurous acid, thus re-forming the binary liquid ready for revaporisation. The chief advantage of the use of this binary liquid, which was called ethylo-sulphurous-dioxide, was, that cold was energetically produced at a low pressure of not more than 15 to 25 pounds. This system has been successfully used in this country, Cuba, Mexico, Hayti, China, and Japan.

After the death of M. Du Motay, Mr. Leonard F. Beckwith became interested with Mr. Rossi in a further study of the binary system, and their investigations have resulted in the discovery of a method of liquefying ammonia through its absorption in gaseous form in glycerine, and the consequent production of cold at a low pressure. This method of producing cold utilising the best known agent, and overcomes the chief obstacle to its use, the necessity of high pressure. The non volatile liquid glycerine was found to absorb about 600 times its own volume of ammonia, producing a binary liquid containing a volatile agent absorbed in a non-volatile one. After being placed in the refrigerating machine, a vacuum is mechanically created, the ammonia separates from the glycerine, and an intense cold is produced. The ammonia is then reabsorbed in a condenser by the glycerine, and then passes again into the refrigerator tank ready to be again used. This method of producing cold is constantly carried on while the machine is in operation, and the waste is comparatively small. Practical tests of this new system of producing cold artificially were recently made before Prof. Charles A. Seeley, an expert in such matters, and other gentlemen. The result showed that, in fifteen minutes after the machine was put in operation, the temperature of the refrigerator was lowered from 68° Fahr. to 18°, and ice was formed in twenty minutes from the time the machine was put in operation. The vacuum under which the ammonia was volatilised in the refrigerator where the binary liquid was placed was twenty-five inches. and the pressure under which the ammonia was reabsorbed in the condenser into the fresh glycerine was an average of twenty-five pounds, never exceeding fifty pounds. There is, it will be seen, a remarkable difference between this and previous methods employed when ammonia has been used, and when the pressure has averaged 125 pounds when at rest, and from 225 to 300 pounds when at work. The mechanical pressure heretofore required in the use of ammonia is done away with, and the much easier method of chemical affinity substituted. The new plan, if wholly successful, will do away with the necessity of the use of heavy machinery that has been an absolute necessity when ammonia was used as the cold-producing agent. Another advantage claimed for the use of this new binary liquid is, that the machinery used, like all low-pressure machinery, is easy to manage. Under the old conditions, when ammonia was used, the services of an educated, careful, and skilful engineer were an absolute necessity, or a destruction of the machines would follow. Under the low-pressure system, now made possible, an ordinary engineer would be able to manage the machine, and the danger of an explosion and destruction of the machinery is lessened. Leaks in the pipes or at valves are less apt to occur, and the expense of production is materially lessened.—*Engineering and Mining Journal* (U.S.)

HOME-MADE DRILL-CHUCKS.*

HOME-MADE drill chucks, as usually found in the average machine shop, are "bores" for reasons not necessary to explain here. This is especially true of those things which have a hole drilled in the end and a set screw in the side to secure the drill. The sockets used for receiving taper-shank drills are good, but these drills are much more costly than those with straight shanks.

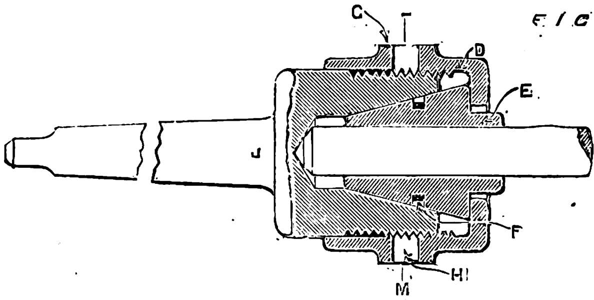
The qualities which drill chucks should possess may be stated as follows: 1. Drill chucks should be simple in their construction, so they can be easily and cheaply made. This is the first thing the "practical man" generally looks for, and it is an excessive demand for this quality that often leads to anything but economy "in the long run," by the use of such things as above referred to. 2. Drill chucks should be so constructed as to hold the drill always concentric with the spindle of the lathe, or drill press, wherever they be used. As straight-shank drills may be found in every machine shop, having all sizes of shanks, whether they be twist drills or the ordinary flat, home made drills, this valuable quality is not possessed by the chuck which secures the drill from one side by a set screw, or any similarly acting device, unless the shanks fill the hole—which is hardly ever the case. The writer has, in times past, found it most convenient and economical to use round steel for home-made drills, very near the size of drill wanted; flatten one end, leaving the point a little wider than the body.

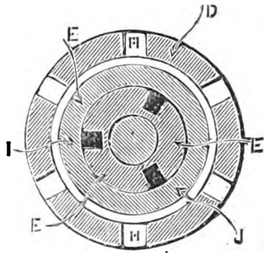
3. Drill-chucks should be easy and quick in their operation, so as to consume the least possible time in setting and removing drills.

4. There should be no projections about the chuck, such as set screws, notches, or anything which would have a tendency to catch a man's clothes or "knock the bark off his fingers," just when he is engaged on a job which "is in a hurry," because this is just the time such phenomena generally take place, and is a time when it is least desirable to have a man stop for surgical operations or for oratorical exercises.

Figs. 1 and 2 of the accompanying drawings represent designs of drill-chucks, which possess all the above qualities to a greater or less degree. The collet part J, Fig. 2, may be fitted to the spindle of a lathe or drill press. There are three jaws, E, held in place by the shell nut D. It may be necessary to have more than one set of jaws, according to the range in the sizes of drills intended to be used. It is best to make these jaws of iron and case-harden them, as steel would be likely to spring more or less in hardening. Pieces of soft rubber, I, are placed between the jaws. These serve to open the jaws by their elasticity, when released by the nut D. F is a rubber band, which serves to hold the jaws together when they are taken out to be replaced by a set with a larger or smaller hole. Springs may be substituted for the rubbers, but the latter are cheaper than the former. The nut D has six holes H, drilled into it to receive a spanner-wrench in setting the larger-sized drills. A knurled band, G, on the nut, will admit of its being set by hand when small drills are used. In the chuck shown in Fig. 1 the nut D is fitted directly to the lathe-spindle C. The disc, K, serves to cover the hole in the spindle to form a backing for the drill. Otherwise the drawings explain themselves.

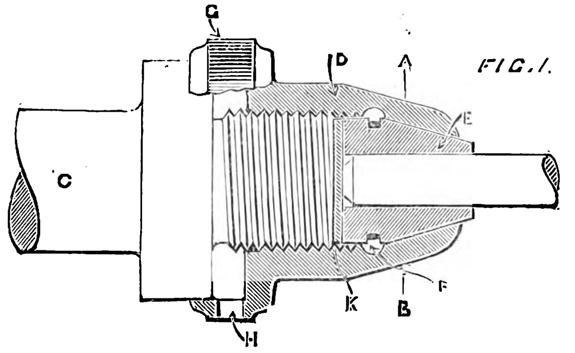
FIG. 2.

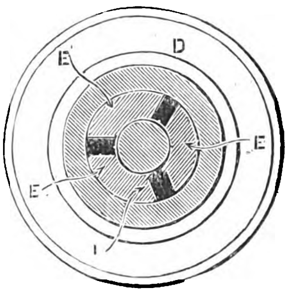




SECTION. L M.

FIG. 1.





SECTION. A.B

A NEW THERMOGRAPH.*

THE instrument under consideration is a thermograph for recording atmospheric temperature, the fluctuations of which are much less regular and more frequent than one who has not made a study of it would suppose. It records the temperature directly from the column of mercury in the tube of a thermometer by dots or perforations upon a sheet of paper previously ruled with degrees and hours.

Its principal parts are, as shown in Fig. 1. 1st. A thermometer in the form of an ordinary mercury thermometer, but open at the top of the tube, and having a wire entering the bulb and connected to one pole of a battery, the other pole of which is connected to the mechanism of the instrument. 2nd. An upright cylinder revolving by clockwork, covered with a paper which is divided vertically into 24 parts by lines representing the hours, and horizontally by lines representing the degrees. 3rd. A bar raised and lowered by mechanism driven by clockwork, furnished below with a needle entering the tube of the thermometer, and carrying a pencil—or preferably a point—driven forward by a small electro-magnet when the circuit is closed by the needle entering the mercury, and then making a mark at the proper place upon the paper and indicating the temperature. The bar carrying the needle rises about half an inch from the point at which the needle leaves the mercury and then descends until the needle again touches the mercury, whether that in the mean time shall have risen or fallen, when the point makes its mark upon the paper and the bar again commences to rise. This movement is accomplished by the mechanism shown in the drawing, of which only the wheel E, gearing into the rack upon the needle-bar, is shown in Fig. 1, but which is shown in full and upon an enlarged scale in Fig. 2, which is a top view. The two wheels A and B are moved by clockwork (not shown) and are constantly revolving in opposite directions, as indicated by the arrows. These wheels are not attached to the shaft upon which the wheel E is fixed, but are attached to sleeves which move without affecting that wheel except when they are joined to it by the clutches C or D. They are so geared that when the wheel E is joined to them its rim moves at the rate of half an inch per minute. Upon the shaft with the wheel E is also a loose sleeve F, which is free when the clutch C is not in action, but which moves with that wheel when that clutch is on. The levers actuating the two clutches unite and move upon a common pivot, from which point they extend as an arm, which is capable of a lateral movement between two stops, bringing one or the the other of the clutches into action. Opposite to the wheel E the needle-bar passes through a guide which is furnished on the back with a small wheel taking the thrust of the gear and reducing friction. For a lower guide the needle-bar is furnished on each side with a rod parallel to the needle, and of nearly the same length. These rods are at such distance apart that they pass clear of the thermometer tube. They are not shown in the drawing, as they would lie directly in front of and behind the needle and tube. The teeth of the clutches are partly V-shaped and partly square, or nearly so, as shown in Fig. 3; that is, they have slightly tapered sides but V-shaped points and bases, so that they enter freely, as entirely V-shaped teeth would do, and when in action they have no outward thrust. The V-shaped base strengthens the tooth and admits the point of the opposite tooth. A very small spring on each side of the sleeve F holds it out of gear while the clutch C is off. Beneath the clutch arm is a pressure spring, one end of which presses against the end of the arm and the other against a plate moving upon the same pivot with the arm, which plate also is capable of a lateral movement between its stops. If this spring-plate is moved in either direction to its stop, carrying with it the base of the spring, the clutch-arm will be moved in the other direction and the clutch on that side will be brought into action; and if the position of the spring-plate with the base of the spring be reversed, the position of the clutch-arm will be reversed—that clutch will be disengaged and the other will be engaged—the wheel E being moved and the needle-bar raised or lowered accordingly. To the sleeve F is attached an arm which is connected by a draft rod to the spring-plate. When the clutch C is in action—as shown in the drawing—connecting the wheel A with the wheel E and the sleeve F, raising the needle-bar, the arm of the sleeve F draws upon the spring-plate—moving to that side the base of the reversing-spring, which, when its base has passed the line, between the pivot and the end of the clutch-arm, presses that arm to the other side, disengaging that clutch, loosing the sleeve F, engaging the other clutch, and reversing the motion of the needle-bar, which now descends. The length of the arm on the sleeve F is such that when the needle-bar has risen half an inch the spring-plate is moved over, and the clutch-action is reversed. When, by descending, the needle is brought into contact with the mercury and a circuit is made, the large electro-

FIG. 2

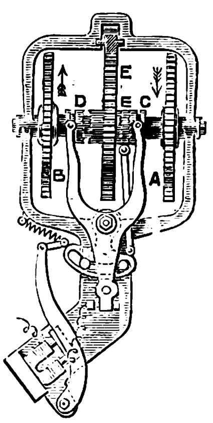


FIG. 1..

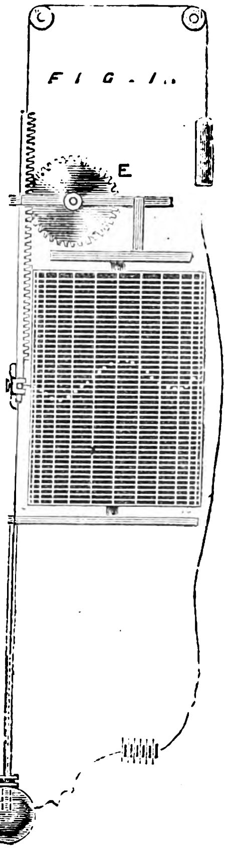
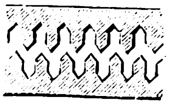


FIG. 3.



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* By C. A. Smith, in the *American Machinist.*

* By G. Morgan Eldridge, in the *Journal* of the Franklin Institute.

magnet, thus vitalised, attracts its armature, which is attached to a lever connected with and drawing upon the spring-plate, and moves the base of the reversing spring to that side, changing the position of the clutch-arm and reversing the action of the clutches and the movement of the needle-bar, while at the same time the recording point upon the needle-bar is, by its electro-magnet, driven into the paper and the temperature is recorded upon the scale. The sleeve F, being loose, yields to the movement of the spring-plate, and is afterwards held by its clutch, and acts as before. The action of the large electro-magnet is supplemented by that of a spring drawing upon the same side of the spring-plate, whose strength is such that it is not quite sufficient of itself to overcome the thrust of the reversing spring, but whose force is greatest when that of the electro-magnet, by reason of its distance from its armature, is least, the greatest possible portion of the work being thus put upon the clockwork and the least upon the battery. This spring aids the electro-magnet, but does not in anywise reduce the effect of the reversing spring in holding the clutch to its work; so long as the base of that spring is unmoved its action is unimpaired. The resistance of these springs occurs only during the ascent of the needle-bar, which is, therefore, counterpoised to excess, and the resistance and the motion are thus rendered uniform. By reason of the form of the clutch-teeth before described there is no outward thrust upon the clutches while in action, and hence the reversing spring requires only to be strong enough to throw the arm over and to shift the clutches. The stop of the clutch-arm next the electro-magnet is an insulated plate to which the battery-wire leading from the magnet is connected, so that as soon as the arm has left the stop the circuit is again broken, although the needle may for a short time remain in contact with the mercury; the recording point is at once withdrawn, and thus makes upon the paper a single perforation which must be a true record of the position of the mercury in the tube, unaffected by friction or other disturbing cause, since this action must always take place at the moment of contact of the needle with the mercury, and these dots or perforations are repeated at the end of each interval of time required for the needle-bar to ascend and descend the required distance, which will be about two minutes with the wheel-motion designated.

The graduation of the scale upon the paper must correspond with the movement of the mercury in the tube of the thermometer as accurately as the graduation of the scale of an ordinary thermometer corresponds with the movement of the mercury in its tube. If but one instrument of this sort is to be made this is very easy; the rate of motion is ascertained, a scale is made to fit it, and the paper is ruled to that scale. In all thermometers heretofore made the scale has been made to fit the tube; but if more than one of these instruments is to be made it becomes necessary, or at least very convenient, to have one set of ruled papers that will fit all the instruments, and it then becomes necessary to reverse the practice and to make the tubes to fit the scale. The rise and fall of mercury in a thermometer depends upon the proportion between the diameter of the tube and the volume of mercury in the tube and bulb, and while it is possible to construct these parts in such proportion as to obtain proximately a given motion, it is not possible thus to obtain it exactly. The tube and bulb are made in separate parts, as shown in Fig. 1, of such size that when the tube is thrust half-way into the bulb the volume of mercury filling the tube half way at 32° Fahrenheit is as nearly as may be properly proportioned to the diameter of the tube. If, now, there be found too much motion, the capacity of the bulb is diminished by thrusting the tube further in, and *vice versâ*, and the proper height of mercury at 32° for that purpose is marked upon the tube. Mercury exposed to the air will slowly form a coating of oxide upon its surface. To prevent this a small quantity of glycerine, or of oil free from oxygen, is placed in the thermometer tube above the mercury. If, notwithstanding, the oxide shall accumulate to an inconvenient extent, the observer in charge of the instrument will remove the thermometer from its place, and will put the bulb in warm water until the oxide is floated off. He will then supply the loss with pure mercury, determining the proper quantity by immersing the bulb in broken ice, when the mercury column should stand at the mark for 32°. The whole apparatus, except the thermometer itself, can be inclosed and so protected from the weather and dust, while the thermometer is exposed to the air below. The system is equally applicable to a barometric record, in which case, on account of the small range of motion, the needle-bar is connected to a lever, thus increasing the range of the record.

THE boring of the Arlberg tunnel is proceeding rapidly, the rate of advance averaging ten metres daily, which exceeds the average made with the St. Gothard by six metres. At this rate boring is expected to be completed before the end of 1883.

SCIENTIFIC SOCIETIES.

ROYAL ASTRONOMICAL SOCIETY.

THE June meeting of this Society was held on the 9th inst., at Burlington House, Mr. E. J. Stone, President of the Society and Director of the Radcliffe Observatory, Oxford, occupying the chair.

Mr. Franklen George Evans, Tynant House, near Cardiff, was balloted for and duly elected a Fellow of the Society.

Mr. Knobel read a paper by Prof. Pickering, being a description, accompanied with photographs, of the photometer employed by him for observations of stars on or near the meridian. At the end of the instrument furthest from the eyepiece are two plane mirrors connected with tubes placed horizontally east and west, and capable of revolution in the plane of the meridian; the inclination of the mirrors to the axis of the tube can also be varied. One of the mirrors is directed to λ Ursæ Minoris, with which the stars to which the other mirror is directed are compared. The light is received by two object-glasses, both pencils of rays first passing through a double-image prism. The ordinary image from one mirror is compared, by means of a Nicol's prism, with the extraordinary image from the other; the prism is then reversed, and the comparison repeated with the other pair of images.

Mr. Knobel read a paper by Dr. Henry Draper "On Photographs of the Nebula in Orion." The negatives, of which enlarged photo-lithographs were exhibited, were taken on March 14th, 1882, with an 11in. refractor, the exposure being 137 minutes. The stars are much over-exposed, and are also somewhat elliptical, in consequence of the wind, which disturbed the mounting of the telescope during the long exposure. On the original negative, however, the stars of the Trapezium can be seen separate on careful examination. Most of the small stars, including some which are almost the *minimum visibile* of the telescope, appear in the photographs, so that it seems possible, by still further increasing the exposure, to photograph stars which are invisible to the eye. Photographs of the spectrum of the nebula, taken without a slit, show that two of the condensed masses preceding the Trapezium give a continuous spectrum, and therefore contain either gas under pressure, or liquid or solid matter.

Mr. Newall: I have procured from the Royal Society the loan for this evening of a drawing of the Nebula in Orion, by Mr. Lassell, which is now exhibited. It appears to me one of the most perfect drawings of the Nebula in existence, and as it has never been published, I should strongly recommend that it should be reproduced by photography, which could, I believe, be done at a small expense. With regard to Dr. Draper's photograph, I think the telescope must have moved considerably to have produced the nebulous masses around the brighter stars.

Capt. Abney: The great increase in the diameter of the stars in Dr. Draper's photograph is due to reflection from the back of the plate. This might have been prevented by backing the plate with asphaltum, which was the method adopted for the photographs of the recent eclipse.

Capt. Noble suggested that if Mr. Lassell's drawing were reproduced, the colours should be reversed, black being put for white, so that the Nebula might be given as it really appears.

Lord Rosse: There is much difficulty in reproducing by photography drawings containing faint detail. I have had experience of this lately in regard to photographs of drawings of Jupiter, which do not by any means give the delicate detail of the original; I believe that the old process of copper-plate engraving is the best, after all, though of course more expensive. There are practical difficulties in the way of reversing the colour, as suggested by Captain Noble.

Captain Abney: It is practically impossible to obtain a perfect photograph of a black and white subject. The only way to obtain a perfect gradation is to have a slightly *tinted* background, otherwise the delicate half-tints must inevitably suffer.

Mr. Maunder read a paper on the "Spectrum of Comet *Wells*," observed at the Royal Observatory, Greenwich. The most striking feature in the spectrum is the development of a bright line in the yellow, apparently corresponding to the D line of Sodium. On June 7th this was so brilliant that the comet might almost be said to shine by monochromatic light.

The President: I do not know whether I ought to mention that I have received a letter from Dr. Copeland, in which he tells me that he has distinctly seen the D-line in the spectrum of the comet *double*.

Mr. Hind gave a few practical directions to observers who desired to attempt the observation of the comet in daylight in close proximity to the Sun. Mr. Hind said: The comet has not quite kept pace with the theoretical law of increase of brightness; still, at noon to-morrow it should have the brightness of a first magnitude star, and be visible in a telescope of not less than 7in. aperture, though only 3° 3′ from the Sun. I may mention that after its perihelion passage the comet will be again visible in this country at the beginning of July.

Mr. Knott read a note on the variable star U Cephei. The minima of this star occur in sets, alternate minima at intervals of about five days, the intermediate minima being observed as each set comes round. There is reason for suspecting a difference of three-tenths of a magnitude between the minimum magnitude reached in the two sets. If this is confirmed, we must regard the period as a double one.

Captain Noble thought that Mr. Knott's observations threw doubt upon Prof. Pickering's hypothesis that the variability of stars was caused by the revolution of a large satellite round its primary.

Mr. Knott: I do not express any opinion as to the cause of the variability. If the variations in the light of U Cephei are caused by occultations, they would appear to be occultations by a nebulous body, as the star changes in *colour* as it changes in magnitude.

Mr. Christie: Captain Noble is, I think, under a misapprehension; the hypothesis of Prof Pickering's, which he mentions, is only offered in the case of stars of the *Algol* type. Prof. Pickering divides the variable stars into four or five classes, and has different hypotheses to explain the different peculiarities in their variability. There are two principal hypotheses which he has considered: the one is the occultation of a primary by its satellite, and the other the revolution round its axis of a body, different parts of which present different degrees of illumination.

The President then gave an account of some of the arrangements which have been made for the observations of the Transit of Venus on the 6th of December. He said:—As far as the British expeditions are concerned, no serious attempt will be made to apply photography, as the committee have not felt justified in recommending the Government to incur the large extra expense that would be involved. Confining ourselves to contact, however, I think the arrangements justify us in expecting a fair estimate of the Sun's distance. Arrangements have been made to have two observers at Bermuda, two at Jamaica, and two at Barbadoes. The Canadian Government have also well seconded our efforts, and have placed a sum of £1,000 at the disposal of observers working in harmony with our scheme. This will give us, if we have favourable weather, 11 or 12 contacts. To correspond with these, there will be six telescopes at the Cape of Good Hope, and another at Natal. There will be one at Madagascar and one at Mauritius, so that we shall probably have nine or ten contacts to correspond with those on the other side. The effect of parallax between these stations is about 11′ 30″ or 12′, so that, unless there is an error in the observations at all these stations of eight seconds of time, we should get the Sun's distance within a million of miles. If all observe the same kind of contact, we ought to get the observations correct within four seconds of time, which would give the distance within 500 000 miles. Besides these stations, however, we shall have observations made at Sydney and Melbourne, Brisbane, and New Zealand. With regard to other nations, a large number of observations will be made in America, though, unfortunately, these will not be balanced by a sufficient number made in the Southern hemisphere. The French will have a number of stations in South America and some in the West Indies. The Portuguese will send an expedition to the West Coast of Africa, and the Spanish to the West Indian Islands. Our own colonies have come forward with great alacrity, and are willingly assisting the Old Country in carrying out the work.

The following papers were also announced and partly read:—S. W. Burnham, "Measures of the Companion to Sirius," and "Double-Star Observations made in 1879 and 1880, with the 18½in. Refractor of the Dearborn Observatory"; Dr. Terby, "Remarques à propos des Recentes Observations de M. Schiaparelli sur la planète Mars"; Prof. C. W. Pritchett, "Transits of the Red Spot across the Central Meridian of Jupiter"; the Rev. S. J. Perry, "Observations of the Solar Eclipse, 1882, May 16th;" T. W. Backhouse, "Observations of Comet *b*, 1881"; N. C. Dunér, "On the Spectrum of Comet *Wells*"; Captain Parsons, "Sextant Observations of Comet *b*, 1881"; E. J. Stone, "Remarks on Prof. Newcomb's Paper on the Instructions for Observing the Transit of Venus"; A. Marth, "Note on M. Loewy's Communication referring to an Apparatus for Determining Flexure Errors," "On the Best Method of Determining the Errors of Division Circles and Scales," and "Ephemeris for Physical Observations of Jupiter"; E. J. Stone, "Curves Showing the Changes in the Diameter of the Moon, from the Greenwich Observations, 1750 to 1830"; and F. C. Penrose, "Elements of the Orbit of Comet *Wells*, obtained Graphically."

SCIENTIFIC NEWS.

THE death is announced of Mr. John Scott Russell, M.A., F.R.S., which took place last week, in his seventy-fifth year. The deceased gentleman will be best remembered, perhaps, by his achievements in shipbuilding, but he was also a distinguished engineer, the great dome of the Vienna Exhibition of 1873, 360ft. in clear span, being, perhaps, his most enduring monument.

At the meeting of the Royal Society last week, the fifteen selected candidates were elected Fellows:—Professor Valentine Ball, M.A., George Stewardson Brady, M.D., F.L.S., George Buchanan, M.D., Charles Baron Clarke, M.A., F.L.S., Francis Darwin, M.A., F.L.S., Professor William Dittmar, F.C.S., Walter Holbrook Gaskell, M.D., Richard Tetley Glazebrook, M.A., Frederic Ducane Godman, F.L.S., Professor Jonathan Hutchinson, F.R.C.S., Professor Archibald Liversidge, F.G.S., Professor John C. Malet, M.A., William Davidson Niven, M.A., Robert Henry Inglis Palgrave, F.S.S., Walter Weldon, F.C.S.

The Rolleston memorial has been established in the shape of a prize, to be awarded every two years, to the author of the best memoir embodying the results of original research in Animal and Vegetable Morphology, Physiology and Pathology, or Anthropology. The fund is vested in the University of Oxford as trustees, and the prize, which will amount to about £70, is open to all members of the Universities of Cambridge and Oxford within ten years of the date of their matriculation.

The general committee of the Royal Cornwall Polytechnic Society have determined to celebrate the jubilee of that excellent institution by making the annual exhibition doubly attractive, and by organising excursions to places of interest in the vicinity. The exhibition will be held in the Polytechnic and Volunteer Drill Halls, Falmouth, from the 5th to the 16th of September, dates which, it will be seen, follow close upon the meeting of the British Association at Southampton. In these circumstances a number of scientific visitors may be expected, and several men eminent in science have already promised to attend and deliver lectures. The committee estimate the expenditure at about £600, and they appeal to Cornishmen for help.

According to Prof. Blyth, who read a paper recently before the Royal Society of Edinburgh, the action of the microphone cannot depend on variation of resistance due to pressure altering the specific resistance of the material, as such resistance is unaffected by considerable variation of pressure. He thinks the effect is due to the sound-waves acting directly on the small arc between the microphone points and the tremor set up in the points themselves by transmitted vibrations. It may be remembered that other experimenters contend that pressure does affect the resistance of carbon.

At the June meeting of the Photographic Society of France, M. Janssen exhibited prints of the recent solar eclipse, and called attention to the fact that the moon's outline was very clear and distinct, proving that if the moon has an atmosphere it cannot be one of great density. The eclipse observers, or some of them, think that the moon has an atmosphere.

A so-called incandescent gaslight is about to be tried in Clerkenwell, in some of the thoroughfares leading to the Angel. It consists in a modification of the Bunsen burner, to which is adapted a cap of platinum gauze. Compressed air is supplied to the burner in a small stream, which induces an inflow of atmospheric air, and the mixture of gas and air being ignited within the gauze cap, the latter quickly glows with a brilliant incandescence, the hot platinum assisting in effecting perfect combustion.

A method of testing nitrate of silver for purity is to dissolve it in the smallest possible quantity of water, filter, and drop in hydrofluosilicic acid. If turbidity is produced, an alkaline salt is indicated. Should the solution remain clear after several drops of the acid, it is mixed with an equal bulk of alcohol, when any alkali is at once precipitated. To detect nitrous acid and nitrites, the liquid is evaporated as much as possible, and a solution of 1-100th per cent. of magenta in glacial acetic acid added. If nitrous acid or nitrites are present the liquid changes colour, running from violet to yellow. Free mineral acids also cause a similar change; but if water is added, the red colour is restored in that case.

Amongst recent patents we notice one that resembles the polysphenic ship. The bottom of the vessel is formed of a number of inclined planes connected to the atmosphere above the deck by means of pipes. When the vessel is propelled she is said to skim over the water. The No. is 4868, 1881.

Mr. Stretton has issued an appendix of three pages, which is to be attached to the third and fourth editions of his pamphlet on railway accidents. It contains the letter we published last week, with some additional matter.

Physiologists have tried to estimate the volume of blood in a living animal's body, but the methods used have not been very exact. An improved method recently adopted by MM. Gréhant and Quinquand is as follows:—The animal (a mammal) is made to breathe gas containing a known amount of carbonic oxide (CO). After a quarter of an hour, the volume of CO remaining is observed; and this shows how much has been fixed by the blood. On the other hand, by analysis of the blood, one ascertains the amount of CO fixed by a given volume (estimating the respiratory capacity of two samples, taken one before, the other after, the poisoning). From these data it appears that the total weight of the blood in mammalia is comprised between 1-12 and 1-13 of the weight of the body. In the normal condition there are no great variations in this relation.

The so-called "Electrotechnical experiments in the Royal Crystal Palace at Münich," from 16th Sept. to 15th Oct. this year, will, it is known, be an exhibition of quite special character, the chief object being to compare the action of various apparatus for practical application of electricity. The examining committee, where not awarding a medal, will give an official certificate as to the results of trial of apparatus to any exhibitor desiring it. Electric street-lighting, and its feasibility in Münich (where gas is very dear), will have special regard. The managers of the Royal Theatre have arranged for trial of various modes of lighting and other applications of electricity in theatres, and a temporary stage will be provided. The waters of the impetuous Isar will be utilised to drive the machines (a company has been formed for this purpose, in case the town authorities do not take the matter up). Among other apparatus to be exhibited will be Gentilli's Glossograph, an automatic quick-writer, based on the physiological laws of speech. A collection of journals and books relating to electricity will be furnished, with facilities for study; and the official catalogue will indicate, with regard to each apparatus, where an account of it may be found.

The annual consumption of dynamite in Saxony is now represented by a value of about £50,000. A project, by Herr Spinner and Dr. Schröder, is now on foot to establish a dynamite factory at Hartha, in the Ullersdorff Forest-district. It is proposed to make it in two divisions, about 443ft. apart; one for the safe operations, the other for the dangerous and for storage. There will be a pond of about 7½ acres between, and the dangerous part will be surrounded by a thick earth wall as high as the enclosed houses. Much objection was taken to the project, but sanction has been obtained from the local authorities on certain conditions. The storage of dynamite must not exceed 25 cwt. in each magazine. Conveyance of the masses within the works must be in spring-furnished waggons on rails. All ways must be kept smooth; stairs are to be avoided; passages are to be covered with peat-ash; the floors in buildings must be of asphalte; and after stoppage of work (which work is to be only by daylight) they must be washed clean. The magazines must be steam-heated, and all freezing of cartridges is carefully to be avoided. For acid gases a condensing-tower and regenerating apparatus is required. The water containing sulphates and nitrates must be fully neutralised with ammonia, and kept from entering the ground. A layer of earth must be formed over the powder-houses.

An important rectification is required, according to M. Guyot, in our ideas about the Shiré river, which has figured largely of late years in accounts of African travel. It has been supposed that the Shiré after entering Lake Lydia, resumes it course southward to the Zambesi. M. Guyot now maintain that the Zambesi really feeds this Lake Lydia through a canal called Zio-Zio, and to a larger extent than the Shiré does. The large lake in question is covered during a great part of the year with aquatic plants, making navigation and discovery of the entrance of the Shiré very difficult. The latter, at its entrance, is about 660ft. wide, shallow and sluggish; whereas the Zio-Zio canal is, in some cases, nearly a mile across, and some fathoms deep.

Measurements of the winter movement of a large glacier in North Greenland (the fjord of Jacobshavn), have been recently made by Herr Hammer, and the summer observations of Herr Helland on the same glacier in 1875 can be compared with them. The velocity is much the same, apparently, in summer and in winter; about 50ft. in twenty-four hours may be taken to represent the rate in the middle of the glacier (where it is greatest).

The company, Schäffe and Walcker, of Berlin, now supply ejectors or mouthpieces for fountains, made according to Böckmann's patent, and requiring, with equal effect, only one-fifth to one-half the water consumption of previous arrangements. The system is adopted in some of the squares in Berlin. The pressure of the issuing water is employed to force up a quantity of the water previously ejected; and at the same time this jet is rendered voluminous, white, and foaming by admixture of air. As shown by figures in the *Deutsche Industrie-Zeitung*, a vertical tapered jet enters, a little distance below the water-level, a piece of cylindrical tube open above and below, and having a number of side apertures at its lower part. This, which projects above the surface, gets filled with water from below. It is surrounded by a tube opening above to the air and fitting closely to the inner tube below; through this the air is sucked down and enters the water of the inner tube by the apertures just referred to. The price of these mouthpieces varies, according to size, from 10s. to £3 5s.

Luminous paint, as hitherto made, has a yellowish-white appearance in daylight. A Dresden firm, Schatte and Co., now produces various paints, pure white, blue, red, green, violet, and grey; so that the objects, which become luminous at night, may have a pleasing appearance by day.

A "burglar alarm platform" is a recent American invention. This is placed level with the floor, in front of a safe or vault, and is so constructed that when it is stepped upon, an electric circuit is closed, and an alarm given at a distant point. The platform is supported on spiral springs, and by day it is prevented from being depressed, when stood upon, by means of a sliding-frame and supporting pins.

Two noteworthy recent events in telegraphy may be here referred to. One is the opening of direct communication between Germany and America by means of a submarine cable between Greetsiel (near Emden), and Valentia on the west coast of Ireland. This, besides accelerating the traffic, has already lowered the cost of telegrams to New York; instead of 1·40 mark, they are now 1·05 mark (say, 1s.) a word. And the new line also benefits the traffic between Germany and England by setting free the Borkum-Lowestoft cable for it. The other event is the opening of telegraph traffic by cable between Trieste on the Austrian Coast, and Corfu, off the Albanian. By this line, forming the first direct connection of the Austrian telegraph lines with the international submarine cable system, a third path is afforded for telegrams to the East, which have hitherto gone *viâ* Italy or Marseilles.

Among processes recently submitted to the French Société d'Encouragement, is one by M. Lutz-Knechtle, a Swiss, for decoration of glass in the cold state. With solutions containing zinc-white or ultramarine, he prepares colours, which he applies to the glass with pads or rollers. Patterns cut from thick paper serve to form reserves by means of which the aspect of cut or ground muslin glass is imparted. By an ingenious method, he easily juxtaposes or superposes two or several colours on the same glasses, increasing the decorative effect. The colours, with silicate of soda base, dry very quickly (in an hour or two), give soft tints and very distinct contours, and resist washing well; and the glasses, so decorated, are much cheaper than those obtained by hydrofluoric acid or mechanical processes. The process can be carried out in glasses in position.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

SEVERAL MORE PUFFS — COMET WELLS—ζ HERCULIS AND δ CYGNI—CENTRE OF GRAVITY OF A REVOLVING SYSTEM—POINTS OF SUNRISE AND SUNSET ON THE LONGEST AND SHORTEST DAYS—IMPRESSION OF A FOSSIL SEA-URCHIN.

[20150.]—If "Paugul" (letter 20089, p. 281), reads the London morning newspapers, he must have noticed that the advertisements of the gentleman to whom he refers are by no means confined to the *Leeds Mercury*. I have been, I confess, most singularly amused, to note in one of your morning contemporaries that, after four or five telegrams enlightening the British people as to what the gentleman in question did (including the returning thanks for a toast to them in their collective capacity), another one came home actually telling us what he *didn't!* This ingenious method of keeping a man's name persistently before the public struck me as particularly fine. The Earl of Aldborough's testimonial to Holloway's pills was nothing to it; and it is enough to make the gentleman who sells the transparent soap die of envy.

"Paugul" (same letter and page) most pertinently invites attention to my omission of the words which he puts in a parenthesis. Of course, I meant to say that the comet would disappear from our night sky before attaining its predicted great brilliancy. As a matter of fact, at six o'clock next Sunday morning (I write this on June 8th) when it will be in, or close to, perihelion, it will only be some 2° 30′ south of the Sun; and at its meridian passage will be nearly 59° above our south horizon.

Mr. Simms (letter 20122, p. 305) is right in his surmise that the distance of the components of ζ Herculis has very slightly increased since 1880; in fact, I fancy that they cannot be now very far from their maximum of separation, which is roughly 1·5″; possibly 1·4″ or 1·45″ would fairly represent it. It happens oddly that the last time I examined this star was with a 3in. telescope, which, *ex necessitate*, wholly failed to divorce it. I am writing far away from my observatory, or I would look at ζ Herculis with my own instrument. With reference to δ Cygni, I may say that two conditions are absolutely necessary for the detection of its companion in a 4in. telescope. The first is the highest power that the objective will bear; and the next is twilight. It is useless to attempt to do anything with this very difficult object with a moderate object-glass after the sky has got dark. I have seen it beautifully immediately after sunset, but have invariably failed to do so two or three hours later.

In reply to "Gimel" (reply 46963, p. 313), every pair of revolving bodies must necessarily perform orbits about their common centre of gravity. In the case of the sun and earth, however (assuming them, for the moment, to exist alone in the universe), the sun weighs as much as 324,000 earths; and hence their common centre of gravity would be removed, comparatively, but a very little way from the sun's centre of figure. When, though, we come to consider the cases of Jupiter and Saturn, whose masses respectively are as great as 1-1046 and 1-3496 of that of the sun, we see that the centres of their orbits must approach nearer to the sun's surface; and, further, if we imagine all the known planets to be ranged in a line on one side of the sun, we should have him describing a very appreciable orbit about the common centre of gravity of himself and his attendant worlds.

I may answer the reiterated query of "Neo" contained in reply 47032 (p. 314) by saying that the Sun rises on the longest day in latitude 52° 25′ N. at a point 40° 43′ 40″ to the North of the East point of the horizon. If my querist employs a compass to determine this point, he must not forget that its needle does not point due north, but at Clun probably some 20° or so to the west of it. Allowance must, of course, be made for this.

And while on the subject, I may answer the cognate query, 47099 (p. 316), by telling "W. B. P." that in latitude 51° 2′ 45″ the Sun rises 39° 16′ 11″ to the North of East (setting as much to the N. of W.) on the longest day, while on the shortest day he rises 39° 16′ 11″ to the South of East, and sets to the South of West by the same quantity.

"W. E. K." (query 47089, p. 315) has found the impression of part of a cidaris (a highly-ornamental form of sea-urchin) in a chalk flint. They are very common. Illustrated descriptions of these organisms, of the fullest and most exhaustive character, will be found in the Volume of the Palæontographical Society for 1862.

A Fellow of the Royal Astronomical Society.

LUNAR PHENOMENA.

[20151.]—I am a recent subscriber to your valuable journal. I have been an amateur astronomer since boyhood—say, for 50 years. When I first read old Ferguson's "Astronomy," the sun's parallax was roughly estimated at about 10″, and distance of the sun (if memory serves) about 82 millions. It has been grand to have watched, through half a century, the growth of our noble science.

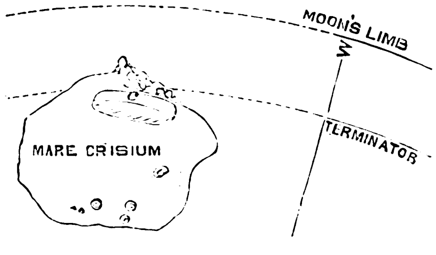
I am almost a worshipper of your old English worthies—your Newtons, Herschels, and others. I read the former's "Principia" when a student, and marvelled at his wonderful insight into the realms of nature. I calculated, in 1837, the Transit of December next, and have a projection of it then made hanging in my office.

Though such a lover of science, my way of life has not led much into practical work in that line, and I never owned a telescope until now; having been engaged during the leisure hours of the past winter in mounting a Calver reflector of moderate power. This much by way of introduction, which you may publish or not, as may seem best. Following is my first contribution to your paper, whose *tone* I like:—

Last evening (May 19th) on observing the moon's slender crescent, about two days old, I was struck with a very peculiar appearance on the westerly side of the Mare Crisium, just on, or immediately within, the dark of the "terminator."

It seemed a curved feathery mist or cloud lying just over the edge of the "Mare," and against the spur or range of mountains bounding the westerly side of the great valley. It seemed to be divided longitudinally by a faint dark line, and looked not unlike a feather. It must have been more than 100 miles long, by 40 or 50 miles wide.

The definition was excellent, and I watched it for nearly an hour, showing it to several friends. In colour and appearance it was so strikingly different from the other illuminated parts, and so different from anything else I have ever seen on the moon, that I scarcely think it possible to be mistaken in its vapoury character. I await with much interest the report of more experienced observers.



The accompanying sketch will give an idea of its whereabouts and appearance.

J. G. Jackson.

Sunset Cottage, Hockessin, Del., U.S.A.,
May 20.

P.S. of May 21.—Last evening I had most excellent definition, but the mist could not be seen, only the faint dark line at C. The question arises. Did the *fog* come from out that long crevice, and have the advancing rays of the lunar morning sun dispelled it?

CLOUD WEST OF MARE CRISIUM.

[20152.]—I hasten to send you the following, coming as it does just after the observations during the eclipse. Jno. G. Jackson, of Hockessin, Del., writes that on the eve of the 19 inst. while observing the moon with a six-inch reflector, he saw, just over the western edge of the Mare Crisium, a peculiar cloud, not less than 100 miles long by 40 or 50 wide, presenting a misty feathery appearance, unmistakably different from other portions of the surface. The cloud was seen by several friends in the observatory. On the following evening the cloud seemed to have been dissipated. He advises astronomers to examine the same spot about two days after the next new moon.

M. Herbert Bridle.

1018, Wood-st., Phila., Pa., May 26.

MERCURY.

[20153.]—Thanks to Mr. Fleming (20068, p. 259). I had a grand naked-eye view of Mercury from 9.30 to 10 o'clock, on the evening of 31st May, setting to the right and a little below Venus. As I could only see him from the front of the house to the street, I did not turn my larger instruments upon him, but my binoculars and a small hand-telescope (1¾) brought him up beautifully. He was, however, very conspicuous to the naked eye, much to my surprise, for, knowing how rarely he is seen, I long ago despaired of ever seeing him. He appeared to me to be about one-third the magnitude of Venus, but much less brilliant, though as conspicuous as any second-magnitude star seen so low. I had a great treat, and wish to record it to encourage others, and to thank Mr. Fleming.

R. W. I.

GRINDING AND POLISHING GLASS SPECULA.

[20154.]—This letter must be the gathering up of the fragments of practical information that could not well be introduced before.

The amateur will do well to finish the lower angle of the triangular hole in the brass chimney, by filing the end for about 1½in. of a piece of steel wire, which is between 1-16in. and ⅛in. in diameter, into a triangular form, with one of its angles slightly smaller than its other two angles; do this with a smooth file, and make the less angle to be sharp; now this will cut the brass, as much as is required, like a very smooth file; but if a little of the finest emery and oil be used with it, a very good angle will be produced in the brass, much better than with the smoothest file. Let the amateur be careful to keep the sides of the hole sloping towards the inside of the chimney, so as to have the sharp edge outside the chimney. I have carefully compared the shadings from a small round hole through a thin sheet of copper suspended before the triangular hole when open to its full extent, with the shadings from the small triangular hole of about the same area, and I can perceive no difference in the indications produced; but I have thought I have noticed this advantage in the triangular hole—that the light goes off more gradually at the last, and thus makes the test more manageable to the amateur. This is produced by the light being shut off along the nearly horizontal angle of the triangular hole, instead of against the nearly perpendicular side of the round hole that the shutter has suddenly to come up to at last. The rivet that is to hold the sheet-brass slide against the triangular hole, had better have a thick head, the head being put inside; then it will stand being rested on a bick iron while being riveted without being injured; this riveting must be so done that the sheet brass will stick anywhere without falling.

If the amateur wants to measure the diameters of any rings on his speculum, he can easily do so by taking a piece of cardboard, in length equal to the diameter of the speculum, and in breadth equal to half the diameter of the speculum; along one of the longer sides he must put notches ⅛in. wide and the same in depth, occurring every inch, beginning with the one in the centre; now, by leaning this cardboard against the speculum, with the notched side across the centre of the speculum, the rings will appear like rainbows on the notched edge, from which the amateur can judge to a ¼in. the diameter of his rings; then he may be able to trace them to his grinding-tool or polisher.

A short-sighted amateur will most likely see—and the more short-sighted he is, the more likely he will be to see, even with his spectacles on—a gauzy or mottled appearance over the face of the speculum, when the light is reduced by the hole being reduced to its proper size for severe testing. This gauzy or mottled appearance will move about as he moves his head; now, all this seems to be caused by the shortness of the focus of the eye, enabling the inequalities on the surface of the cornea of the eye to be perceived. The remedy is for the short-sighted amateur to constantly move his head from side to side about 1-16in. or ⅛in. while testing, when the gauzy or mottled appearance will disappear, being made into an average distribution of these inequalities, through which the shading on the speculum will be perfectly seen. To accustom the amateur to be on the look-out for these sources of mistakes and blame his speculum instead of his eye, let him, when testing, with the hole as small as possible, so as to give enough light to see the shadings by, partly close his eye till the upper or lower eyelid just covers half the speculum. Now let him suddenly open his eye wide, and he will see left on the speculum a dark line, marking where his eyelid has left a ridge or wave of tear, through which he has to a certain extent to see his speculum; if he keeps his eyelids open, he will see this wave fall by its own weight over the cornea, and gradually subside at the same time.

The amateur may perhaps some time see suddenly shoot across the face of the speculum shadings that look like flexure of an irregular character, and he will begin to blame himself for omitting some precaution, and thus getting his speculum bent; he perhaps will think to examine the edge of his shutter in the daylight with his unaided eye, but he sees nothing to account for his trouble there; but let him examine the edge again with care and a ¼in. lens, and he will probably discover that some floating fibres or bits of dust have attached themselves to the edge of the shutter, and thus have been the cause of his trouble. This will show him the importance of having the edge of his shutter smooth and clean. I occasionally rub a piece of the finest emery cloth on each side of the edge of the shutter at an angle of about 45°, then I rub my finger along the edge to clear off any bits of dust. In fact, I often pass my clean finger along the edge of the shutter to be sure that there is no dust there when I begin to test.

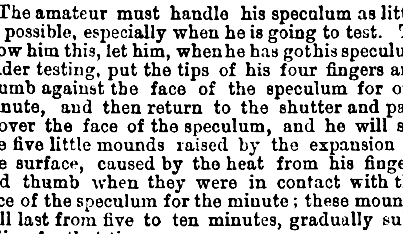
Of course, I take it for granted that the amateur knows that all his testings must be done in a dark room, and that no second person is walking about at the same time, who would be sure to cause currents of air by his movements, and if the air in all parts of the room be not perfectly of the same temperature, which is most unlikely to be the case, then these currents will be seen, and interfere with the shadings: in fact, they will produce shadings of their own in a most fantastic and tantalising way. Further, it is impossible to test satisfactorily on a boarded floor—it has so much spring in it, and every movement is seen when testing. This is specially detrimental when measuring the difference of the zonal foci. I find the solid cellar-floor the best.

The amateur must handle his speculum as little as possible, especially when he is going to test. To show him this, let him, when he has got his speculum under testing, put the tips of his four fingers and thumb against the face of the speculum for one minute, and then return to the shutter and pass it over the face of the speculum, and he will see the five little mounds raised by the expansion of the surface, caused by the heat from his fingers and thumb when they were in contact with the face of the speculum for the minute; these mounds will last from five to ten minutes, gradually subsiding for that time.

I will now give a practical illustration of the application of the zonal test to the testing of a speculum. I shall do this upon a speculum lent to me by a friend for testing, and with his permission. The speculum was made by a London maker over twenty years ago, and I give it the more readily as showing that there has been great progress made since then, for I believe that neither Mr. With nor Mr. Calver, nor any first-rate maker in London now, would turn out such a speculum; the fact being they have greatly improved methods of working now compared with twenty or thirty years ago, and I further introduce this speculum to show all who have to buy that they cannot be sure of getting a really good speculum unless they go to makers whose reputation is thoroughly established. I may further observe that I am not aware that the maker of the speculum I am about to remark upon is now in business. I believe he is not; I knew him personally over twenty years ago as in business, and my object is not to injure anyone now in business. I would rather help them if I could; at the same time I would urge all, both professional and amateur makers, to a greater degree of perfection.

Fig. 1 gives to the eye an ideal representation of the figure of the speculum, which is 6in. diameter. I divided it into ½in. zones, which are marked by dotted lines and numbered. Now the figure of the speculum I at once drew when I put it under testings, and before I took the foci of its zones, its figure was so manifest. The lengths of its zone foci are as follow:—

FIG 1.



1.	2.	3.	4.	5.
·063	·042	·025	·013	·0047
·16	·042	– ·04	– ·04	·01

The upper line is the zones, the second line the true parabolic aberration; the third line the actual aberration of the speculum. Now, it will be observed first, that the edge turns down fearfully, so much so, as to make it completely useless. I had, therefore, to set the index to start with the next zone, No. 2; I then measured the outside zone as best I could, taking its average length, and found it to be ·16, in other words, it was between two and three times longer than No. 2 than it ought to have been; this would make it impossible to attempt to get good definition by uniting the two outer zones; then again, the turn down towards the edge of this No. 1 zone was so rapid that the edge would have been much more out than ·16: this being the focus of the centre of this zone, there being a visible difference without measuring between the focus of the centre of this zone and the focus of its edge. This ought not to be in any zone; the shadings ought to come on evenly as far as we can see over each edge (outer and inner) and the centre of each zone; in fact, we ought to divide our speculum into such a number of zones that we can see no difference between the two edges; if we can, then our zones are too wide or the speculum is fearfully bad. Now, if we divide our speculum, whatever its diameter, into six zones (including the centre), we shall be right as to width of zones. No. 3 zone was – ·04; i.e., it was 4-100in. shorter than ·0; we must, therefore add this to ·025 to give its real departure from the true length of a corresponding zone of a parabola; in other words, it was over 6-100in. too short. It would be impossible to get good definition by attempting to combine it with No. 2 zone, much less with No. 1 zone. No. 4 zone was the same as No. 3 zone, so that it was part of the same spherical surface; these two acting together would have produced better definition than zones 1 and 2 or 2 and 3 together. No. 5 zone was slightly too long for the starting zone No. 2, being ·01 instead of ·0047. Now, these two would have worked best together, being nearest to the two corresponding zones of a parabola; but this No. 5 zone would not have worked well with No. 4, nor with No. 3, for here the proportion was reversed to what it ought to be, No. 4 and 3 being considerably shorter than No. 5, instead of slightly longer. From all this it will be seen that no three zones of this speculum could have been advantageously combined in actual observation; only two sets of two zones each could be formed, and these two sets could not be well used together, while the outside zone was utterly useless with any other zone. It will be observed that there is a fearful depression at the crosses; this is the pecking in I always get when I use a tool or polisher not cut away at the edge, and is caused by the outside of the tool or polisher not wearing away fast enough; it therefore wears away the speculum as far as it reaches inwards at the end of each stroke, and there the depression ends. Now, the centre of the speculum not having the advantage of the wear of the raised edge of the tool or polisher, is left above the general level as a mound, as seen in the figure, not that it is actually a mound, but it is not so short a focus as the rest of the surface, and appears, therefore, in comparison with the outside of the speculum to be raised, for as the spherical surface appears under testing at the centre of curvature as a plane, any departure from the sphere appears to be raised or depressed from this apparent plane, according as it is shorter or longer in focus, although every part of the speculum is concave as compared with an actual plane. The Foucault's testing, without the measuring, only shows any departure from the sphere, but it does not tell how much, the sphere being the only figure it can detect with certainty without measuring when used at the centre of curvature. The tool and polisher would always be concave as compared with the speculum —i.e., it would touch the speculum at the edge if rubbed on it; this concavity would go to produce the turning down of the edge of the speculum as seen in the figure; because the stroke, which would be from the edges to the crosses, being large in this case, about ⅓ the diameter would make the tool and polisher very concave as compared with the speculum, especially if the tool were top; consequently it would wear much on the edge of the speculum, and turn this edge down, all the more if the polisher were soft, such as cloth (and this I suspect was the case in this instance from other indications); but if the stroke had been ¼ or ⅓, then the turning down of the edge would have been almost counteracted by the general wear, and the depression would have been direct from the edge to the crosses (which mark the end of the stroke), which would, in this case, be the ⅙ to 1-6 the diameter from the edge; thus the figure which Mr. Calver says is most likely to be produced by amateurs would be formed. From all this it can be easily seen how difficult it is to produce a true spherical surface by grinding two tools together, just as Mr. Calver says in his "Hints," page 9 (1877). "It is generally supposed that the spherical curve is a very easy matter, so easy, indeed, that it is difficult to avoid. This is a great mistake—a spherical curve of undeviating truth is as difficult a problem as the true parabola. . . . The curve most liable to be obtained by the amateur is the spheroidal, a curve with its marginal rays shorter than the central, or half the radius of curvature." All this I can corroborate from my own past experience, and from amateur work I have examined. How difficult it is to get the speculum good up to the edge, and to avoid the turning down, is witnessed by Mr. Thornthwaite, F.R.A.S. In his "Hints," p. 82 (1880), he says: "As a rule specula are worked in discs of the required size, and therefore the extreme edge is often slightly defective. This is the reason why there are 6½, 8½, 10½, and 12½in. mirrors, it being supposed that the marginal ¼in. shall be covered with a stop." From this latter quotation it would appear that even professional opticians cannot always secure their specula good at the edge. The fact is the whole working of specula wants taking out of the region of haphazard production, where a good speculum is a happy accident, into the clear region of a perfect understanding of all the laws that govern the various processes. This is the region I am trying to find, and I am sure I have got nearer to it than I used to be.

In answer to "Prismatique's" letter (20110, p. 285), I would call the attention of all to the fact that he has most consistently kept to what he set out with—viz., the giving of the trade mode of working specula; that, if there be anything to be gleaned by the amateur from it, he might have the advantage of it. This is noble. I have, I hope, as consistently kept to what I set out with—viz., the giving of the amateur mode of working specula: thus any difference is only incidental to the different circumstances of the two modes; for instance, I hope to tell the amateur how he can make his specula without going to the trouble and labour of making and grinding two iron tools to a perfect fit—and this is a fearful job to the amateur (I know what it is); but my way would not be the best way for the trade, simply because the trade wants tools that will last a lifetime, and produce hundreds of specula from each tool; the amateur, only wants tools that will last for a short time, and at most do only a few specula, perhaps only one for each size. The fact here is, as in many other things, "circumstances alter cases"; thus each of us is right in his own sphere. I am very thankful to "Prismatique," for I have learned from him what I hope to use up for the amateur's benefit, and which I shall not be slow to acknowledge in its proper place. As to the quotation from Sir John Herschel, I may observe that he did not understand fully the Foucault's test—this he acknowledges; and then the measuring accurately of the zonal foci was not definitely adopted or brought to its present perfection. The fact is, we have advanced since Herschel's time, I believe very much in the last twenty years. We can now measure the figures of our specula, and whether they are regular; thus, what was true in Herschel's day, has ceased to be true now, on account of the advance we are making.

Mr. Calver has kindly offered to lend me a large aperture and short focus speculum, which is the very thing required to test the rule by, and I have received an 8in. With specula for testing, and am promised, through the kindness of our correspondent, Mr. Vallance, four others, two Withs and two Calvers. I hope by carefully taking the zonal foci of all these, and reducing these zonal foci to one size by calculation, and taking the average for each zone, to get at the true rule, at least very near, for I believe that these two makers produce, from their long experience, some of the best specula—*i.e.*, having their zones' foci for parallel rays brought to one point. The results I hope to give in my next letter. If I cannot get them ready by that time, I will commence with the machine. **H. A. Wassell.**

Addenbrook Villa, Love-lane, Stourbridge.

MR. WASSELL'S SPECULUM TESTING.

[20155.]—We who know something about working specula are all obliged to Mr. Wassell for the trouble he is taking in elucidating the mysteries of that art, especially the testing. I appreciate his difficulty—viz., to convey to a tyro what he himself thoroughly understands, and in testing by "Foucault," that is the difficulty. It is not the form of the shadings of the mirror, but it is the relative intensity of the various shadings. Now, that unfortunately cannot be delineated by engraving or described in writing, so that a novice will comprehend it properly; no, not after twelve months' constant practice, unless he has had someone by his side to guide him.

As to the amount of aberration, that can be arrived at mathematically. Mr. Wassell's proportion of twice the focal length is about the mark. Draper says eight times focal length; that is too much, and means under-correction:—

$$\frac{\frac{1}{2}\text{ diam. mirror squared}}{8\text{ focal length in inches.}}$$

There is one point in which I differ with Mr. Wassell—that is, using stops with Foucault test at centre of curvature. I tried it some years ago with the screen worked by a micrometer screw, and now abandon it as unreliable. When I use stops it is with the eyepiece and the image out of focus, when you see exactly which zone is in the wrong place. Suppose the eyepiece forward, giving a uniform disc but a bright centre, and suppose, without moving eyepiece, you stop off the margin inch, you then find the centre uniform. It shows your margin to be too short, and the bright centre was not due to centre of mirror at all, as you would naturally suppose. The same way you can find the exact zone that gives a ring either bright or dark. This I consider the only practical way to use stops in testing; to use them with Foucault I believe to be practically impossible, though theoretically you should be able to do so.

I use the Foucault test with the full aperture of the mirror, and from long practice can tell the figure better that way than any other, combined with the eyepiece test. I measure the aberration with the screen by taking the extreme points of confusion, and halving the difference, which should equal my calculated extreme distance between the inner and outer ray—that is, move the screen to and from the mirror, and mark those two points where the shading comes half-way on from each side. You then embrace between these points a length of the optic axis which includes all the errors, or, in the case of a perfect mirror, all the aberrations. In a 6½ mirror, 6ft. focus, this distance should not exceed ¼in., equal to ⅛th of an inch for the required quantity. This is a palpable, easy, measurable quantity, and the Foucault test will show you if the intermediate zones are lying properly.

I shall be glad to learn the result of Mr. Wassell's examination of the several mirrors he has received, but exquisitely figured mirrors will belong to those who have had a long experience and thereby acquired the art, independent of any mathematical formula.

The lamp I now use is a small sixpenny paraffin night-light, with a small round wick, and a flame considerably less than a wax match, a brass chimney 2in. long, and ⅝in. diam., a hole bored through the brass and covered with thin platinum foil, which is punctured by a fine needle, the hole being less than 1-200in. You can put your eye close to it with comfort. I first saw Dr. Blacklock use it, and it is amply sufficient.

Another point I have arrived at in my own experience is that with a parabolic mirror at centre of curvature you get perfect definition at one point in the optic axis, very similar to a spherical mirror, but within and without that point the two mirrors show a wide difference. To demonstrate the fact will take too much room, and I have already trespassed too much on the Editor's space. An artificial star, with jagged edges and particles of dust adhering thereto, is very useful for that purpose.

John S. B. Bell, C.E.

Newcastle-on-Tyne.

TESTING MIRRORS—STAR SKETCHES.

[10156.]—The papers on testing specula by Mr. Wassell have been read with considerable interest on this side the water, as I know from numerous letters I have received. Mr. Wassell is writing to clear up the mysteries of the subject for the benefit of the amateur, and deserves much credit for his painstaking and elaborate descriptions; and his writings are not so ambiguous as professionals frequently give us, for which he deserves all the more credit. The method of using the Foucault test, as described by Mr. Wassell, is substantially that given by your humble servant in No. 772, Vol. XXX., letter 16706, in which letter I noted the one difficulty to contend with,—namely, the bright diffraction rings at the edges of the diaphragms, which eventually led me to abandon the diaphragms altogether. The proper way, I would kindly suggest, is to get the proper and exact focus of the central zone and the outer zone, then if the amount of longitudinal aberration is correct, and the curve is regular from centre to edge, no diaphragms need be used. This has been already suggested by "Orderic Vital," and I much prefer it, though the lessons of Mr. Wassell are excellent schooling for the beginner. Like Mr. Wassell, I abandoned long ago the eyepiece test for measuring the aberration, as the eye will accommodate itself to small quantities; and if I would measure the aberration once, then move the eyepiece some distance, so as to remove all *bias*, and try it again, very frequently I found serious errors, that caused me to rely wholly on the screen test, as the eye never fails to see the focus of a zone when it has a little practical experience. As to the proper amount of aberration, I inclose a letter to "Orderic Vital," which, I hope, our Editor will forward to him, as I do not know his personal address. The letter was written me by Dr. Hastings, and as he sends a graphic description, I shall give "O. V." full liberty to publish it if he thinks best. The letter, I trust, will be of value and practical use to your readers. I have induced my friend Du Pont to write you a description of his method of printing, by the blue print process, stars, clusters, nebulæ, comets, &c. He has sent me some of the most exquisite sketches, and they look so much like looking right into the field of the eyepiece of a good telescope on an exquisite sky, that they come the nearest to Nature's pictures of any I have ever seen. Thanking "Orderic Vital" and others for the kind words spoken of my humble letters, I remain, yours truly, **J. A. Brashear.**

Pittsburg, Pa., May 27.

THE MOTION OF SIRIUS IN SPACE—ASTRONOMICAL EYEPIECES—"A GLIMPSE THROUGH THE CORRIDORS OF TIME."

[20157.]—Will "F.R.A.S." kindly say whether the motion of Sirius, announced in the *Monthly Notices* for March, and mentioned by himself on page 150 (letter 19935), has any connection with the revolution of that star round its companion, or, rather, round their common centre of gravity? I imagine that this is a revolution round some more distant centre.

Had I known before that "Aldebaran" is a paradoxer, I should not have attempted to prove anything, but have contented myself with contradiction. We are gradually learning the full extent of his curious ideas on the subject of theoretical optics; but my guess, in a previous letter, that he had been puzzled by the involved appearance of textbook diagrams, proves very near the mark. "Aldebaran" says (letter 20125, page 305) "All rays cross in the o.g." Cross what? They certainly do not cross each other. "Aldebaran" calls a place where rays of different series cross an "apex" of a cone of rays; that is, he would call the place E or F in "Orderic Vital's" diagram (letter 20126, p. 305) an apex, or apices, perhaps, neither of which it really is. He also speaks of blunt apices, and in using the word apex to signify several different kinds of things, he is defying the dictionaries, defying usage, and defying the science of optics. "Aldebaran" has confused the rays belonging to different series, whereas each series should be considered quite separately. I wish "Aldebaran" were here: I could soon show him, by the help of lenses, how the rays go. His assumptions of my complete want of practical knowledge, and of the uselessness of theory are incorrect, and the latter nonsense. My ignorance of practical optics exists only in "Aldebaran's" imagination.

"Interest" (query 47102, p. 316) should substitute "increasing" for "diminishing," in line nine of his query. If there is any tide—any friction—the day must lengthen, whatever the amount of the friction, and whether it is increasing or diminishing. **Paugul.**

ON THE ACTION OF EYEPIECES.

[20158.]—The criticism of "Orderic Vital" is written in a true Darwinian spirit, which we should all do well to accept as a model. Adverse criticism, though often a very salutary medicine, is one over which the best of us are apt to make a wry face. Your correspondent has, however, so considerately gilded the pill, that all its bitterness is gone. Of course, from his position he could well afford to be generous, but I appreciate it none the less, and hope he will accept my thanks. The aim of all controversy should be to arrive at the truth, and I am sure that any disputant who candidly admitted his error would not suffer in the opinion of our readers; but to this end each should endeavour to make it easy for the other to retract, and so far imitate the strategy of actual warfare as to keep all bridges in the rear in good repair.

The phrase "cone of direct rays from the object-glass" (letter 20069) certainly seems calculated to mislead, though I hope my subsequent letter has better explained my meaning. The idea I wished to convey was that the cone was useless, or nearly so, after the image had been projected, and that a perception of the image was due to other rays, none of which were delineated in textbook diagrams. This conclusion was arrived at by reasoning *a posteriori*, therefore, "Orderic Vital" is quite correct in his surmise that the confusion has arisen through a different interpretation of the meaning of the term *parallelism of rays incident to the eye.* And indeed, the whole gist of the question centres in this, for if it can be shown that the retina is insensible to rays that are vergent to its axis, the inutility of this cone will have been demonstrated.

That your correspondent is correct in his statements bearing on refraction goes without saying; but as regards the structure of the eye, I hope he will excuse me for saying I think he has taken too much for granted. For, though he has spoken of the eye as an image-producer, he seems to have overlooked the fact that, in this respect, its action is precisely similar to that of a convex lens, and I am sure he would be the last to allow that rays, "parallel among themselves," but falling on a lens at different angles to its axis, would all be refracted to the same point behind it.

The eye being movable, can accommodate its axis to all the angles of entering rays, and in this respect it closely resembles a mounted telescope, the field of which, like the image formed behind the eye, is composed only of rays that have entered the object-glass parallel to its axis. Other rays there no doubt are that enter, but these are converged to a shorter focus, and are thus lost to vision. To render my meaning clear we will take as an example a disc of this page, say about 4in. in diameter and at a distance of 10in. from the eye. If the attention be concentrated on the middle line of this disc, its axis will be parallel to the line of rays that pass between it and the eye, and the object will form myriads of images which will become coincident, and therefore distinct, at its principal focus, or in other words, on the retina. Whereas the rays travelling from any part of the circumference of this disc, though they will in like manner be super-imposed will be so before the retina is reached, and will have again separated and become blurred at the only point where they can be appreciated.

Perhaps, however, a more interesting experiment would be to place the eye in the position of A in my diagrams, Figs. 1 and 2, on page 259. The necessary conditions being a dark room and a fairly distant lamp or gas-flame for the object. Under these circumstances a bystander will see a very brilliant and erect image of the flame on the eye of the observer, while the observer himself sees only the inverted image. The rays that form the image on the outside of the pupil are, of course, divergent, and thus reach the retina before they are focussed, while the rays appreciated by the eye are parallel, as may be proved by the fact that the size of the image remains the same at any reasonable distance from the eye-lens. This experiment may be varied by substituting a concave or a terrestrial eyepiece, when the image will appear erect to the observer and inverted to the bystander. I could relate other experiments bearing on the same issue; but I think I shall have trespassed quite far enough on the forbearance of "Orderic Vital" if I ask him to explain these phenomena consonant to the generally-received theory of the parallelism of the rays incident to the eye.

Aldebaran.

NEW COMBINATION OF ALTAZIMUTH AND EQUATORIAL MOUNTING.

[20159.]—If Mr. Grubb so described the instruments figured on page 307, he has made a mistake which an optician should avoid. The principle is that known as "Smeaton's Block," shown in Plate XIII., Fig. 5, and in Plate XXIX., Fig. 6, in Rees's "Cyclopedia," Plates, Vol. 1; but Mr. Grubb's adaptation is far inferior to Smeaton's. There is a long and accurate description of this stand in the same "Cyclopedia" at the end of the article "Equatoreal." I have often wondered why amateurs of limited means have not adopted it; it is symmetrical, and should be very steady—two essential points which are notably wanting in Mr. Grubb's instrument. If you wish it, I shall be happy to send you a rough sketch for the benefit of those of our readers who may not have access to that "Cyclopedia."

N. S. Godfrey, F.R.A.S.

St. Bartholomew Vicarage, Southsea, 10th June.

MEDICAL REPLIES.

[20160.]—47088, 47097, 47118, are all cases not eligible for reply in English Mechanic. Read previous remarks as to such eligibility.

Optical Illusion (47092).—The halos described are probably diffraction halos, due to senile changes in the lens, or other optical media of the eye. See that the refraction of the eyes is accurately corrected by means of spectacles. If this does not suffice, have eyes carefully examined and reported upon by means of the ophthalmoscope. But new eyes cannot be put into old people.

Polypus in the Nose (47101.)—I do not understand what querist means by having his polypus "cut every few months," and if he is being quacked he should consult a good doctor, or go to a hospital if he cannot afford this. Polypus of the nose is often removed by being twitched off by means of a slender pair of forceps passed into the nostril to seize it by its base. But it often comes again; as a wart on the skin, if twitched off, would grow again. These polypi are soft excrescences from the mucous membrane of the nose, which increase and block up one or both the nostrils. Sometimes constitutional treatment removes them, as it does a certain kind of soft warty growth (condylomata) upon the skin, and this is a point that ought always to be considered before submitting to their mechanical avulsion. Sometimes the use of some sort of snuff, such as those named, is useful. Tannin, as snuff, I have frequently found useful. Gallic acid was effectual, but acting similarly. Zinc oxide again is useful, and perfectly innocuous and painless. Any one of these may safely be used by querist. The best way to apply such a powder efficiently is to blow it into the nostril out of a piece of indiarubber tube. The first named remedy is impracticable and dangerous, unless one understands clearly what "Dutch drops" is, and unless the polypus is so within sight that it can be touched and corroded away without corroding the contiguous parts of the nose. I daresay the last named remedy might safely be used, but I should not use it myself, and I have no knowledge of its effects. All the good that can be got will be—1st, by constitutional medication. 2nd, by mechanical avulsion. 3rd, by astringent or corrosive applications. Locally, I should limit operations to simple astringents, such as tannin or oxide of zinc, with the alternative of mechanical avulsion. Sometimes a snare of fine steel or brass wire may be used to tear off the polypus, and by that means I have often operated very easily and efficiently, and with a minimum of inconvenience or risk to the patient. This latter is the only form of mechanical avulsion which a patient or his friends should attempt, and I do not recommend that, if the patient be anywhere within reach of a skilled doctor. The constitutional treatment would be too large and complex a subject for me to enter upon here.

HÆMORRHOIDS (47132).—Piles are varicose veins of the lining membrane of the rectum. Sometimes, when the liver gets obstructed, they will swell and worsen. If cold be then taken, they will inflame, gather, and break, leading perhaps to fistula—perhaps to more or less plugging and obliteration of their venous channels, and then they remain as more or less painful grape-like growths around the end of the bowel. The treatment of this common and very painful affection is as follows:—1. Preventive and palliative. Live sparingly if corpulent or gouty, and avoid getting the liver gorged (read remarks on corpulence). Cleanse the end of the bowel carefully with a soft sponge and cold water *always* after emptying the bowel, and then press the perfectly-cleansed protruding mass carefully and persistently back until it is comfortably retained and supported by the sphincter muscle which closes the end of the bowel. Inject half a pint of cold water into the bowel every morning on waking, and then, on coming downstairs, one comfortable evacuation should take place, and be followed by the sponging process. *This treatment will often cure.* If the protrusion be very soft and tender, and oozing with blood, dab it (after sponging, but before returning it into the bowel) with an astringent lotion, consisting of ½oz. of white copperas (zinc sulphate), rubbed up with a drachm of spirit of camphor, and dissolved in a quart of water. Should the bowels become contiued, and the fæces hard, mechanical injury will be inflicted upon the tender parts, and large bleeding or inflammation will supervene. A teaspoonful of pure precipitated sulphur in milk at bedtime is the best laxative to assist the action of the cold-water morning injection. If the piles become inflamed, lay up and poultice till the inflammation subsides or the gatherings discharge, and then go back to the treatment. If much bleeding occur, purge freely with salts and senna and ginger, until the liver and other viscera are unloaded, then the bleeding will cease. After thus unloading the viscera, 30 drops of oil of turpentine on sugar, or in milk, may be taken thrice a day, if necessary, until the bleeding stops completely. 2. Radical or curative. If the piles have become large and painful, producing a sort of prolapse of the bowel, they must be removed by the ligature or other suitable operation, which, if properly done, is very safe, not seriously painful, and certain to relieve if suitable cases only are operated upon.

James Edmunds, M.D.

Grafton-street, Bond-street.

LEGAL REPLIES.

[20161.]—INHABITED HOUSE DUTY (47091).—The shop being occupied is liable to pay inhabited house duty at the reduced rate of sixpence in the pound. It is also liable to be assessed for the relief of the poor, and rated in the usual way; while, with regard to income-tax, that is of course payable upon the value of the property.

(47096.)—Where a wife goes away from her husband of her own accord, and not through any fault of his, he cannot be made liable for her support, unless indeed she came upon the parish, when other questions would arise. I do not know what proceedings can be taken against the husband in such a case, except by the parochial authorities. It is the wife's duty to return to her husband, and if she does not do so, he cannot be compelled to pay for her maintenance. As to the other part of the question, a wife has no right to take away her husband's property, though she may have a claim to what he has given her absolutely.

(47127.)—The best thing "Epsilon" can do in this case is to send in a written demand claiming the return of his models, or the payment of a sum such as he thinks they are worth. If they are not returned within the time stated, or the money paid, he can sue for the recovery of the same or their value in the proper county court.

Fred. Wetherfield, Solicitor.

2, Gresham Buildings, Guildhall.

ATMOSPHERIC AIR REQUIRED FOR COMBUSTION OF COAL — PEARL-ASHES—ALKALIMETRY—CHLORATE OF LIME—TO MR. ALLEN—COLOURS FOR CONFECTIONERY.

[20162.]—"ATMOSPHERIC AIR" can readily ascertain the quantity of atmospheric air requisite for the "combustion of coal" (query 47094, page 316) by employing the following data:—3lb. of carbon require 8 of oxygen to form CO_2; hence 88·42lb. require 235·79lb. of oxygen. 1lb. of hydrogen requires 8 of oxygen to form H_2O; hence 5·61lb. require 44·88lb. of O. So the carbon and hydrogen of 100lb. of the coal together require 280·67lb. of oxygen. Of this amount 5·97lb. is present in the coal itself; hence 274·70lb. will have to be provided. But this is the amount required for 100lb.; the amount for a ton will be 22·4 times as great, or, in other words, 6,153·28lb. Air contains 23 per cent. by weight of oxygen; hence the weight of air required for the complete combustion of 1 ton of the coal will be 26,754lb. In practice, it may be taken that coal requires twelve times its weight of air for complete combustion; but if burnt in a furnace which relies on a stack for the production of the draught, twice this amount of air requires to be employed.

"Pearl-ashes" (query 46953, page 249) may be assayed for their contents of carbonate of potash by titration with standard acid in the manner described in any work on chemistry. If litmus be used to indicate the point of neutrality, excess of acid should be added, the liquid boiled to expel carbonic acid, and the excess of acid employed ascertained by titrating back to the neutral point with standard caustic soda. By employing Poierier's methyl-aniline orange instead of litmus, the end of the reaction can be ascertained directly, in the cold, and without expelling the carbonic acid. The change of colour is extremely definite.

"Chlorate of Lime" (query 47058, page 293) is produced, together with chloride of calcium, by passing chlorine into hot milk of lime. The separation of the resultant chlorate of chloride is very difficult, and I am not aware that it can be perfectly effected on an industrial scale. Great advances in this direction have been recently made in France, whereby a very large proportion of the chloride of calcium has been removed. I should recommend the querist to try the addition of an equivalent amount of calcium chloride to commercial sodium chlorate, and then boiling down the liquid and allowing the sodium chloride to "salt out." Ultimately there should remain nearly pure calcium chlorate. Another plan would be to dissolve lime or marble in chloric acid obtained by decomposing potassium chlorate by hydrofluosilicic acid. What good the calcium chlorate will be, when he has it, the querist alone knows.

In answer to query No. 47070, page 293, headed, "To Mr. Allen," I don't think I should recommend any aniline colours to be added to confectionery. Arsenic is far too common an impurity in coal-tar products to render their indiscriminate use desirable. There are vegetable colouring matters which ought to answer every purpose.

Alfred H. Allen.

Sheffield, June 10th.

FORECAST OF STORMS.

[20163.]—LOOK in the *Almanac* and read this—Full Moon, July 1st, 6·8 morn; next look in Dr. Herschell's Weather Table, and it reads—"If the moon change between 6 and 8 a.m. in summer, expect wind and rain." The next and most important thing is that every one interested in meteorology (which, by the way, has not obtained the dignity of a science) should keep a daily register of barometrical pressure. He who does that may then connect his twelve months' sheets in one continuous band, reading from left to right: it will then be at once apparent that a periodical decrease of atmospheric pressure takes place over our islands. Next, it will be noticed that displacement occurs, followed by compensation. Thus we get small depressions in June, culminating, in all probability, in wind and rain about the time of Full Moon, at the latter end of June, or beginning of July.

In a similar way we may note wind and rain about five days after New Moon in July. The periods then follow: August 9th, moon about quadrature, so that the storm period may be accelerated two or three days, August 29th to September 4th; September 20th, moon about quadrature. In this way we get two periods in one month and one the next month. In closing, let me say that I am a poor man, and therefore, I made my own barometer, and have kept a daily register of atmospheric pressure since September, 1880, and this method of mine is founded upon observation and comparison of data, gathered within the period above named.

W. M. Gardner.

P.S.—I can give a short description of a very sensitive water barometer, having a range of eight inches rise and fall if it is desired.

ORNAMENTAL LATHE THREADS.

[20164.]—To help amateurs who have the ornamental slide-rests with a screw of ten threads to the inch, to cut their own screws for repairs, &c., I have given the setting of wheels: they are all within the set sold by Messrs. Lloyd and Co., for 12s. 6d.

	Wanted.	M.		S.	Cuts.
1	6·58	60	35		
			40	45	6·56
2	8·25	50	30		
			40	55	8·25
3	9·45	95	80		
			40	45	9·473
4	13·09	65		85	13·0769
5	16·5	50	60		
			40	55	16·5
6	19·89	45	55		
			40	65	19·86
7	22·12	95	75		
			25	70	22·105
8	25·71	60	65		
			40	95	25·729
9	28·88	45	65		
			40	80	28·888
10	36·10	45	65		
			40	100	36·111
11	39·83	40	75		
			40	85	39·813
12	55·11	50	65		
			20	85	55·25

I think lathe-makers might make a great improvement in slide-rests and chucks by putting left-handed screws in places where the screw works in a nut that moves the part; but where the collar moves the part, the nut being stationary, the right-hand screw is proper. This is the rule of the best Lancashire makers, and saves a lot of mistakes in turning the screw the wrong way.

And in chucks they might follow the American practice, with great advantage to clients living a distance away from the workshop; as it is, in case a new chuck is wanted, the lathe itself has to be sent to make the new chuck upon, so that it will run true; whereas the chuck might be built in the workshop on any lathe with a small face-plate. A casting of the face-plate could be supplied with the chuck, which the amateur could fit to the lathe, and turn up for the chuck to fit on, without the inconvenience of being without the lathe a time, long or short, as may be required in the making of the chuck.

I think there would be more work for the makers if they would do so, as the objection is so great, that few would care to pack and send the lathe after it becomes an indispensable tool.

Will some one of your contributors kindly describe a transfer chuck? Not having seen one, I am at a loss to know how they are made; but I fancy that others would like to know as well as

W. W. S.

PHOTOGRAPHIC.

[20165.]—AT this season, many readers of the "E. M." are going into the country or off to the seaside to spend their holidays; and many, if not most, of these enlightened health and pleasure seekers will take with them a pocket or satchel photographic instrument. The ease, cleanliness, and certainty, with which negatives may now be taken, are indeed a strong incentive why we should bring home transcripts of places and friends, and it is like going over the scenes again—doubling our pleasures—to examine our photo transcripts in the calm and quiet of home.

Instantaneous views, expressing all the activity of life and motion, are just as easily taken, with suitable instruments, as any other, and generally have more interest and charm to attract our attention.

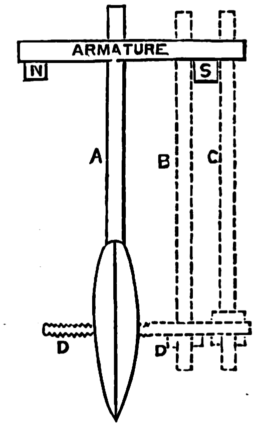
To take instantaneous pictures well, it is of the first importance to have a well-made, rigid, substantial apparatus. With many of the light, flimsy, pocket cameras, so cheaply got up, and which, with scarce an exception, are marvels of cheapness, excellent results are often obtained of landscape or architectural subjects, or studies of still life: but failure is almost the certainty when, with such apparatus, we try to work instantaneously, for they have no rigidity or sufficient weight to resist the action and reaction and shock of the spring or shutter, whichever it may be, which opens and closes the lens.

Whatever camera the tourist may select for ordinary pictures, I would advise him, if he desires instantaneous results, to get a substantial well-made instrument, which shall not be affected by the tremor, shock, or vibration of its moving parts. This is the secret of success.

E. B. Fennessy.

NEW E. MAGNETIC CLOCK—E.M. MOTORS.

[20166.]—Mr. Floyd (20101) says that my compensated pendulum (20077) is an abortion. Now, look at the figure herewith, and imagine the



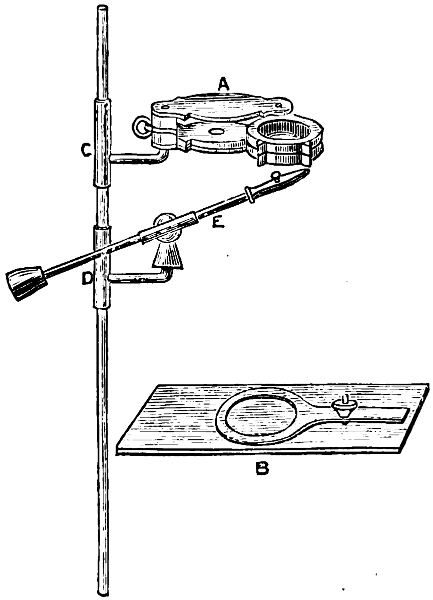
ordinary pendulum-rod A removed, and replaced by the rods, as dotted lines, B, C, D. What difference would it make to the working and vibration of the bob, except compensating? Why *must* the bob be in the *same plane* as the rod or rods? What is there abhorrent in an alteration to effect an improvement? I defy Mr. Floyd to give a valid reason. He does not say the works of a clock are an abortion because all the wheels are not in the *same plane*, or that the human leg is an abortion because it does not rest on the *middle* of the foot. I might go on;—but enough, and I conclude by observing that his other *assertions* are about equally valid.

With respect to the electro-motor (19997), I must inform Mr. Kanthack (20100) that the word "enormous" is Mr. Ponton's, not mine, although I still hold that the power is great—that is comparatively, taking into account the space in which it occurs. As to lengthening and shortening: authorities give some one and some the other; and as to the amount, I have seen it stated somewhere as between one and ten-thousandth part of length. I am also not responsible for the statement about rapidity, as I find an authority says, "If the pulsations of the current be produced at the rate of 1,000 per second, the alternate absence and presence of the magnetic virtue in the horseshoe will equally be produced at the rate of 1,000 per second." I look upon the magnet as the seat of power merely in a comparative sense, as acted upon by the current. The variation of length in a bar used as a makeweight, as proposed by Mr. Ponton, would not be one per cent. of the power used as I propose, whatever that may be.

Barry-road, S.E. **J. H. Huxley.**

THE MICROSCOPIST'S COMPANION.

[20167.]—Inclosed I send sketch of a small apparatus I rigged up from a friend's invention, and



which generally accompanies me on my microscopical rambles. B is one of Forrest's compressors, made by Mr. Bolton, of Birmingham, and I have a wooden stage with two clips for its reception. Instead of C and D my friend used a cork; the rod running through the lens A, the forceps E fixing in at right angles.

John Alex. Ollard, F.R.M.S.

Enfield.

THE CONCENTRIC MICROSCOPE

[20168.]—Mr. Wenham's remark, "By all means let him grasp what credit he can," is neither wise nor gentlemanly. It has been shown that I thought out and first published *pro bono publico* this new principle—a principle which will, I venture to say, govern the future construction of microscopes of the first class. The public questions raised by these attempts to expropriate a principle enunciated without reserve at a learned society have been efficiently dealt with by "Another F.R.M.S." It remained for me to give such evidence as would prevent patentees from expropriating the credit of my design, and from monopolising the manufacture of "the concentric microscope." This, so far as is necessary at present, I have done.

James Edmunds, M.D.

ADJUSTABLE ROLLER BEARINGS.

[20169.]—I should like to submit the following to the criticism of the readers of our Mechanic, as I feel convinced it is a marked improvement upon the bearings at present in use for bicycles and tricycles. I make the rollers conical and running upon a conical bearing-surface or spindle, the largest portion of roller running upon the largest diameter of spindle or shaft, and bore out case to fit outer circumference of rollers. In order to insure that the whole of the surfaces in contact shall travel at the same velocity, I make them by this rule: as largest diameter of spindle is to largest diameter of conical roller, so is smallest diameter of spindle to smallest diameter of roller.

It will be seen by Fig. 1 that in case of front-wheel bearings I show adjustment in bearing, but in hind-wheels and tricycles I prefer to place it upon spindle (Fig. 2). This bearing is subject to many modifications; but I claim that in this form we have the maximum of bearing surface with the minimum of friction together with a perfect adjustment. I trust this will explain itself sufficiently. I have made it as brief as possible to avoid infringing upon your space; but shall be happy to answer any inquiries, or give any explanation.

E. Martin.

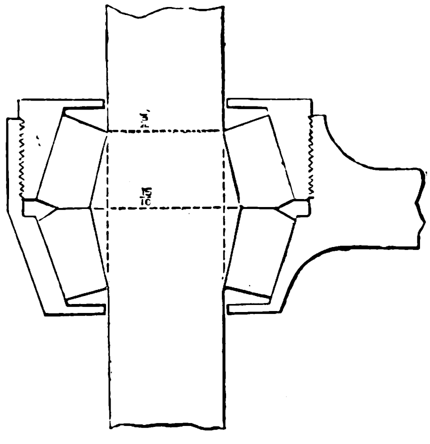
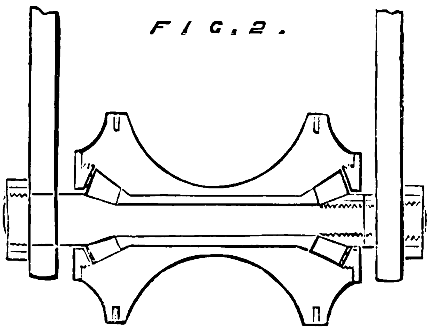


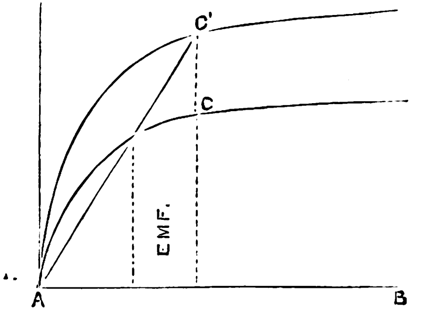
FIG. 2.



NOTES ON DYNAMO-MACHINES.—IV.

[20170.]—32. Referring to the characteristic curve for the ordinary dynamo-machine, it will be observed from Fig. 5 that if the resistance in the circuit represented by tan C A B, be constant, on increasing the speed of the machine the E.M.F. will increase in a greater ratio, so long as we are dealing with the curved portion of the line A C.

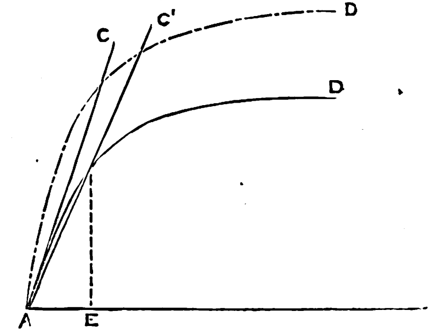
FIG. 5.



On approaching the flat part of the curve, however, the E.M.F. becomes approximately proportional to the speed, the field, by reason of the saturated condition of the magnets, now being constant. When the characteristic curve has been drawn for a particular speed it is easy to determine by construction the E.M.F. for a given resistance at any different speed.

33. Let A D, Fig. 6, be the characteristic curve for a dynamo at a particular speed. The speed being fixed, an increased resistance lessens the current and E.M.F. Let the resistance become of such magnitude that the tan of the angle C A B represents its value. Here A C is a tangent to the

FIG. 6.



curve A D, and when this is the case there can, of course, be no current. If the resistance, however, is diminished by the smallest amount, equal now, say, to tan of A C', we shall have a current equal to A E. The resistance represented by tan C A B is termed the critical resistance of the machine for that particular speed. If the internal resistance of the dynamo exceeds the critical resistance for the speed at which it is driven, it will not feed itself.

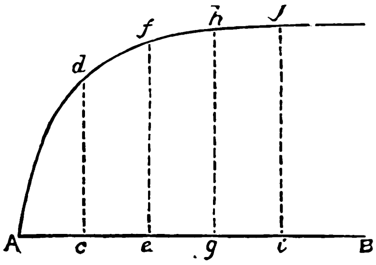
34. When the resistance in circuit is anywhere near the critical resistance, the current will be characterised by enormous fluctuations. It can readily be seen that a small change in the resistance causes a great difference in the strength of the current, when at the beginning of the curve, and the slightest misbehaviour on the part of a lamp would be followed by great irregularities in the current. If fluctuations are observed in the current which seemingly indicate that the resistance approaches the critical resistance for the speed at which the machine is being driven, the speed should be increased so that the line A C fall within the new curve A D' obtained for the higher speed. To obtain the steadiest flow of current, the field-magnets should be fully saturated, when the dynamo becomes practically a magneto-machine.

35. It has been shown in previous notes that in a dynamo-machine running at a fixed speed the E.M.F. is simply proportional to the strength of the field, this latter of course depending on the current flowing round the field-magnets. The ordinates *c*, *d*, *e*, *f*, and *g*, on line A B (Fig. 7) will consequently represent directly the strength of the field when currents A *c* and A *e* respectively flow through the machine. It will be seen that after the current has reached a magnitude A *g*, the field is scarcely strengthened by increased current, and it is important to observe this when producing the field by a separate dynamo.

36. If we have a number of dynamo-machines at work of similar construction and dimensions, it is advisable to take the current from the brushes to the lamps direct, and to use a separate dynamo for the purpose of producing the field in the lamp dynamos. This practically transforms the lamp dynamos into magneto-machines, and greater

steadiness and regularity is obtained, since an increase of resistance in the lamp circuit cannot react in such a way as to weaken the field. This plan is adopted by Siemens in lighting the Royal Albert Docks, London.

FIG. 7.



37. The use of a separate dynamo to produce the field renders it possible to burn a number of lamps on a machine not specially devised for this purpose. Suppose we have a machine giving a current of 60 ampères through a resistance 4 ohms. Such a machine would have an electromotive force of 240 volts, with a current of 60 ampères flowing through the field-magnets. Now, an increased resistance in the circuit when the machine is self-excited will diminish not only the current but the E.M.F., as well, from the weakening of the field. If, however, we excite this machine with a separate dynamo, sending a current of 60 ampères round the field-magnets, we render the E.M.F. of the machine practically independent of the resistance in the lamp circuit, and for a single lamp of 4 ohms resistance with 60 ampères of current, we can substitute half a dozen lamps of the same resistance, having a current of ten ampères through each—since 4 × 6 × 10 = 240 volts, the E.M.F. being approximately the same as when the machine was self-excited with a current of 60 ampères.

38. When producing the field by a separate machine, the strength of current ought to be such as to fully saturate the field-magnets: any excess is only adding a percentage of waste and heating to excess the machine, while anything less causes irregularities in the current.

E.

OHM'S LAWS ON ELECTRICITY.

[20171.]—Having recently taken up a number of a well known educational book, I found the following formulæ of Ohm's, of which the three latter were utterly inexplicable to me, and thought some of "yours" might no doubt enlighten me on the subject.

We will suppose we have six cells of our battery, and, for the sake of simplicity, we will suppose them to be simple elements of copper and zinc, the thicker plate in the drawing representing the zinc. Now, we can connect them in four ways. They can be arranged in a line one behind the other, as shown in Fig. 1, the zinc of one being connected with the copper of the next; or they may be arranged in two rows, each containing three cells, as shown in Fig. 2, or three abreast as in Fig 3, or lastly, side by side, all the zincs being connected together to form the negative pole, while all the wires from the copper plates unite to form the positive terminus, as at Fig. 4.

FIG. 1.

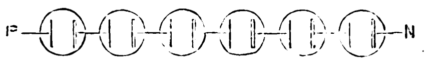


FIG. 3.

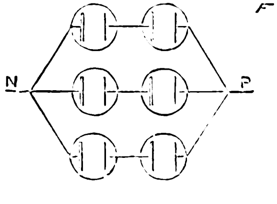


FIG. 2.

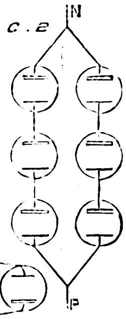
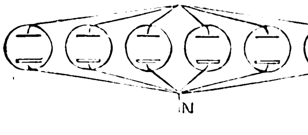


FIG. 4.



These different modes of arrangement have been investigated by several electricians. Professor Ohm, however, was the first to reduce them to a few general principles.

Hence we have :—

E = the power which a cell possesses of evolving electricity, or its electromotive force.

R = the resistance in the cells.

r = the external resistance on the conducting wires.

I = the total quantity of electricity or the intensity which passes along the conducting wire in any given time.

Ohm's law, then, may be enunciated as follows: $I = E / R + r$.

Now, if any number (n) of elements of a battery be connected together, there is n times the electromotive force, and also n times the internal resistance; the external resistance, however, remains the same, and hence the formula: $I = nE / nR + r$.

We will now suppose r to be represented by 4, and R by 1; that is, the resistance in the line to be four times as great as the internal resistance of the cells.

When the batteries are all connected in line as in Fig. 1:

$$I = \frac{6E}{6 \times 1 + 4} = \frac{6E}{10}$$

Now let them be connected so as to be two abreast as in Fig. 2, and we have then in reality three elements, each of double the size; the resistance, therefore, is only half, and therefore,

$$I = \frac{3E}{3 \times \frac{1}{2} + 4} = \frac{6E}{11}$$

When they are connected, as in Fig. 3, $R = \frac{1}{3}$, and the formula becomes

$$I = \frac{2E}{2 \times \frac{1}{2} + 4} = \frac{6}{14}$$

While, when all the zincs are connected together, and the copper plates also, as in Fig. 4,

$$I = \frac{E}{\frac{1}{6} + 4} = \frac{6E}{25}$$

We see thus that with this external resistance the greatest advantage is gained by connecting them singly. If, however, we suppose r to be just equal to R, these formulæ will respectively become

$$\frac{6E}{7}, \frac{6E}{5}, \frac{6E}{5}, \frac{6E}{7},$$

which shows that the greatest power is obtained when they are connected in twos or threes.

Now, the first formula works all right, but the last three certainly want explanation, as to the working, to

Stud. Inst. C.E.

ELECTRIC METERS—ELECTRIC v. GAS-LIGHTING.

[20172.]—The idea on the subject of electric meters which Mr. Leaper mentions (20132, p. 308), is described in my patent. But it is not an available means of measuring currents; at least, in the form which is most obvious—the decomposition of water, so-called. It is true that this decomposition gives us a very convenient measure when corrections for temperature and pressure are made; but it is attended with two drawbacks, which render it useless.

In the first place, it sets up an opposing electromotive force which absorbs energy, and would, therefore, uselessly consume part of the working power. Then, also, the resistance of surfaces giving off gas is constantly varying, which would introduce an irregularity in the action. Both effects would combine in producing a more serious evil, in that they would make it impossible to use shunts, and therefore would necessitate using the whole current, and levying a heavy tax upon it for the purpose of measurement. Mr. Edison also has patented a mode of using decomposition of water which is evidently impracticable. He proposes to let the gases raise a bell-jar of measured capacity, and then automatically explode them. This would do away with the loss of water, but it is difficult to conjecture how long the apparatus would work.

The utilising of the gases is chimerical; they would not pay for collecting, and would rarely be useful on the spot. The value of deposited metal is of course nothing, because it is only transferred from one plate to another. In my meter the one weight of metal simply passes to and fro between the electrodes continuously. Unlike gas generation, it absorbs no energy, except that of the electric resistance, and it introduces no complication of counter-forces.

I am sorry to see Mr. M. Williams pandering to a very stupid but popular fallacy, 20731, p. 308. He joins in the absurd and ignorant outcries about gas and its cost, and in doing so makes, as every one else does, statements which he would find it difficult to support. It seems to be adopted as a sort of axiom that gas ought to be provided by the public authorities as a public convenience, and not as a commercial enterprise. This is a fallacy, and one of the forms of a growing communistic theory. Let me ask any one to give even a plausible reason. As to water supply, there is a reason for the public supply, because water is a natural product and an inevitable universal necessity. Our congregating in cities cuts us off from the natural supplies, and we can best remedy this by collective control over those supplies and the distribution. But gas is a manufactured article, involving constant individual work to improve it. Every supposed reason for its public control applies with equal force to the supply of bread, of meat, of milk, and so on, and the result would be a pure communism in which private energy would be crushed out.

Mr. Williams says the prime cost of gas is nothing. If this be so, to whom is it due? Is it not the result of the work and business energy of gas-makers who have created the industry? In any line of business, if men improve it and make it profitable, ought they to be grudged the fair return?

He says: "If gas were subject to ordinary competition, we should be supplied at 1s. per 1,000ft." I much doubt if that could be done were no profit made by anyone, and capital not considered at all. But even if so, how has it come about? A few years ago, there was that competition. But, then, the price of gas was very much greater than now, its quality much inferior, and the gas companies got no profits. The existing conditions by which all have advantaged, and which excite the cupidity and animosity of people who ought to know better, are due to the efforts of a few wise and energetic men of business. The prosperity of gas companies is based upon two things: (1) the substitution of competition by a regulated monopoly, under conditions to protect the public interest, settled by the public authorities; (2) the substitution of clay retorts for iron ores.

Why should not those who produced the result reap the benefit? Is 10 per cent. an unreasonable profit upon a capital embarked in a trading and manufacturing enterprise? That it is subject to risks is obvious from the circumstance that it is now threatened with total extinction by the electric light—a threat, I may add, which does not greatly alarm, but none the less shows the enterprise to be one entitled to a profit covering it. Some railways pay 6 or 7 per cent., and they are not subject to any such risks. The fact is, that for many years gas companies paid small or no dividends, and then no one wanted to take their work from them; but because for some time they have attained a most legitimate reward for energy and ingenuity employed in doing a great public work, they become the mark of all envy, hatred, and uncharitableness.

Let the electric light supersede gas, and, of course, the same result will arise. As soon as companies have made it a success, and look for a profit, there will be the same outcry. Yet, what induces men to carry out these enterprises, but the hope of obtaining a benefit themselves?

Meanwhile, will Mr. Williams state the names of some of the towns, where, as he says, the corporations supply gas at "about half the price of London gas," and yet make a profit? Will he also show how the result of extensions can supply the only fair data for calculations. My experience in various matters indicates that extensions are very different from a complete affair, and would give very fallacious data.

As to the electric light companies, they will follow the usual course of pioneers in a great work. Just as gas, railway, and cable companies fared, so will they. But, suppose all their first capital is sunk, the country will be none the poorer. The case is very different from that of throwing away many millions in, for instance, a foolish invasion of Afghanistan; there money and lives were wantonly thrown away, with nothing but evils to show as a result. Here the money will not be lost: it will only change hands, and there will be a result in the establishment of a new and beneficial enterprise, which, in the end, will be a great boon to the community, and a legitimate and profitable source of employment for capital.

Sigma.

[20173.] — Your correspondent, Mr. Mattieu Williams, in 20131, makes some statements which seem to require reconsideration.

In this letter it is said, "the by-products—coke, ammonia, naphtha, &c., cover the cost of making the gas." Is this correct?

The Gas Light and Coke Company's account for 1881, give in round numbers the value of the residual products—viz.:—

Coke, breeze, tar, ammonia, &c., at ..	£615,000
The cost of coals at	963,000
The cost of manufacture of gas, including coal	1,460,000

showing the value of the by-products to be only 42 per cent. of the cost of making the gas. The account of another gas company, with a capital of over £700,000, shows 39 per cent., both much under 100 per cent.

Again, it is implied that one shilling per 1,000ft. would pay expenses, and a fair interest on the capital outlay.

The rates of the Gas Light and Coke Company in 1881 were, 3s. 2d. for common gas, and 3s. 11d. for cannel gas.

If charged at 1s., the company would lose above $\frac{2}{3}$ of their receipts for gas, or more than £1,312,000, and in that case there would not only be no dividend on nine millions of capital, but the expenses would exceed the receipts by half a million per annum.

C. E.

ELECTRO-MOTOR.

[20174.]—Two of your correspondents have pointed out the rock ahead upon which Mr. Huxley's idea (if put in practice) will founder—viz., the alteration of the length produced by magnetising iron, may be absorbed, by reason of the elasticity of iron, upon any attempt being made to use the force in the manner suggested by Mr. Huxley.

For example, using the figures given by one correspondent, the iron lengthens, one 272,000ths of its length when magnetised; hence, a bar 23ft. long, one inch sectional area, lengthens one thousandth of an inch when magnetised or when submitted to a stress of 94lb. Consequently, the whole stress produced by magnetising such an immense electro-magnet is neutralised by a stress of 94lb. From this statement it follows: Mr. Huxley must employ the unwieldly size of an electro-magnet 23ft. long and 2in. sectional area to lift 94lb. one thousandth of an inch, and from that datum he can easily calculate the horse-power of his proposed electro-motor—taking care, however, to make allowance for the friction of the iron particles "inter se" when calculating the strength or force of the electric current. As Mr. Huxley takes exception to my use of the expression "friction of the particles of iron," may I be allowed to state such an expression is not difficult to be understood, and means a definite force of electric current is required for any magnetism to be produced in each cubic inch of iron, just in the same way as a definite stress is required to produce the first strain in each cubic inch of iron, and that owing to the friction of the particles of iron "inter se," strains proceed "per saltum"? Sir W. Thomson made experiments on iron magnetised under different stresses, and Mr. Huxley ought to study these.

10th June. A. C. Ponton.

LECLANCHE BATTERIES WITH PEROXIDE OF MANGANESE V. LECLANCHE BATTERIES WITHOUT MANGANESE.

[20175.]—I THINK the following lines on the above subject may be interesting to some of your readers.

To test the value of G. Tolman's assertion that Leclanché batteries without manganese would work equally as well as those containing manganese, I determined to test the fact myself. On May 1st I fitted up four batteries, two of which contained four cells of the gravity form, and two eight cells of the form in use by the Post Office Department.

One battery of each kind was fitted with the usual mixture of broken carbon and peroxide of manganese, and the other two with broken carbon only. The four batteries were charged with sal-ammoniac in the usual way. These batteries were running the same length of time each day, and when examined, June 5th, those containing manganese were found in good working order, while those prepared with broken carbon only were practically useless. When they were first fitted up they each gave the same resistance and the same electromotive force; but on testing them, May 7th, although the resistance had not changed the electromotive force of those without manganese, had run down considerably. They were tested again on the 15th May, and I found that the electromotive force of those charged with manganese was more than 50 per cent. greater than those not so fitted up. They were again tested on the 22nd May, when I found that the electromotive force of the cells charged with peroxide of manganese was exactly double that of the others. Both batteries without manganese failed on June 5th.

I am convinced, however well the Leclanché battery may work without manganese, it works infinitely better with it.

Arch Key.

THE BERLINER VIOLIN.

[20176.]—I SHAKE hands with Mr. Berliner, and congratulate him on his success. Through the kindness of our editor I have had an opportunity of perusing this new patent violin. The resonator does improve a weak-toned cheap instrument—viz., 15s. 6d. German make, 30s. retail; but there is a shorter French make at same price that I think would produce better results? Why? Because the bass wants consolidating; the reaction is not quick enough. The 1st string is all good, 2nd string partly so, the 3rd and 4th want power. But this is the case with most violins that have a soundpost: the difficulty is to get an equal weight, tension, or resistance over the whole of the soundboard to suit the various tones. This is not theory, I'm putting it into practice. Note.—The Berliner violin is strung (without a tail-piece) on to a continuation of the finger-board, so that there is no tension on the hinder part of soundboard but what already exists, in the pressure of form, sides, back and front, glued together. If this normal pressure or tension could be increased, the bass would be louder, and the 3rd string firmer—a most important consideration. I do not think that because the treble part of soundboard is apparently as free as the hinder or bass part, that it is not affected by the metal and ebony stringholder, and the internal strip; the fact is, the increased weight, 3 or 4oz., is the cause of increase of sound all round, and more especially in the treble region, because it is to this part that the resonator, &c., is *indirectly* attached. This attachment is managed so cleverly, that the vibrations are not stopped or absorbed, but thrown back with increased force, as a shuttle in a loom. Now, this is the difference between a good or bad violin—if you have not sufficient resistance there is no tone. The mere attachment of weight is not what I mean; but what in electrical parlance is called internal resistance; it must be in the wood, in the make up of the wood into form or shape, in the strain of the strings; this can only be done by adding pressure or weight without stopping the vibrations—indirect action to produce reaction—positive and negative. I apologise all round for this digression, and beg to say that Mr. Berliner's patent is valuable when applied to weak instruments; but where all is provided for in a first-class violin, its application is not needed, and would be dangerous. The tone of the Berliner violin is soft or suave, and forms a delightful musical acquisition.

I wish to know the price of violin; also of patent resonator, if our friend will oblige by making them known through the Sale Column.

Fiddler.

A DOUBLE TRICYCLE.

[20177.]—I AM now contemplating the building of a tricycle to carry two riders, and shall be very pleased if some of the able contributors to the ENGLISH MECHANIC will tell me whether my plans are likely to turn out a success.

The machine will be a 50in., with a track of between 50in. and 60in., the axle in two parts, each part being a double crank of 5½in. throw, and driving its respective wheel. The saddle or seat will be about the same height as a bicycle seat of a 50in. machine, and about 9in. behind a perpendicular line passing through centre of axle. The frame work will consist of three curved pieces of steel tube, united together by two horizontal pieces and meeting together at the head of small wheel in the rear. The curved tubes will carry the bearings for the axle, the centre tube having a double bearing for the ends of the two cranks. The horizontal bars will carry the sockets for the saddle or seat.

I also propose adding two levers worked by hand, to be used when mounting hills, and to act with greatest force when the cranks are at their dead points.

The advantages I hope to get from this machine are—1. Simplicity of construction. 2. Ease in working, as the power will be applied directly on the axle, after the manner of a bicycle. 3. A good view of surrounding scenery. 4. Ability to apply extra power by means of the levers when travelling is difficult. 5 Ease and readiness in turning, as the crank being divided, one rider can remain inactive, or even back his crank, whilst the other works his machine round. The disadvantage I fear is a great liability to upset, but this will be mitigated by the width of the machine and position of seat behind the axle and between the rear and front wheels, and also by the position of the point of application of the driving force.

Why are cranked axles and levers abolished except in the case of the "juvenile machines"? The chains and cog-wheels used as a substitute seem to involve a very complicated construction and waste a deal of power.

I am led to propose this question from having lately made a short trial of the "Velociman," essentially a lever tricycle, and being struck with its immense superiority over my own, a chain machine. I ought to state that the wheels of these two machines were exactly of the same height.

A Littlemore Mechanic.

FITTING NEW TEETH TO WATCH AND CLOCK-WHEELS.

[20178.]—IN accordance with an intimation given by me several weeks since, I now contribute a little instruction on the work of fitting new cogs, or teeth, to watch and clock-wheels, premising that in so doing my remarks will be of benefit to a few of the younger members of our fraternity, and, at the same time, give a few serviceable hints to amateurs. I am aware that many high-class workmen discountenance the "patching" of wheels; but every *ordinary* watch and clock jobber knows that such repairs must frequently be done. It is obviously a more simple and less expensive job than fitting new wheels, and, I am bold to say, is more often resorted to. Although the difference of size between one and the other is so great, the manner of fitting is nearly identical, the tools only varying in their sizes. There are various ways in which teeth may be fitted, and the precise manner of fitting must be governed, in great measure, by the class of wheel to be operated upon. I will proceed at once, then, to describe the several modes of fitting, and the manner in which the repairs may be done. Taking the wheels of a verge watch seriatim (I have elected to take a verge watch because it has the largest kind of watch-wheels, and is more easily operated upon), we have the fusee or great wheel; this is the stoutest wheel in the watch, and seldom, but sometimes does, get ruptured or broken. Generally speaking, this wheel has a broad rim or ring, which will admit of deep cutting without in any way diminishing its strength. The teeth, from their large size, are comparatively easy to fit. Presuming that a tooth of the fusee-wheel is broken, remove the pin, collet, and the coned part, and secure the wheel in the hand-vice, or the bench-vice, between two pieces of cardboard or thin metal, to prevent bruising by the screwing up; then, with a fine saw, or saw-file, cut down into the rim of the wheel to about two-thirds the length of the teeth, and with a suitably-shaped file undercut the slot the form C, Fig. 1, after the manner of dovetailing. Then take a piece of brass wire and hammer it moderately, to harden up; afterwards file and shape the extreme end to fit the dovetailed slot. Make it a close fit, and, as nearly as can be, make the part which will form the new tooth the precise stoutness. The tooth can be secured either by riveting or soldering. The former is preferable, because soldering, by reason of the heat required, is sure to bring about a little weakening of the parts. Where the wheels under repair are small, the teeth can hardly be sufficiently secured without solder; but great care has to be exercised in using it. A small soldering-bit is very useful in this work, as the wheel need not, by its use, be brought in actual contact with the flame. I use the blowpipe but little in soft-soldering. I keep a few differently-sized bits, and find them, in the majority of jobs, all that can be needed for the work. Having fitted the new tooth fairly tight, and you desire to solder it, apply a little zinc solution to the parts, and having a small quantity of solder on the bit, heat up, holding the wheel in the tweezers. Place the point of the bit at the base of the new tooth and the protruding end of the wire in the edge of the flame—as this will assist the solder to flow correctly when it runs to its place round the tooth. The job should be done quickly, so as to prevent overheating of the wheel. The surplus wire must then be cut away, and the remaining portion reduced and shaped to the exact form, taking care that the tip of the tooth is true to the circumference of the wheel. If you rivet the tooth in, the edges of the slot must be slightly bevelled, and the metal of the new tooth hammered over. The finishing off should be done with Ayr stone and burnisher.

Coming next in order to the centre wheel, we have one of about half the thickness of the fusee-wheel, and, like it, a solid one—i.e., not cut open into a bar-wheel (a few exceptions occur); and admitting of a deep cut for the new tooth or teeth, for it sometimes does happen that several teeth give way together. Whether this is so or not, a fairly deep cut should always be made, and be dovetailed as before described; or, in the case of a single tooth, the wheel should be drilled at the base of the old tooth as at B, Fig. 1, and cut into with a saw or notching file. As before, the brass should be hardened previous to insertion, and fitted as closely as possible before soldering or riveting. A very small speck of solder will suffice to make all secure if the fitting is perfect. The thickness of new teeth should in no case exceed the thickness of the wheel itself, so whether it is soldered or riveted the true flat of the wheel should be retained. Some little care is always needed in riveting, to prevent the adjacent parts being swelled out of truth. Now we come to the third wheel, which is one having a narrow ring, and cut open with bars. In these wheels there is seldom more than about the same breadth of ring as there is in the teeth, so only about half of it must be cut away for the insertion of the tooth. It is advisable not to rivet teeth in these wheels, as they are almost sure to get out of round in so doing. If the wheel is a thick one, it may be drilled through from its edge inwards, as at A, Fig. 1, but in this way the tooth cannot be made of the same form as the existing ones, inasmuch as the drilled hole must of necessity be less in diameter than the wheel's thickness, and the pin inserted less than that, and somewhat round in form. After the tooth has been roughly shaped up, soldered in, and cut off, the end may be trued off in the turns, as in ordinary "topping," and then shaped at its sides to match the others. The teeth of these wheels may also be fitted as at B and C, Fig. 1.

The contrate wheel is next in order. This wheel will require somewhat different treatment to the others as, owing to the usual narrowness of the ring, no space is left for cutting; therefore a hole must be drilled through its edge.

This wheel is more liable to breakage than any other, owing to its proximity to the edges of the plates and consequent interference by the wearer. I have frequently had verge watches brought to me with ten or a dozen teeth turned over or broken off. Obviously, a wheel in such a state should be replaced by a new one. In drilling a wheel for a tooth, it must always be observed to start and keep in the centre of the ring, and central between the two next to it, and the diameter of the drill must be less than the wheel's thickness. If this cannot be accurately determined by the eye it must be gauged. The drill, as in Fig. 5, should be nicely shaped, and left with a good clearance aft the cutting edges. When the hole is correctly drilled insert a tapered pin, and apply a little solder to the underneath part and cut off flush. I advise a tapered pin because a small hole will suffice, and the part forming the tooth be larger in consequence, and be nearly, if not quite, the same size as the existing teeth. The finishing off may be done as was the third wheel. The wheel next in rotation is the 'scape-wheel or balance-wheel, as it is by some called (Fig. 2). Great precision is necessary in repairing this wheel, so as to make it effective in its action. So much depends upon the escapement, that the most trifling error in shape, thickness, or length, may cause the watch to stop.

FIG. 1.

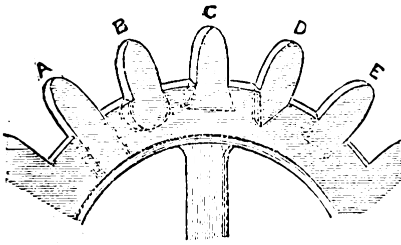


FIG. 2.

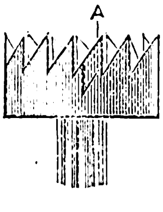


FIG. 3.

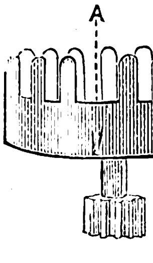


FIG. 5.

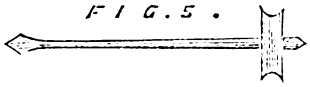


FIG. 4.

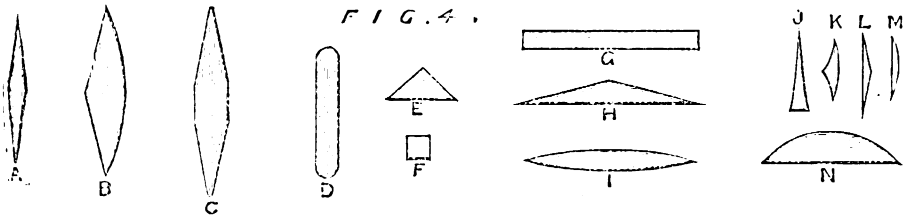


FIG. 6.

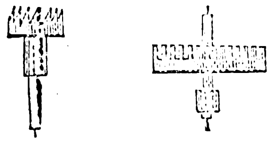
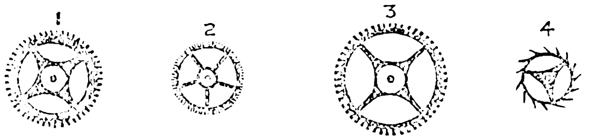


FIG. 7.



If the wheel is a very thick one, and only the extreme end of the tooth is broken, it may be drilled for the new one. Otherwise, it must be cut with a thin-edged file, A, Fig. 4. In doing this, observe the pitch of the teeth, and make the cut in the wheel at the same inclination. Insert a piece of good hard wire, which has previously been shaped as nearly as can be to what is required, and no thicker than the existing teeth. This repair must be done with the soldering bit, and care must be taken that there is no overheating. Any excess of solder must be removed, or the wheel will be out of poise—*i.e*, it will be heavier on one side than the other, or may become blocked in the potence. With a balance-wheel file K, Fig. 4, shape up the tooth to the correct form, and, with a piece of Arkansas-stone tip the tooth until it is the same height as the others. This may done upon a piece of perfectly flat stone, but it is best done in the "turns." To quickly ascertain if the wheel is correct, set it in the depthing tool and bring one of the poppets flush with the teeth-tips. On revolving the wheel, it will at once be seen if correct or not; another way is to place a flat burnisher on the teeth, and look closely at it with the eye-glass when held between you and the light. If the tooth is too short, another must be put, or the the others must be cut back to it. This, however, entails, in most cases, the cutting away of the potence-face and the counter potence; so it will be apparent that more than ordinary skill is required in fitting teeth in a 'scape-wheel. The tip of the tooth must be equidistant from the next ones on either side, and a simple way to determine this is as follows: Press the wheel's teeth slightly upon a piece of white paper, and, opposite to the marks made by the new tooth and the two next, make dots with pen or pencil to distinguish them; then bring round the other side of the wheel, which is, presumably correct. If these teeth fall exactly into the marked holes without deviating in any degree, the tooth is truly pitched and perfect so far. The verge being void of what may be called teeth, little or nothing need be said about it here. I only speak of it to say that I have seen worn verges so twisted about that what was formerly the back of the pallet has been made its acting part. I do not intend to advise its adoption, so will say no more about it.

D and E, Fig. 1, are examples of modes of fitting teeth, but they are not so reliable as the others. The wheels of other watches, such as chronometer, duplex, lever, and Geneve, may be repaired in the same manner as those already described; but all being, more or less, of a delicate make, or requiring greater nicety in fitting and finishing, a skilful hand is needed to make a good job. I must admit that it is advisable to have new wheels where exceedingly fine work is in hand, such as will be found in 2, Fig. 7, which is the actual size of a Geneve wheel of small make, and having about 90 teeth in its circumference; but every jobber will know that repairs of this kind have frequently to be done off-hand, without any consultation with the owner, who, if advised of the breakage, would possibly object to the inevitable outlay attaching to a new wheel, some wheels costing from 3s. to 10s., or more, each.

It is needless for me to go into detail with every kind of watch-wheel. because the already-described modes of fitting hold good for nearly all, the most suitable being adopted according to the ideas of the workman. Nor do I think it necessary to do so as concerns clock-wheels, because anyone who can correctly fit teeth to watch-wheels must, without doubt, be competent to fit teeth to those. The form of fitting is the same on a larger scale. There is this much to be said, though, as regards them. In the case of large and heavy wheels and toothed barrels, the drill-hole and the tooth may both be threaded to screw in. This is an advantage, as soldering and riveting are dispensed with, and the wheel is in no way softened or misshaped. A more correct shape, however, can be got if the teeth are dovetailed in, as a pin-tooth cannot be the same thickness as the wheel.

In conclusion, let me say that a feeling of satisfaction always comes to a man who loves his profession when he is conscious that he has done his best to turn a job out of hand well. I regret much to see how badly work is done by some watchmakers (?)—notably in the way screws are fitted. It is no uncommon thing to see screws set in the plates or bars of watches, which are as rough as they left the makers' hands, and entirely without colour. No good workman would ever be guilty of such a disregard for appearance. Just so with the teeth. Always strive to make the new ones as nearly as possible to match the old, and never have it on your mind that you have inserted rough pins and called them teeth.

A, B, C, D, E, F, G, H, I, J, K, L, M, N are sectional examples of files used in watch and clock work. Figs. 6 and 7 are examples of verge, Geneve, and lever wheels, actual size.

Alfojoe.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[46443.]—**Handel Organ.**—The account of the repairs and alterations to the Crystal Palace organ appeared in the *Engineer* of June 2.—J. W. W.

[46495.]—**Silicate Paints** (U.Q.)—I presume M. Pineard's silicate of soda; try "transparent silicate paint." I have used it for preventing the rain beating through the gable-end of houses. The whitewashers and painters applied it. First of all the mason pointed any loose bricks there might be with mortar. The silicate was poured into a bucket, and then put on with whitewashing brushes, exactly as whitewashing is done. Three coats were put on, allowing each to set before the next was applied. It must be done when the weather is fine. When ordering the second lot I wrote to the maker describing the method I had used, asking if it were a good one. I was told it was a very good method. The water was running in streams down the walls of one house, which the silicate entirely stopped. I shall be glad to give "M. P." any other information I can, should he require it.—W. L.

[46549.]—**Science Questions** (U.Q.)—It is quite impossible, within anything like reasonable limits, to do more than give an outline of the method to be adopted for the analysis of the mixture given, namely, O, H, CO, HCl, CO_2, and N. The HCl must be absorbed by a bullet of crystallised sodic phosphate ($HNa_2PO_4, 12H_2O$); it owes its absorbent power to its water of crystallisation, and should be of ample size to avoid deliquescence. The CO_2 is next absorbed by a bullet of potassic hydrate (KHO). The O is next got rid of by a bullet of papier-mâché with potassic pyrogallate. There now remain H, CO, and N, which are best determined indirectly; a known volume of oxygen is added, and the mixture exploded, whereupon the CO takes up half its volume of O and forms CO_2, which occupies the same volume; the H takes up half its volume of O and condenses to water. Call the original volume A, the contraction after explosion C, and let O be the volume of CO_2 produced, determined by KHO as before. Then we evidently have $CO = D$, $H = 2C - D/3$, $N = 3A - 2C - 2D/3$. In practice there are all sorts of details to be attended to, and various corrections of volume to be made for pressure, temperature, moisture, &c. Let x = weight of C $SrCO_3$ in mixture, then it will evolve $44x/147{\cdot}5$ of CO_2. $(1{\cdot}3332 - x)$ will be weight of $CaCO_3$ in mixture, and it will evolve $(1{\cdot}3332 - x) \times 44/100$ of CO_2. So we get $44x/147{\cdot}5 + {\cdot}44 \times (1{\cdot}3332 - x) = {\cdot}5104$. Thus equation multiplies out to $44x + 86{\cdot}52468 - 64{\cdot}9x = 75{\cdot}284$, $11{\cdot}24068 = 20{\cdot}9x$, from which we get the amount of $SrCO_3$ in mixture $= {\cdot}5378$ grm. Thus quantity of strontium carbonate contains ·319grm. strontium, and the mixture, therefore, contains 23 9 per cent.—WM. JOHN GREY, Elswick Science School.

[46690.]—**Waterproof Clothing.**—I am sorry I have not been able to give my experience here sooner, as it may interest your readers. I have had a great coat, a thin serge suit, and a very light Inverness waterproofed, the mode being, I understood, that the cloth is dipped in acid, and whenever it comes in contact with moisture it closes the fibres. The advantages are the air passes in and out, and you have not the unpleasantness of a mackintosh. The disadvantages are that in a cold dry wind the clothes are cold; in moist, rainy, warm days intensely hot. The wet does not run off, but hangs on. With regard to the great coat, it is made of a furry cheviot, has been in constant wear for over five years in all weathers (no umbrella), and only once let the wet in when I accidentally tried the experiment of sitting in a puddle. I have carefully avoided further experiments of a like nature. You can see through the cloth. It is extremely light, but takes some time to dry. The serge suit was a failure, being too thin. It stood a heavy shower for some time, the wet congregated, and the result was a shower bath. I had no further reliance in it. The Inverness is now being worn, and answers fairly well. Cloth when thus waterproofed will hold a basin of water provided nothing touches it so as to cause suction, which shoulders and knees generally do. There is a smooth brown (also black) cloth, which I would recommend, but I believe it is expensive, at least. at my tailor's, who dwells in the West-end. I think waterproofing adds about 5s. to the cost of a coat, and is done before the coat is made. Do not animals with waterproof clothing shake off the wet?—JOHN ALEX. OLLARD, F.R.M.S., Enfield.

[46700.]—**Intensity-Coil.**—To Mr. Lancaster.—I am pleased to be again able to write answers to correspondents. The principal cause is now removed. My thumb ceases to pain me when writing, and I shall hope to speedily fulfil my promises. I shall be pleased if any querist that I have apparently forgotten will point out to me anything that remains unanswered, and I will do my utmost for his benefit. Being unable to write to "ours" has been a source of much pain to me. Life is at the best short, and what little good we can do should be done at once, or it may be too late. I do not know whether anyone else has been good enough to answer this query; but I can assure "Brontes" I shall be only too pleased to answer any question he may now have to ask. Will "Brontes" tell me whether or not he has now any difficulty with his coil?—W. J. Lancaster.

[46711.]— **Terra-Cotta.** — Terra-cotta colour can be make to look best, if the plaster to be painted on has not been previously oiled. Give the plaster a coat of size first, and when that is dry mix the following colours:—Indian ink, yellow ochre, chrome yellow, white lead flatting, with turpentine. The colours to be got dry, and ground down and mixed to the right shade. To paint on plaster that has been oiled:—Mix a *little* lampblack and red-lead with oil, and put with the colours before mentioned: these colours to be ground with turps as before.—Sculptor.

[46719.]—**Reading-Lamp.**—This, and some other lamps on the same principle, act as the thermometer does. They are put away in a cooler place, and perhaps not quite filled when they are trimmed; the consequence is, that when they are brought into the sitting-room and are lighted, and get a little warmed, the air in the reservoir expands, and sends out the oil too fast. This is the worst of that kind of lamp. Care should be taken always to fill the reservoir with oil; they won't run over then.—Edw. Thos. Scott.

[46737.]—**Wild's Anemometer.**—I am sorry I cannot just now call to mind any anemometer invented or made by Wild. There are a number of anemometers with swinging plates, but I do not remember one of Wild's. Let me know as much as you know about it, and I shall then be able to find out which it is you refer to.—W. J. Lancaster.

[46760.]—**Making Boiler.**—The model adopted for your boiler is a bad one, and if you have not gone too far you should alter it to represent an ordinary vertical boiler, or make a plain horizontal shell. The parts can be brazed together, but no one should attempt to do that with boiler work who has not had considerable experience. You had better rivet the seams. Fix the tubes in your "furnace" plate, but leave them only a tight fit in the dome. Calculations as to the pressure such a boiler would bear are altogether beside the question; for though there may be some empirical rule stowed away in a wonderful note-book, it would be unsafe to trust it, even if it does allow for a large margin of safety, for the simple reason that no rule can possibly take into account the workmanship. It is obvious that a coppersmith, accustomed to such jobs, would turn out a stronger affair than any tyro possibly could with the same materials. But "Juno" may do this safely: Let her decide on the pressure she wants to work at, or somewhere near it, and then load the valve to four times that. Say, 20lb. is wanted, then put 80lb. on valve, fill up brimming with cold water, and start the "fire." If the valve lifts without any weeping at the seams or any distortion of the shell, she may then safely work with steam at 20lb. or more. As a matter of fact, with care it would be safe to work at 40lb., or one-half the testing pressure, but it is as well to be over-cautious with these little affairs.—Essar.

[46761.]—**Compensated Watch.**—If "M. F." would take his watch to any respectable watchmaker, such as Dent, Webster, Barraud and Lund, or Frodsham, he can have the compound balance carefully adjusted and compensated for £2 or £3, and his watch will then be as good as any chronometer—if anything, a little better, as the lever escapement is not so delicate and likely to get out of order as the chronometer escapement.—E. G. H.

[46763.]—**Coil.**—To Mr. Lancaster.—A coil 9in. long, with a core ¾in. diameter, three layers of 16 silk-covered primary, and 1lb. of 36 secondary, will give you a good ¾in. spark; then for a longer spark you can double the quantity of secondary.—W. J. Lancaster.

[46764.]—**Punch for Boiler-Plates.**—If your correspondent will look on p. 78 he will see one of the best punches in the market. As to a full-size sketch, showing how a punch is held in the machine, it would be a great waste of space. Many are simply fitted into the ram or plunger, and held there by friction; others are held in by a set-screw. The reason that many holes are ragged is either the punch is not adapted to the work, or the metal punched is of inferior quality.—C. G.

[46771.]—**Zincography.**—A "Canadian Subscriber" should refer to p. 141, No. 656, and to Vol. XXVII. for much information on this matter. The zinc plate should be smoothed up to a polish first, and then be grained by means of very fine moulding-sand worked over it with a zinc muller. After the transfer is on the zinc, gum it up with gumwater dosed with phosphoric acid, taking care to wash all the gum off again. From your query, you applied the ink roller without washing the gum off plate. You must also damp plate between each application of the ink roller, with a sponge and hard water preferably. If the plate was free from grease, the ink will then adhere only to the lines where it is wanted. While writing on this subject I send a short note of the process as carried out by photography—for line drawings only, of course:—The zinc plate is first prepared by cleaning, and then a solution of gallic acid and gum is flowed over it; this is wiped off, and when the plate is dry it is coated with a solution of bitumen of Judæa in benzine; it is exposed behind the original drawing—that is to say, a positive—and the bitumen which has not been rendered insoluble by the action of light is dissolved out by means of spirit of turpentine. The lines of the drawing appear everywhere where the metal has been laid bare. It is next treated with water acidulated with acetic acid, a solution which restores to the zinc the property of retaining a fatty substance—that is, the property of which it had been deprived by the solution of gallic acid. A roller charged with fatty ink is then passed over it, producing a picture in black, and the whole plate is then cleaned up with essence of turpentine. Impressions can now be immediately taken in the lithographic press from the zinc, and we obtain positive prints identical with the original drawing.—P. N.

[46772.]—**Steam-Launch.**—If you look through back numbers you will find a variety of notes on steam launches. Probably a two-bladed propeller would run best, but it is purely a question for experiment in each boat, unless they are built to the same lines. A mean speed of about six miles an hour is all you will get out of such a boat.—C. J. V.

[46779.]—**Bleaching Cotton.**—If the chloride of lime process is not suited ("Dix" appears to have omitted the important dip into the sours or water made slightly acid with oil of vitriol), try exposing to the fumes of sulphur, or subject them to ozone. The latter is rather too expensive at present, though in the same number as the query there is an article on the application of ozonised oxygen for bleaching, which seems to point to an extensive use of that agent.—T. P.

[46783.]—**Battery for Continuous Current.**—A Daniell would, I should think, be the best.—E. G. M.

[46786.]—**Ventilating Weaving Shed.**—If the only air-inlets to the shed are covered with screens of scrim canvas kept constantly damp, the air will not only be cooled, but will be kept damp. There might be so many of these inlets as to prevent any draught.—Nun. Dor.

[46788.]—**Varnishes and Stains.**—If "Wood-Turner" will apply to any good firm of varnishmakers they will supply him with just what he wants. He can make it easiest by dissolving pale or brown shellac in methylated spirit. The "colour" is dragon's blood dissolved in alcohol, 1oz. to the pint; but cheaper work is done by boiling in decoction of Brazil wood.—T. P.

[46792.]—**Aquarium Front.** — Patent plate, ⅛in. thick, would be strong enough for such a tank. The pressure on the glass is a question for calculation. Clearly it would not be so much 1in. above the water as 1in. from the bottom, and as the querist does not state where he wants the calculation made, he can easily arrive at the total by remembering that a cubic foot of water weighs, say, 62lb.—T. P.

[46797.]—**Academy Boards.** — Would this querist kindly say what are "academy boards?" I have asked the question of draughtsmen and others, but the invariable answer is, Don't know: never heard of them.—Nun. Dor.

[46803.] — **Movable Bookshelves.** — The old form, so many boards held on cords, or shelves neatly framed together, and hung on brackets or wall-hooks.—Nun. Dor.

[46804.]—**Furniture Cleaning.**—I am afraid you are asked to accomplish an impossibility, for whatever will remove the "nasty black stuff" will certainly take off the polish, too. The only remedy is to scrape off and repolish.—Nun. Dor.

[46806.] — **Mounting Plate Machine.**—No doubt you have mounted your machine before this; if not, I shall be pleased to give you full instructions how to do it. The Winter's ring should be same diameter as the plate.—W. J. Lancaster.

[46806.]—**Plate Machine.**—This querist should refer to back Nos.—say No. 836 for instance, p. 95, where he will find a Winter's ring. As to the general mounting, cannot he contrive to see a machine. Answering queries put in such general terms, is not altogether satisfactory to any one.—T. P.

[46809.]—**Restoring Leather Bag.**—Wash over with a strong hot decoction of logwood, and if the colour does not please, go over afterwards with solution of green copperas.—Sabbas.

[46809.]—**Restoring Leather Bag.**—A bottle of the black varnish, sold in square pasteboard box, with brush inside ready for use, and which dries on the instant, will make your bag look quite "spiff and 'spectable." Try it! I have done so again and again at a cost of a few pence only.—H. O'B.

[46817.]—**Griscom's Electro-Motor.** — This query can only be answered by someone engaged in the manufacture or who has taken one of the machines to pieces; but it may be said that it is a simple little dynamo or motor about 4in. long over all. Some particulars will be found on p. 387, No. 823. The "alteration" to make it a "dynamo" consists merely in revolving the armature by power, and providing something to take off the current.—C. P. V.

[46820.]—**Piston Ring.**—Hammer it straight again.—Blacky.

[46825.]—**Electric Bell-ringing by Cylinder Machine.**—You will ring your bell much more easily by using a small battery. You can get a piece of copper and a piece of zinc, say, 6in. or 8in. square each, and put them into an acidulated solution, say, sulphuric acid 1, water 10; then join a wire from each to the binding screws on bell, and your bell will ring easily.—W. J. Lancaster.

[46826.]—**Dulling Brass.**—Take one part by weight of iron rust, one part white arsenic, and 12 parts hydrochloric acid, mix. Clean the brass thoroughly, and apply with a brush until the colour desired is obtained; then oil well, dry, and lacquer.—S. D. R.

[46828.] — **Railway Brakes. — G. W. R. Vacuum Brake.**—I am much interested with the description which "North Star" gives of the above brake. Will he kindly favour me with a few further details? How is the vacuum created and maintained—by pump or ejector? When put on, does it leak off, or will it remain on until released? I mean, is it a two-minute brake like we use on the Midland? What kind of hose couplings are used between the carriages? I agree with all which has been said against the use of two-minute brakes, and it may interest all your readers to know that in view of the danger of trains breaking loose and running back down inclines, every passenger-guards' van upon the Midland Railway is now provided with two hand-scotches, to be used as directed by Messrs. Bramwell and Cowper. This seems to me a poor substitute for a really good brake. With regard to the Board of Trade Returns, I noticed lately in the *Engineer* that all failures of brakes are not reported. What is the law and penalty upon the subject? I know for a fact that the returns are very incorrect, as I was once driving a train when the automatic vacuum leaked away and let my train run its full length past the danger-signals. Well, Sir, I reported the case, and it was investigated by my superior. I bought a brake return, and to my surprise found the case reported as one of "Slight difficulty in applying the brake; no delay." You will see that this hushed up the matter, and did not give a true account of the case, making it appear a little matter, when, indeed, it was a very serious one, and might have been more so had not another train started in time.—A Driver.

[46841.]—**Vacuum Pump.**—You must have made some mistake in constructing your pump if air once forced out can get back again. You speak of "the vacuum in G sucking up the mercury in F," but obviously it cannot do that unless air-pressure on outside is greater than in G. Are you sure you have not some leakage? If you can visit the Crystal Palace, in the eastern gallery you will find one of the simplest, quickest, and best of all air-pumps of the kind, exhibited by Mr. Müller, I think, in which the mercury is forced in by elevating the vessel containing it. In this pump the air is dried by taking it through sulphuric acid.—Nun. Dor.

[46842.] — **Estimation of Tannin.** — The following extract from the report of the United States Commissioner of Agriculture for 1880, may possibly be of use to the querist: Of the several methods tested in this laboratory for the quantitative estimation of tannin in the different tanning materials found in the market, the volumetric one proposed by Estcourt, and modified by Löwenthal, has thus far given most satisfaction. This method depends upon the oxidation of a tannin solution by an acid permanganate solution, a definite amount of indigo being added to serve as indicator in the titration. In order to obtain as nearly as possible the reducing coefficient of the tannin of sumac leaves, about 100 grams of the latter, after being powered, were treated as follows, with a view of procuring a sample of nearly pure tannin. An extract was made with hot water, which, after being evaporated to a small bulk, was added to enough alcohol to make the mixture about 80 per cent. alcohol; after filtering, this alcohol was in turn removed by evaporation, and the diluted filtered solution treated with normal cupric acetate, which gave a soft brown precipitate of a compound of tannin and copper. This precipitate, after being separated and washed several times with water, was suspended in water and decomposed with sulphuretted hydrogen. The resulting cupric sulphide was filtered from the solution, the filtrate slightly acidified with sulphuric acid, and, after being neutralised by means of barium hydrate and filtered, was evaporated nearly to dryness, dissolved in 90 per cent. alcohol, and then treated with sufficient ether to form about a 16 per cent. ether mixture; a dark-coloured precipitate of small amount was filtered off, and the solution evaporated upon glass plates. The dried residue was scraped from the glass in scales of a dark-yellow colour. This sample yielded 0.01 per cent. of ash, 0.83 per cent. of organic impurity, 7·25 per cent. water at 100° C. After making deductions for these amounts, 1 gram of pure tannin required for oxidation 0·6239 gram of potassium permanganate, 1 gram of the latter requiring 1·6028 grams of tannin. A sample of gallotannic acid, obtained in the market, was also tested in the same way, and, after making similar deductions for impurities, 1 gram of the tannin required for oxidation 0·7153 gram of potassium permanganate, 1 gram of the latter requiring 1·3981 gram of tannin. In carrying out these titrations, a water solution containing 0 5 gram of tannin in 1,000 grams was used, 25 grams of the solution being taken for each titration, to which were added 20 cc. of a solution of potassium sulphindylate, containing about 7 grams of the salt per liter, about one liter of water and a few drops of sulphuric acid. This was titrated with a one-fortieth normal solution of potassium permanganate, this concentration giving much more constant results than stronger ones. In the above formula the indigo solution requires for oxidation about one-third of the entire volume of potassium permanganate used. This relation has been found to work as well as one in which the indigo present would require two-thirds of the volume of potassium permanganate used, the latter being given by some writers as the lowest ratio in which the indigo should be present in order to secure the complete oxidation of the tannin before the solution becomes bleached. When solutions of the above strength are used, and the titrations carried out very slowly, taking at least five or six minutes for each one, this process serves as one of the best for the estimation of commercial tanning materials; the end reaction, indicated by a change of colour from indigo-blue to straw-yellow, being quite distinct. In testing a sample of bark or leaves, a weight of from two to five grams should be percolated with petroleum naphtha (boiling below 70° C.) in order to first remove as many substances not tannin as possible, and then the tannin extract should be made by percolating with eighty per cent. alcohol, the alcohol evaporated and replaced by water, this solution filtered and diluted to two hundred or five hundred cubic centimeters. Ten cubic centimeters of this solution are then titrated under the same conditions as above described. The amount of permanganate required, less the amount necessary for oxidation of the indigo used, is the amount necessary for the oxidation of all reducing substances present in the extract. One hundred cubic centimeters of the latter are now treated with ammonio-cupric or ammonio-zinc acetate, and the tannin precipitated as a compound of tannin and copper or zinc. After standing a few minutes, the precipitate is filtered off, and the filtrate titrated in the same manner as the original solution. The amount of permanganate required to oxidise the entire oxidisable material of the extract, less the amount necessary for the oxidation after the removal of the tannin, gives the amount reduced by the tannin alone.—N.R.

[46844.]—**Clock.**—If you cannot burr the hand so as to fit tight on the square of the minute-hand spindle or arbor, you can surely drop a piece of wax or something on it when it is in right position. You indicate the remedy yourself when you say the hand is loose. Make it tight—on the proper side, and it will be right.—Horologos.

[46847.]—**Equation.**—To "M. I. C. E."—Thanking "M. I. C. E." for his kind attention, I take the liberty of giving a second solution of the adfected quadratic equation. I would have done so before had not examination work prevented me from writing. As in my first solution, so here, an adfected quadratic occurs in the course of the solution, which has, however—as was pointed out by "M. I. C. E." and Mr. J. Lane Davies—the drawback of having an equation of the 4th degree to be solved; one solution—and the only one suitable—is obvious. I hope this solution will prove satisfactory, for it is quite sufficient that an adfected quadratic makes its appearance in the course of the operation, which, however, must be essential for the further proceeding of the equation. It is not necessary that the final result is found immediately from an adfected quadratic. I almost think that any other way of solving the equation in a satisfactory way is impossible. Usually, when engaged with such an equation, I consider a solution satisfactory which brings out the correct result in a correct way, without limitation to any one method. According to my opinion, the advantage of a method is that it gives a definite mode of attacking a problem, while at the same time one is not rigorously bound to the method throughout, and so may make a departure from it, if it be likely to prove either easier or more serviceable. But then, in the present case, an adfected quadratic was wanted, and this condition I have tried to satisfy. I do not know how far I have succeeded, but humbly submit my solution to your and my opponent's criticism:—

$$x + y + z = 11 \quad \text{(i.)}$$
$$x^2 + y^2 + z^2 = 49 \quad \text{(ii.)}$$
$$yz = 3x(z - y) \quad \text{(iii.)}$$

Since—

$$2yz = (z - y)^2 - (z^2 + y^2)$$
$$= (z - y)^2 - (49 - x)^2,$$

we have, by (iii.)—

$$(z - y)^2 - (49 - x^2) = -6x(z - y)$$

or—$(z - y)^2 - 6x(z - y) - (49 - x^2) = 0$ (an adfected quadratic).

$$\because z - y = -3x \pm \sqrt{49 + 8x^2} \quad \text{(A).}$$

Again, by (i.) (ii.) $2yz = (y + z)^2 - y^2 - z^2$
$$= (11 - x)^2 - (49 - x^2)$$
$\because$ by (iii.), (A) B $= 2(36 - 11x + x^2)$ .... (B).
$$36 - 11x + x^2 = -9x^2 \pm 3x\sqrt{49 + 8x^2}.$$
Or, $10x^2 - 11x + 36 = \pm 3x\sqrt{49 + 8x^2}.$
$$\because 100x^4 - 220x^3 + 841x^2 - 792x + 1296 = 441x^2 + 72x^4.$$
$$\because 7x^4 - 55x^3 + 100x^2 - 198x + 324 = 0$$
$$(x - 2)(7x^3 - 41x^2 + 18x - 162) = 0$$
$$\because x = 2 \quad \text{(C).}$$
$$\because y + z = 9$$
$$yz = 6(z - y) \quad \text{(E).}$$
$$y^2 + z^2 = 45 \quad \text{(D).}$$
By (C) (D) $yz = 18$
$\therefore$ by (E) $z - y = 3$
and by (C) $z = 6$
$y = 3$

—A Medical Student.

[46852.]—**Swollen Glands.**—Let "Inquirer" use a "wet bandage," fastened round the affected part, every night, viz., a pad of linen three or four folds thick, wetted—and squeezed not too dry—outside this a thicker and larger pad to check the drying of the wet one; fasten all round the neck, or the head, according to the situation of the swellings. Put on so tightly that air shall not get in between the wet bandage and the skin, but not so tightly as to impede circulation by pressure. Apply for weeks or months until the lumps are dispersed. In the morning, rinse the pad in clean water, and dry it for use next night.—Experience.

[46900.]—**Mounting. Micro. Lens.**—For mounting a plano-convex with the plane side outside, turn a concave shoulder into which the lens will fit, as truly as you can turn it; then turn a sharp bevel, not a long one, but short and sharp, so that only a little will roll over; put lens in position, hold it there, and burnish over. It requires care, but you would soon do it.—W. J. Lancaster.

[46903.]—**Electric Bell.**—Make the bobbin same thickness as the diameter of core, then let the armature be $\frac{1}{8}$in. away from poles when at rest; then paste on the inner side of armature a piece of thin cardboard; this will prevent the armature sticking, and will prevent any jarring noise.—W. J. Lancaster.

[46905.]—**Incandescent Lighting.**—The question put by "Seaweed" cannot well be answered without trial. The battery named is not suited to the purpose; but if "Seaweed" has the cells and the lamps, he might try for the benefit of fellow-readers.—J. L. M.

[46940.]—**Soap-Making.**—To determine approximately the amount of soda in the leys, "Svenska" must ascertain the specific gravity of the solution—by means of a hydrometer, or otherwise—and then refer to some table which gives the percentage of soda in solutions of different densities. (Bayley's "Pocketbook for Chemists," Spon, 5s., contains the required table.) "Svenska" would, however, obtain a far more accurate result if he determined the amount of soda by means of a standard acid solution. So many degrees "B." denotes so many degrees of Beaumé's hydrometer; a table comparing the degrees of the hydrometers of Beaumé and others, with specific gravity degrees, is also given in Bayley's admirable little book.—Pygmalion Phibbs.

[46941.]—**Soap-Making.**—I have not noticed an answer to "Svenska's" question, and I only write a line to tell him to beware he don't get the Excise upon him, which, unless things are altered, he may do.—Edw. Thos. Scott.

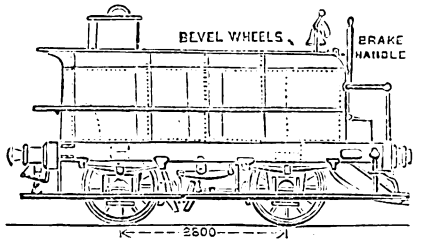
[46944.]—**To Mr. Lancaster.**—Perhaps the simplest method for you to adopt is to drill a hole into the top of the carbons, right through, then widen the hole in the centre, run a wire through, and fill up the hole with solder, then take the wire upwards, and soak the whole of the upper part of the carbon in melted paraffin, and you will have a connection that will last a long time.—W. J. Lancaster.

[46945.]—**Leclanche Battery.**—The carbon, &c., will do again, but you had better have new porous pots; the old ones would be a source of annoyance if used again. Well wash the carbon, &c., before putting into cell again, and add some fresh manganese. Ordinary sal-ammoniac answers every purpose; there is no necessity to pay a high price for it.—W. J. Lancaster.

[46958.]—**Half-Chronometer.**—In correction of reply to same by "T. M.," I beg to say that the reply by G. H. Stockton, which appears on p. 270, is a correct description of the escapement called "Morton's patent," to which the term "lever-chronometer" or "half-chronometer" is quite applicable. But his remark that "it is not liked by watchmakers" is only partially correct. I have never met with any who thoroughly understood it who had any objection to it. It is no more difficult to adjust or repair than the chronometer, or even the lever escapement, and as a pocket timekeeper it is much more reliable, being less influenced by any shaking or motion to which it may be subjected when being carried in the pocket. "T. M." says that "Morton's patent is an escapement never used." To the contrary, I may state that before commencing business on my own account, I was employed by Mr. Morton in the manufacture of his patent watches until he left Liverpool, and afterwards by the man who bought an interest in the patent, during which time a great number of them passed through my hands. Since then I have had many of them in hand for repairs, &c., and only a few days ago I had one to clean. With regard to lever watches being passed off as chronometers, I can only say that I never knew of it being done by any practical watchmaker; but, unfortunately, too many jewellers, drapers, tailors, and such people have lately gone in for the sale of watches, and they mark them up and represent them as being all that is wonderful and good, without having the slightest knowledge of what the articles really are; so whoever goes to buy from them, instead of from practical men who have reputations at stake, must expect to be served accordingly. Plenty of people have the ambition to be possessed of first-class watches, but begrudge a reasonable price for them, and it is such bargain hunters who are always taken in by unscrupulous traders, who are always ready to humour such customers, and extract the money from their pockets by representing the articles as being worth three times as much as they are asking for them, said articles being got up to imitate genuine ones, and to deceive the unpractised eye.—J. C., Liverpool.

[46962.]—**Stereoscopic Camera.**—I gave, some time ago, all the information you require about making a camera, and all that you will have to do will be to make the camera to take a plate 6$\frac{3}{4}$in. by 3$\frac{1}{4}$in.; then have a division in the centre of the camera to keep the two halves distinct, and use two lenses. "Le Merveilleux" is the kind of camera you should make, and the easiest way to go to work would be to make two bodies, 3$\frac{1}{2}$in. square, instead of one wide one, with a division in the centre.—W. J. Lancaster.

[46986.]—**French Locomotives.**—To Mr. E. E. R. Tratman.—The sketches I sent were the elevations of standard fast locomotives for the Western and Northern Railways of France. For ordinary and goods trains there are special types that mark an epoch in the history of the French locomotives. The single driving-wheel engines are not now used for main or branch traffic. These engines have been transformed, either into four-coupled ones or into tank-engines only. We must except, however, the following companies:—Paris-Orleans, two types: the oldest, by C. Polonceau, was built in 1855, according to what is named here, the Allan or Crewe type; the more recent by M. Forquenot, inside frame, outside cylinders and valve gear. The Northern Railway, along with the Eastern, still use the Crampton, the former for the tidal trains. The Paris, Lyons, and Mediterranean Railways had also Cramptons, but, through pressure of traffic, they had to build more powerful engines (1868), and so they sold their Cramptons to the Northern. I must not forget to say that the Northern was the first to adopt this beautiful engine in 1847, whence Mr. Crampton made his money. The adoption of this peculiar system marks the beginning of a new epoch in French practice. Afterwards, the French locomotives borrow from the Crampton all their leading features; the boiler, the regulator-box, the outside gear, mounted on a return crank, designed by Sangnier; all these improvements have originated with the adoption of the Cramptons. The result was, also, that from that time, express outside cylinders would be preferred, since facilities were provided for putting the gear outside. But the Northern Railway of France seems to have taken lately to the reproduction of English practice. I am sending a sketch of the tender of the Western engines. I am sorry I cannot get that of the Northern, as they were only beginning to design it when I left France. It is very difficult to understand why the majority of our tenders in France are only four-wheeled. This one is also mounted on four wheels. It is built like the Great Northern and North-Western tenders—viz., with timber and frame-plate for the carriage. Stilman's brake is used, as is so favourite with the Western of France; this disposition does not at all preclude the use of the Westinghouse brake-cylinder; on the contrary, the Westinghouse disposal is a powerful complement of this peculiar sort of brake. The bell on the tender is for the use of the train's guard; but, as the Westinghouse Company have found that their brake can be made a means of communication between driver, passenger, or guard, this bell is not so important now as it used to be. The following are the dimensions:—Wheel base, 2,800mm.; diameter of wheels, 1,120mm.; Contents of tanks, 6,500 litres; weight full, 21 tons. Plate thickness: External, 4·5mm.; horseshoe, 4mm.; top and bottom, 5mm.—ED. GOBERT, B.Sc., Islington.



[47001.]—**Miniature Electric Light.**—To MR. LANCASTER.—You can have a small globe containing a short piece of platinum wire, and carry some Leclanché cells in your pocket; or you can have chloride of silver cells. But at the best, it is not worth the trouble and carriage.—W. J. LANCASTER.

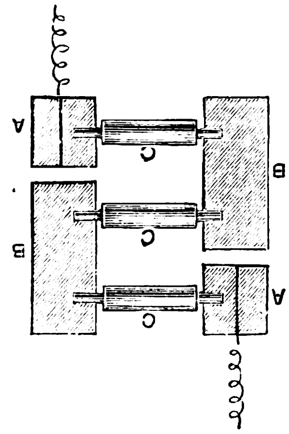
[47007.]—**Photographic.**—Probably, owing to small air-bubbles adhering to the surface of the plates, and preventing the action of the developer. If rocking the tray does not remove them, touch them with the tip of the finger or a small, soft-haired brush. To remedy any which should be overlooked, spot out on negative with black varnish, and on prints with suitable colour. To prevent frilling, if treatment with common alum, as per Swan's instructions, does not answer, try chrome alum, about 20gr. to 1oz. water.—W. ROBINSON, JUN.

[47010.]—**Magneto-Electro Machine.**—Of course you can magnetise the steel magnet with the current from 60 Smee's cells. Wind three or four coils of insulated wire from one end to the other, then send the current through until the magnet will hold up at least 7lb. when the circuit is open. You can use the electro-magnet instead, and magnetise the steel with it, if you have the electro-magnet already made.—W. J. LANCASTER.

[47011.]—**The Voice.**—Good singing is dependent on command of the breath and the muscles of the vocal organs, on good quality of tone, and clear, active pronunciation. Sustaining power can be gained by singing a steady tone until it is possible to hold on for nearly a minute. Inspirations should always be through the nose. The lungs should be filled from the bottom first. The shoulders should on no account be raised in breathing. Good quality can only be produced by making the tones "forward," or by directing the breath to the lips. Nasality is corrected by practising the gape. Flexibility or agility of voice is best attained by practising the interval of a semitone to the word "koo." Strength of lips, tongue, and throat is obtained by practice of alliterative groups of words introducing labials, dentals, and gutturals. Hoarseness and dryness of the throat during singing are often caused by nervousness. The best remedies I have met with for sore throat are Phelps Brown's catarrh cure and an iron tonic, both used as gargles. It is impossible to do justice to this subject in a condensed reply. If the Editor thinks a few articles would be useful, I shall be glad to write them. I shall also be glad to receive any communications, and will reply to any queries which I am able to answer.—J. WALLIS, Ryde, I. Wight.

[47012.]—**Transmitter.**—A pair of Bell telephones will do all you require, and will save a lot of trouble in keeping in order. The articulation of the "bell" is much purer than in the loud-speaking transmitter. You can get any amount of noise, but the articulation is nothing like so clear for so short a distance. I would have a pair of "Bells." You would find a speaking-tube much less trouble than the telephone, and really more efficient.—W. J. LANCASTER.

[47012.]—**Transmitter.**—I inclose sketch of a transmitter which I have found to give good results. The two carbons A A are $\frac{3}{4}$in. square; B B are the same thickness, but $1\frac{1}{2}$in. long; the three rollers C C C are 2in. by $\frac{1}{4}$in., rounded at the ends, and are fitted loosely into the carbon-blocks; a piece of copper wire, 24 gauge, is twisted round the two carbons A A—one end to telephone, the other to copper of battery. The four carbon-blocks are glued on a piece of pine $\frac{1}{4}$in. thick, which forms the lid of a box 9in. by 7in. by 3in. Any question answered.—ELECTRIC.



[47015.]—**Greenhouse.**—Why not cut them square and put an extra pane in. You can get an efficient glass-cutter for 1s. 6d.—W. E. K.

[47016.]—**Repairing Ebonite Dish.**—I should use a little guttapercha applied with a hot iron.—W. ROBINSON, JUN.

[47018.]—**Mus. Bac. Degree.**—To take this degree in Trinity College, Dublin, the candidate must be matriculated in arts, and must pass an examination in the following subjects:—1, English composition, history, and literature; 2, a modern language (Italian, German, or French); 3, Latin, or, instead of it, a second modern language; 4, arithmetic. He must also compose a piece of vocal music, of which a portion at least shall be in five real parts, with accompaniments for a stringed band or organ; this composition, if approved of by the board, is to be publicly performed, in such place and manner as they shall direct, at the expense of the candidate. The candidate must produce a certificate proving that he has studied or practised music for seven years. Before the private grace of the house is obtained, the candidate must pass an examination in the theory and grammar of music, and in thorough bass. He will also be required to write extempore, and within a given time, a piece of counterpoint on a proposed subject. Now, as to fees. In order to matriculate, the candidate will not have to pass any examination except that mentioned above; but I believe he will have to pay the regular entrance fees of £15, which also keeps his name on the college books for the half-year then current; if he does not complete the entire matter during that half-year, he will have to pay £8 8s. to keep his name on for the next half-year, and the fee for the degree is £10 unless the candidate is already a graduate in arts, in which case it is £5: there is also a fee of 30s. for the "Testimonium" of the degree. The half-years commence on 1st April and 1st October, and commencements at which the degrees are conferred are held in October, December, on Shrove Tuesday, and in July. The full score of the musical composition required for the degree must be lodged with the Senior Proctor one month at least before the commencements at which the degree is to be conferred. This is about all the information I can give; but the querist, if he has any idea of taking out the degree in Dublin, should write to Sir Robert P. Stewart, Mus. Doc., Professor of Music, Trin. Col., Dublin, for particulars of the various examinations, and the best time to go in for them; he should do so at once, as the long vacation will shortly commence, and no one will be in college till October. As to time it will take, if querist is able to do it, he can have his degree by Christmas, or, at any rate, by Shrove Tuesday, but, of course, it is impossible to tell how long he will take to prepare for the examination. By the way, does "Medical Student" really know anything about musical degrees at the English Universities? If so, there must have been great changes, at Oxford, at least, of late years, as some years ago residence was certainly not required for musical degrees at Oxford, but I can give no particulars of what is required.—G. J. H., M.A., T.C.D.

[47020.]—**Mus. Bac. Degree.**—Residence used not to be required at Cambridge for a degree in music, but many changes have taken place of late years. A letter addressed to the tutor of any college (Pembroke, Caius, Trinity Hall, for example), would receive attention, and the inquirer would obtain all particulars.—ROSICRUCIAN.

[47020.]—**Mus. Bac. Degree.**—Residence for musical degrees is *not* required either at Cambridge or Oxford. It is necessary first to pass a preliminary Arts test; certain sections of the senior local exam. will suffice. All particulars may be obtained from the University Calendar.—A MUSICAL STUDENT.

[47023.]—**Sea-Sickness**—If the querist will refer to a reply on this subject in Vol. XXVII., p. 532, he will find a remedy on the principle of Dr. Edmunds' recommendation to adapt his body to the motion of the vessel. The reply referred to gives details of how to do this. Lately, I was told by a person who had tried it, that it was successful.—BRICKWALL.

[47032.]—**Stonehenge and Sun Worship.**—In letter 20088, "A Fellow of the R.A.S." promises "Neo" some information about the point of earliest sun-rising. Will he please do the same for me with regard to Stonehenge, as it is very probable that I shall be there at the right time to make a few observations; and should any results accrue, they shall be reported. I think Sun Worship should not have been entered into the question; it seems more likely that the stones which we are noticing—i.e., those pointing towards earliest sun-rising—were placed there for astronomical purposes.—H. STOOKE.

[47034.]—**Dog-Chuck.**—"E. D.," in your number for May 26th, asks for a description of a dog-chuck. The only one I know of that name is an ordinary face-plate used with dogs for gripping work by the edge. Fig. 1 is a front view of same, showing four dogs in position, with pinching screws set radially; but they may be turned round in any position to suit shape of work. The face-plate may be merely drilled with a number of holes, or have four radial slots for use with holding-down bolts, and a number of holes in the intermediate spaces, as well as in the one shown. Fig. 2 is an enlarged view of the dog; it consists of a square-headed bolt, with another screw tapped crosswise through the head. The shank of bolt is inserted in whichever hole on face-plate suits, and is clamped by the nut at back of chuck; the shank should be left as

FIG. 1.

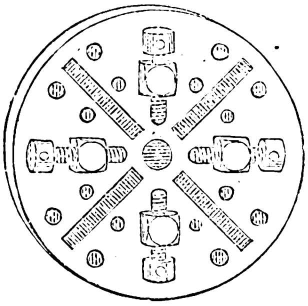


FIG. 3.

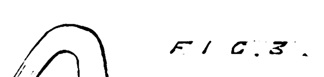
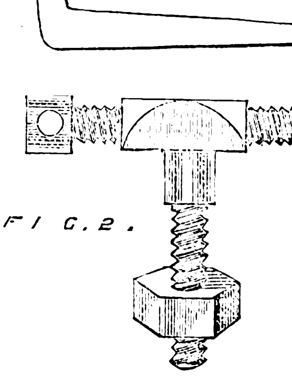


FIG. 2.



long as possible, as it is often necessary to raise head of bolt on washers to suit different thicknesses of work. The heads of mine are 1in. square and ½in. thick, the pinching-screws are ⅜in., and may have a travel of 1in. The plain part of shank is ⅜in., and the screw part ¼in. diameter. Fig. 3 is a Tommy to be used in turning the capstan heads of pinching screws. I often use these dogs on the catch-plate of my lathe when turning square bars of wood or iron between centres, and they serve as both carrier and driver-arm.—F. W. G.

[47035.]—**Safety-Valve for Kitchen Boiler.**—Mr. C. Stuart, of Bletchley Ironworks, makes a novel safety-valve for kitchen-boilers. If you communicate with him, I have no doubt he will send you full particulars of same.—H. A.

[47042.] — **Fixing Alarum to American Clock.**—In these days of electrical science you should state whether you require a mechanical or electrical alarum. Say if latter, and I will reply.—H. Stooke.

[47043.] — **Camera.** — The lens described I should take to be a quarter-plate one (4¼ by 3¼), but the front combination used alone for landscape purposes would probably cover at least half-plate size (6½ by 4¾).—W. Robinson, jun.

[47051.]—**Crutches, &c.**—Tough wood, not too light, is what "R." wants. He will find ash about the best timber to use. On his own (or his joiner's) judgment rests the choosing of a straight-grained piece. We have had more than a little experience in our family.—H. O'B.

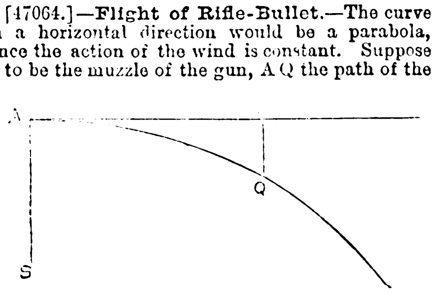
[47053.] — **A Question for Spectrum Analysts.**—Ground glass has no effect whatever upon sunlight beyond softening and diffusing the rays. Unless, therefore, there is something peculiar about the composition of the glass which would render it unsuitable even if unground, some other cause must be sought for the plants failing.—W. Robinson, Jun.

[47062.]—**Plaster Casts.**—Soak the casts in milk, add an atom of boracic acid to keep the milk from turning. When dry, the casts will take a good polish.—Zelia Naien.

[47062.]—**Plaster Casts.** — Casts ought to be left alone after they are taken from the mould, unless the querist understands anatomy and drapery. If he will write again and tell me whether the casts are from a piece mould or waste mould, I might be able to help him. The cast can be made to look a slight creamy yellow if he oils it with boiled linseed-oil, taking care to evenly cover the cast, and that no froth-bubbles are in the corners.—Sculptor.

[47064.]—**Flight of Rifle-Bullet.**—The curve described will be a parabola, with the muzzle of the gun for vertex, since the force of the wind is a uniformly accelerating force. In calculating the deviation in horizontal direction, we may imagine that the force of the wind is the only force acting upon the bullet. Let a denote the acceleration in feet per second of the force of the wind, S the deviation in feet in the time t. Then $S = \frac{1}{2} a t^2$ $\therefore a = 1 / t^2$, since here S = ½ft. Now since the horizontal velocity of the gun is uniform, if the bullet travels 100 yards in time t, it will travel 200 yards in time $2t$, and so on; therefore, in above equation, substituting the value $1 / t^2$ for a, and for t the successive values $2t$, $3t$, $4t$, &c., we get for the deviations at 200, 300 yards, &c., 2ft., 4½ft., 8ft., 12½ft., 18ft.—Slide.

[47064.]—**Flight of Rifle-Bullet.**—The curve in a horizontal direction would be a parabola, since the action of the wind is constant. Suppose A to be the muzzle of the gun, A Q the path of the bullet, and A P a horizontal line. Let P Q be drawn perpendicular to A P. Then by conic sections we have the formula—$PQ^2 = AP^2 / 4AS$; where S is the focus of the parabola. Since the deviation at 100 yards is 6in., we find from the formula, A S = 15,000 yards. $\therefore PQ^2 = AP^2 / 60{,}000$, from which we get required deviations; i.e.,



at 200 yards 24in.
at 300 yards 54
at 400 yards 96
at 500 yards 156
at 600 yards 216

—Hemisus.

[47065.]—**Gaiffe's Medical Battery.** — The cause is that the resistance of the primary suits the cell.—George Tolman.

[47067.]—**Dynamite.**—1. By all means put it in a hole bored for the purpose—in a root as near the centre of the solid part of the root as possible—not the stem, but root; and it breaks better. The stem is more apt to split, but plenty of power will smash it in any case; in a rock towards the centre, but about 9in. deep in a stone 30in. diameter is ample. Avoid drilling into or to a joint, it will take from three to six times the quantity if applied loose on the top or bottom. It is a sheer waste of money to use it so upon roots. 2. All nitro-glycerine compounds will give you a fearful headache after explosion—*i.e.*, the fumes, and much more so if the explosive is burnt and not properly exploded; but all miners avoid going into it till the fumes have cleared somewhat. Dynamite is the worst for doing so, owing to its high percentage of nitric acid which is diffused, as it were, into a fine spray at the explosion, and is inhaled by the men. If you handle it freely or smell at it strongly, you will soon find the headache, and perhaps the most agonising one you ever had; but miners seem to get wonderfully used to it. 3. For that particular purpose dynamite is best—powder is next to useless. For general mining work, dynamite for all wet, close-cornered, or bad ground, still keeps the lead; but otherwise it is quite worth a user's time to see what lithofracteur and tonite will do. Tonite has of late made good improvements, that it amounts to a question of time to prove which is the best universal explosive for mining purposes.—M. C.

[47068.]—**Swelled, &c., Knees and Joints.**—I have proved the efficacy of the two following remedies:—For any swelled or stiff joint, from whatever cause—if the bone seems to be affected—use a poultice of the green herb called "Mouse-Ear Chickweed." It is now (June and summer months) well in season. Chop up fine a good handful of the green plant, put into a clean pan with some nice sweet lard; stir them together over a clear fire until you have the herb cooked enough to make a nice soft poultice. Pour this out into a double piece of rag, and bind it, nicely hot, upon the affected part at bedtime. Of course, you wrap all up warmly. Renew the poultice in the morning. Three or four days should produce considerable improvement. This plant is coarser and larger than the common chickweed. Another: Make a poultice of white bread, or of fine oatmeal very well boiled: sprinkle the surface well with finely-ground cayenne pepper, and apply it to the weak limb, the pepper next the skin. It may be renewed after a few hours—that is, when its peculiar stinging has subsided, and before the poultice becomes dry, which makes it stiff and uncomfortable, as well as useless. I knew a case of incurable disease of the knee-joint, the patient suffering agony when the paroxysms of pain recurred, continually disturbing sleep—a case of years' standing, and quite beyond recovery—but through the soothing effect of cayenne poultices at night, sleep was obtained for five to six hours at a time—sound and refreshing sleep!—greatly to the astonishment of the attending M.D., who had believed that he had previously exhausted all the resources of science, but could not equal the cayenne. It rouses nature to a more vigorous healthy action, and thus promotes the restoration of health.—H. O'B.

[47068.] — **Swelling and Pain about the Knees** —From the description given by "Pontus" of his son's knee, I should think it is very much like, if not the same, as my wife suffered from some 14 years since. If so, and if what I strongly advise him to try does him any good, I shall be amply repaid from the trust placed in my recommendation. My wife's knee got bad very suddenly from a cold caught from walking through some fields. She went to a ball on the Wednesday; on the Thursday she took this walk, and on the Friday morning, about 11, feeling something serious the matter, she sent for the doctor; and when I say she was on her back from that day for three months, you will own she was very bad. The remedy consisted of hot bran poultices applied every quarter of an hour—at least that was the doctor's order—but it could not be done oftener than every 20 minutes at first, owing to the very great difficulty in being able to get them ready. We tried by making them with fresh bran and boiling water; then by pouring fresh hot water to the already-made poultices, and squeezing the surplus water from them; next by emptying the bran into an iron saucepan; but this was found to burn very quickly, and before the bran got hot enough, for you must bear in mind we were limited to, if possible, a quarter of an hour; and, lastly, we were recommended what turned out to be the best of all—viz., to put the (newly-made) poultice into a flannel bag, and sew the end up flat. This was always put into a steamer over boiling water, and the steam playing round it penetrated it so thoroughly that it was always hot enough by the time it was wanted. It must be understood that two poultices were in use at the same time, the one getting hot while the other was on the knee—and they were always placed on as hot as it could be borne on the back of the hand. The clothes were lifted up at the side to change the poultices, which was done for over two months every twenty minutes, night and day, three of us taking our turn to attend to it. Towards the last the knee was painted with iodine, and the leg was put in a guttapercha splint, with the knee slightly bent. This was kept on some little time after she got up; but not being able to use her leg she was at first carried up and down stairs; then the leg was supported while she lifted herself backwards upstairs. After a time she used crutches, and about eight months after that she went to Buxton to the baths, and it was not till she had been there some time that she was able to get about with one crutch and a stick, but when she left she used a stick only. Altogether, she used crutches for twelve months. She can now walk very well, but cannot bend that leg more than at right angles—thus ⅂. The editor has my address, and I shall be very pleased to give "Pontus" any further information should he desire it. I might add, the complaint my wife had was "inflammation of the knee-joint," and caused an accumulation of some soft matter on the upper inside part, and just above the knee-cap, and shows itself now at times very plainly, especially when she has over-exerted herself.—Cured.

[47069.]—**Fruit-growing.**—There is no scarcity of books on this subject—quite the contrary. Your correspondent will find a good one by D. T. Fish, called "Hardy-Fruit Gardening," I think, published at 170, Strand; and the *Journal of Horticulture* office, Fleet-street, also publishes handy books on the subject. Any bookseller up to his business will have a list of the published books, and will be able to give the querist hints as to what will suit him.—Nun. Dor.

[47073.] — **Astronomical Eyepiece.** — The dulness "Tiro" mentions is more likely to be caused by the lenses of the eyepiece having lost some of their polish than through the greenish hue of the object-glass. I have myself a 7in. object-glass—said to be an original Dollond—with just the same tinge, and have no reason to complain of the quantity of light it transmits. I do not say it might not be better if the glass were clearer, but there are a great many chances that it would be nothing like as good, for with all possible objections against lenses of this tint, there remains a pretty fair certainty that they were turned out by the hands of a master who would rather smash a dozen glasses than allow a faulty one to leave his hands. For celestial observations some light would be gained if the erector were removed: there would then remain a Huyghenian eyepiece of low power (perhaps 20 diameters), which would be very suitable for observing nebulæ and star-clusters, and would, perhaps, serve for picking up the lost comet. I have also very usefully employed one of the astronomical eyepieces from a "combination" telescope; these may be bought at about 5s., and if too small to fit the tube, might be made larger by rolling round it a piece of cloth. A Ramsden eyepiece, though not quite so achromatic, is, perhaps, better adapted to a small aperture, as it will give a larger and flatter field. It is also much easier of construction, and "Tiro" would gain much experience by trying his hand at making one. For this purpose, it will only be necessary to prepare a tube of brown paper to fit the eye-tube; this should be 1½in. long, and fitted with an inner tube of the same material, ¾in. long, for the lenses to bed against. The lenses should be plano-convex, both of 1in. focus, and placed as in the diagram on page 259. They may be kept from shifting by placing spare pieces of the inner tube at their outsides. If the insides of the lenses are carefully cleaned before placing them, these pieces of tube may be glued in, as the lenses would never require taking out; but before doing this it would be better to ink the insides of the tubes. Such an eyepiece would give a power of about 40 diameters, and would, I am sure, be altogether so satisfactory that "Tiro" would not be long before he attempted others of greater pretensions.—Aldebaran.

[47077.]—**Casehardening.**—I don't think that K. Paxton (page 315) has any practical knowledge of casehardening; 'tis something novel to my experience to be told that soaking iron in "coal-dust" will convert any part of it into steel. My "Nut" thinks that the oftener steel be "stewed" in a coal fire, the worse for said steel, but the more 'tis hammered (whilst kept square in section) the better will its nature become. (Memo.—This also applies to malus puers). Healthy pabulum for good steel is to be found in a "charcoal fire" only. As to casehardening I would say, if a piece of gas-tubing is not to the fore, rivet up a box of sheet-iron, "fill it with hoof parings and any waste leather do."; rigidly exclude Messieurs Coal, Sulphur, and Co.; lute up the end with clay, and keep at a red heat for three or four hours; take out with a tongs, loosen the clay and plunge the whole concern quickly (before the air has time to act) into a tub of water. (Memo.—Prussiate of potash is the "thinnedest, skinnedest coverer conceivable").—J. J. A., Liverpool.

[47085.] —**Dynamo-Machine.** —To George

Tolman. — Your field-magnets are too small. What is the resistance of the wire on the ring? How many layers on each coil and rows of wire?—George Tolman.

[47086.]—**Picture-Frames.**—I fear that "Salt," page 315, is at sea and out of his latitude when he applies to an ordinary "picture-frame maker" as to matters of taste. I recently procured some mahogany board 1in. thick, sawed it up into strips of various breadths, planed out groove for glass, half-checked together, similar to an Oxford frame, average breadth being 1⅜in. for a picture of 20in. by 14in., got up smooth on front and sides; left some the natural colour; stained others with logwood, "Stephen's stains," then French polished; a gilt, ornamental brass nail (of cruciform shape), in the centre of each of the four intersections. This makes a nice, novel frame, and will last for ages. It is an improvement, then, to frame up the landscape, &c., in ordinary German moulding—viz., frame, glass, mount, and backboard, and then slip this into a frame of mahogany, a couple of sprigs keeping it in situ. I may say that I designed this specially for water-colour subjects provided with large, white mounts, and cannot say what would be the effect in contrast with "oils."—J. J. A., Liverpool.

[47087.]—**Small Launch.**—I would advise "Mariner" to have all his arrangements as to build of boat, boiler, machinery, &c., settled before commencing any one portion, as all depends on suitable combinations. Opinions will differ as to beam, &c. A boat of light build, 18ft. long, with 5ft. beam, should have a speed of 12 knots under favourable circumstances; of course, less in rough weather. I shall be constructing a boat of light draught of "Mariner's" proportions, and shall insure her to course 15 knots an hour. If "Mariner" will send me rough sketch of his lines, I will inform him how he may (with the assistance of any carpenter), quickly build his launch in the very best and cheapest manner; and with the Editor's permission, I will send simple diagrams, with brief description for publication in English Mechanic.—W. H. Phillips, Linden Grove, Nunhead, S.E.

[47090.]—**Tramway into Gravel-pit.**—What does Mr. Booker want to elevate the outer rail for? A horse condemned to walk up such an incline with a load behind him will not go at a dangerous speed, and there is no necessity, so far as I can see, to raise the outer rail at all. Still, it may ease the labour, if your correspondent raises the outer rail, say ½in. I shall watch the replies to this question with some attention, for I am not clear whether any advantage would be gained by elevating the outer rail.—Nun. Dor.

[47094.]—**Combustion of Coal.**—12 of carbon require 32 of oxygen for complete combustion, and 2 of hydrogen require 16 of oxygen—88·42 carbon require, therefore, 88·42 × 32 / 12 = 235·79, and 5·61 hydrogen require 24·88, or 260 67 in all. Since the coal contains 5 97 oxygen, we shall have to supply 260 67 − 5·97 or 254·7, which (since air contains 23 per cent. of oxygen by weight) is contained in 254·7 × 100 / 23 or 1107·4 of air. Consequently 20cwt. of coal will require 221·5cwt. of air.—X. N. X.

[47094.]—**Combustion of Coal.**—Dividing the quantities of C H and O by 5 to get the contents of 20 cwt. gives—

Carbon	17·684 cwt.
Hydrogen	1·122 ,,
Oxygen	1·194 ,,
	20·000

In complete combustion carbon burns to form CO_2—i.e., 12 C combine with 16 × 2 = 32O, so that 12 : 32 = 17·684 : 47·157 gives quantity of O required for the carbon. Air has 23 per cent. O by weight, thus 23 : 100 = 47·157 : 205 cwt. = weight of air required. In like manner we may find the air required for the H, remembering that this forms H_2O in burning completely, and that there is already some O combined in the coal.—Chromio.

[47094.]—**Combustion of Coal.**—The querist gives the assumed composition of a coal, and asks to have it explained to him in plain figures. Now, to find the amount of air needed for the combustion of one ton, I am not quite clear as to what he means by "plain figures," but will endeavour to make the calculation as simple as possible, at the same time telling my friend that he will certainly not understand it unless he knows a little elementary chemistry. One ton of the coal contains ·8842 ton of carbon, which burns to carbon dioxide as follows:—

$$\begin{array}{ccccc} C & + & O_2 & = & CO_2 \\ 12 & & 32 & & 44 \end{array}$$

from which we have 12 : 32 : : ·8842 : x = 2·3579 tons. One ton of the coal contains ·0597 ton oxygen, which may be taken as being in combination with ·0075 ton hydrogen, leaving ·0486 ton available. Hydrogen needs eight times its weight of oxygen for combustion, therefore we get ·0486 × 8 = ·3888 ton oxygen, which, added to the amount required for the carbon, gives a total of 2·7467 tons. In air, only 23 parts in every 100 are oxygen, so we get 23 : 100 : : 2·7467 : x = 11·94. We thus find that one ton of the proposed coal will need nearly twelve tons of air for its complete combustion.—Wm. John Grey, Elswick Science School.

[47100.]—**Loco. Valve-Setting.**—To begin, you will require a trammel, pair of spring dividers, centre-punch, a piece of tin, and a brass plate—but a piece of tin will do; it is to put the opening of ports on. We will suppose the loco. is an inside cylinder, and valves ready to be put in place. You will put one valve and spindle in coupling it to guide, leaving it free from eccentric rods, and, with the strip of tin in front port, draw the valve-edge to it; then with trammel on steam-chest back, on a part of guide which does not become covered in the traverse of valve, put a small dot on line, then place tin in back port, pushing the valve-edge back to it, and mark again on guide. In most inside-cylinder engines you will have to take out the first valve to mark No. 2, because you cannot get your hand between to do it. Well, having done the same with No. 2, you can box-up valve-chest and couple-up eccentric rods; then, with reversing-lever in the second notch (which is the one usually run in), from centre or out of gear, back or forward, as the case may be, pinch the engine (not yourself), but some labourers, while you, with trammel, as each line comes to trammel-point, scratch on guide until valve begins to close again, catching each four ports; then, with dividers, measure each port or opening, marking down front and back port, right-hand fore-gear, or otherwise, as case may be. Well, if the marks on guide are equal, your rods are right; but supposing your front port largest, then your rod is short, and requires lengthening half the difference of the two circles or opening of ports, or shortening the same if front port is the least. The brass plate referred to, if "Dome-Joint" will look at it, he will find is marked with letters—at one end, fore-gear; at other, back-gear; then R.F. and R.B. (right-front and right-back), and L.F. and L.B.; so with dividers and width of marking from centre-pop on guide, you mark quarter-circle, so then when your valves are right the whole will be a complete circle. Anything not plain will answer further.—J. O. E.

[47105.]—**Enamel for Silver Prints.**—The following formula for an encaustic paste is given in the *British Journal Photographic Almanac*:—Pure wax, 500 parts; gum elemi, 10 parts; benzol, 200 parts; essence of lavender, 300 parts; oil of spike, 15 parts. For varnish, mastic is about as good as any, the prints being first sized with a solution of gelatine. Enamelling with collodion, however, gives the finest glaze, and if you think you would like to try the process I will give you particulars. Mr. Newman will, I feel sure, readily answer any inquiries as to his encaustic paste.—W. Robinson, Jun.

[47106.]—**Dry-Plate Photography.**—1. The "simple lens" referred to, although generally called a "single" lens in order to distinguish it from the doublets and triplets also used in photography, is not simple in the sense of being a single piece of glass, but is an achromatic combination of two glasses, usually of a more or less meniscus form. If, therefore, "F. J. N." used a simple meniscus lens, the chemical and visual foci would, of course, not be coincident, and an indistinct image would be the result. Good photographs may, however, be taken with such lenses if, after ascertaining the visual focus, the back of the camera be pushed in a little, the chemical focus being shorter than the visual. The exact distance can, however, only be found by experiment. 2. An emulsion is a combination of bromide, or other haloid, salt of silver with collodion, gelatine, or other colloid body; the term being used because the silver salt is not dissolved, but only mechanically mixed with the gelatine, or other colloid substance used. The changes which take place in gelatine during the process of emulsification are not very well understood. There is usually more or less decomposition dependent upon the time of "cooking" and temperatures employed, and also (I think) a certain amount of chemical combination between the gelatine and nitrate of silver used. 3. Yes, or if common alum does not answer, try chrome alum.—W. Robinson, Jun.

[47110.]—**Template.**—To hammer a sheet of iron or steel, so as to remove all "buckles," is no easy job for an amateur to tackle. In the first place, if a large sheet, we must be provided with a smooth-faced anvil, and the face of the hammer should be slightly convex, or the plate will be shockingly "dinted" when done. Now, let us examine the worst "bulge" on the sheet, carefully study its boundaries, and strike gently all round in gradually widening circles (taking particular care not to strike on any neighbouring bulge, but nicely up to its edge.) Mem.—It is very good practice to try the 'prentice hand upon a buckled tenon saw, or an ordinary sheet of tinned iron.—J. J. A., Liverpool.

[47112.]—**Welding Cast Steel.**—Take the following articles by weight:—5lb. of silver-sand, ¼lb. of common blue, ¼lb. of common soda. Mix together and use as sand.—J. W. Wood.

[47113.]—**Moderator Lamp.**—If the overflow from the wick runs down the outside of the wick-tube and into the reservoir in more than just quick drops, then the oil is "supplied too fast," and this can be remedied by taking off first all the movable brass rings and fittings on the chimney and globe-rests. There will then be exposed two screws, which hold the head of the lamp to the body, take out these—don't drop them inside—the head can then be lifted off *upwards*, a wire will then be exposed. This wire regulates the supply. If too little oil comes the wire is too thick; if too much, too thin; file or exchange as required. If the overflow is not large, then the leather piston is like to be at fault. To get at this the bottom must be unsoldered; take care to wind up a little way first, and make fast the winder until you take the bottom off, or you may burn the leather. Having unsoldered carefully, let the spring down again, clean the leather or supply a new one as needed; you can see for yourself.—Hoinos.

[47117.]—**Tinning Steel Wire.**—The following, taken from Spon's "Workshop Receipts," will perhaps give you the information you require. "Iron which is to be tinned must first be steeped in some acid material. Then scoured and dipped in melted tin, having first been rubbed with sal-ammoniac."—J. R. E.

[47122.]—**Size of Battery.**—You do not say what power your steam-engine is. If above a man-power, better say no more on the subject.—George Tolman.

[47122.]—**Size of Battery.**—You may use a bichromate bottle battery of a pint capacity for each gallon of water you want to raise 3ft. in an hour, but a larger size would be preferable, as it would not require charging so often. You must immerse the least amount of zinc surface that will do the work required. A bichromate battery more suitable to your purpose, and very constant in action, can be made if you put a large piece of carbon into a glass jar, and fill the jar half-full of carbon in small pieces, place the zinc element at the top part of the jar, and use the ordinary bichromate solution. A battery of this kind will drive an engine for a long time, and give no smell if the zinc is amalgamated. I shall be glad to give you any further information on the matter.—J. Sutcliffe.

[47125.]—**Transmitter.**—Certainly you can alter how you think proper, after you have paid for the microphone—not the cases or switch.—George Tolman.

[47125.]—**Transmitter.**—The instrument you describe is what is known as the "combination" instrument, and was designed simply on account of its compactness; but, after a fair trial, its use was discontinued as unsuitable. It is not a patent, and you may alter it in any way you please.—Yoshi.

[47126.]—**Electrical.**—The frost will not affect the working—perhaps crack the cells, which should be placed on a dry floor.—George Tolman.

[47126.]—**Electrical.**—Frost has a decided influence on the working of batteries, reducing considerably the E.M.F. The temperature could be kept up by a petroleum lamp or greenhouse-stove.—Yoshi.

[47130.]—**Decorating Organ-Pipes.**—If "J. E. B." refers to No. 421 he will find several very ornamental designs for organ-pipes.—Cymro.

[47131.]—**Pedal-Pipes.**—Scales:—CCC, 4¼in. by 3¼in.; CC, 3in. by 2¼in. (inside measurement). Lengths:—CCC, 8ft.; CC, 4ft. 2in. The above are actual measurements from a pedal-stop of Bourdon; the pipes, as will be seen, are of very small scale, and are well suited for chamber use. The lengths are taken from the top of pipe to the bottom of the mouth, a short length for tuning being included.—Cymro.

[47132.]—**Hæmorrhoids.**—Gather a handful of crane's-bill, put the same in a pint pot, fill the pot full of boiling-water, cover over. Drink half of this at night; fill up your pot again with water, drink the lot the two following nights. Many ladies and gentlemen whom I know have been entirely cured by this simple herb. If you do not know the herb or cannot get it, and will advertise your address, I will send you a fresh-gathered supply gratis.—Tom B.

[47133.]—**Gold.**—When auriferous iron ore is smelted, all the gold should pass into the reduced iron, from which it can subsequently be separated by fusion with lead.—A. K. Huntington, King's College, London.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last "W. L." has replied to 46495; W. J. Grey to 46549.

46558. Oil for Canvas Belting, p. 114.
46567. Micrograph, 114.
46571. Air-Pumps, 114.
46576. Embossing, 114.
46578. Roof Ventilator, 114.
46580. Governors of American Colonies, 114.
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46766. Lathe, p. 204.
46770. Cold-Air Motor, 204.
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46808. To Mr. Evans, 205.
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46815. Paste for Pottery Transfers, 205.
46816. Sulphate of Baryta in Glue-Making, 205.
46829. G.N.R. Slide Valves, 205.
46830. Spring Pins, 205.
46834. Churchwardens, 205.
46835. G.N.R. Engines, 205.
46836. Chloride of Silver Cell, 205.
46837. Electro-Magnets, &c., 205.

QUERIES.

[47136.]—**Mellogen $C_{11}H_2O_4$.**—This substance is said (No. 897, p. 280) to be obtained from the electrolysis of water by carbon plates. What is the theory of action? Is the carbon from electrodes dissolved by the current, or is the carbonic acid attracted from the atmosphere by the electric current?—ZELIA NAIEN.

[47137.]—**Wood-splitting Machine.**—I want a quantity of thin wood about $^1/_{16}$in. thick, similar to what toy-boxes are made. Will any fellow-reader kindly give a description of a machine for making same?—EVERTON.

[47138.]—**Tapering.**—Will any fellow-reader inform me how to taper or point small circular pieces of soft wood, about the length and thickness of blacklead pencil, the taper to commence about 2in. from the end, and terminate in a sharp point.—EXPERIMENTER.

[47139.]—**Staircase.**—Would any reader of this paper inform me how to put a well in a flight of stairs with four winders in the quarter-space, the string to be cut?—A CONSTANT READER.

[47140.]—**Ampere.**—Will "E." (who has lately favoured us with some capital "Notes on Dynamo-machines") thoroughly explain the electrical measurement known as an ampère?—H. STOOKE.

[47141.]—**Notes on Dynamo-machines.**—May I be allowed to ask our friend "E." what we are to represent the resistance as, which we read off the tan / A e, &c.? Is it noted in ohms? If so, will the resistance read true in ohms, taking the same scale as was used for lines A e, A c (Fig 1). Suppose a machine rotating at a rate of n times, and at that rate I have a current of ten ampères (A e), and the E.M.F. (A C) gives seven volts. Should my resistance read ·35, as being the best resistance for n revolutions?—H. STOOKE.

[47142.]—**Marquetry.**—Would some kind reader inform me how the burning or shading is done in marquetry work? I have a little of it to do;—one portion of it is in the form of a fan, one side of each blade is shaded to give a hollowed-out appearance. It is a pattern very often seen in old work for corner-pieces, &c. The other portion is a bird let out into a sycamore ground stained green. How am I to stain the sycamore green? where can I obtain marquetry veneers ready done in pattern? Also, some narrow stringing in black and white diamonds ⅛in. wide, such as is seen in workboxes of Tunbridge work?—J. R., Liverpool.

[47143.]—**Aluminium.**—I have discovered a method for obtaining aluminium (as an impure alloy with zinc) by a very simple and inexpensive process, direct from the ore which I employ. Will some kind reader give me an easy process to purify it?—I wish to make the process perfect before taking a patent.—ZELIA NAIEN.

[47144.]—**Bending Wood.**—Can any reader tell me how to make an apparatus for steaming and bending sticks of wood, 3ft. long, 1in. thick, and the best wood for bending?—W. P.

[47145.]—**Oil.**—I should be much obliged for a receipt for preparing and purifying light drying oil and linseed oil for mixing with artists' colours.—ROSICRUCIAN.

[47146.]—**Tin Plates.**—Can anyone tell me the process used in tinning the usual sheet-tin plates, as by using spirits of salts I do not get a clean bright surface? What I want is a clean bright surface without having to wipe them while hot, such as you get on tin plates.—A. G.

[47147.]—**Photographic.**—In the picture by an ordinary ¼-plate lens, distant objects, such as a house across a river, are very small. Would a half-plate lens amend this? If so, could the necessary lengthening of the camera be effected at the front end? I see Messrs. Lancaster advertise in "ours" an "instantograph" lens. I purpose purchasing one of these if any of the kind instructors of photographical tyros would please say whether it is possible to adapt it to my existing camera, and so that it could be used at will with its own lens?—PYRO.

[47148.]—**Fogging.**—I took ten views at Keswick on Whit Monday, but they are all more outrageously fogged than any in my previous experience. I changed the plates in a double thick black twill calico sleeve, perfectly light-tight. I wonder, as the calico smells of the size, whether this adulterant chemically affected the film. I am awaiting ferric oxalate to redevelop.—PYRO.

[47149.]—**Changing Plates.**—If plates are slightly cemented together by the back with a piece of black paper intervening, the difficulty of changing them into the dark slides in the field is minimised. As dealers do not supply them thus cemented, I shall be glad if any of "ours" would suggest the best cement, so as not to endanger the sensitive film by damp in the drying. Would a very narrow band of thin French polish painted round near the edge of the glass answer? If so, could the plates be at once replaced in the box, so as to avoid danger from light?—TYRO.

[47150.]—**Steam-engines.**—Will some competent engineer kindly advise me which of the two following engines will work most economically, giving his reasons? Boiler at 50lb., main shaft to run at 120 revol.:—Compound engine, high and low-pressure cyls. 16in. and 28in. diam., 3ft. stroke, 60 revols. per min., driving main shaft off flywheel pulley two to one, with ropes; or, inverted engine, two cyls., each 15in. diam., high pressure, condensing, 22in. stroke, going 120 revols. per min., driving main shaft with equal pulleys.—QUOD DIXI DIXI.

[47151.]—**Washing-machine.**—I wish to know the proper manner of putting axles in washing-machine rollers, if any kind subscriber would kindly oblige—M. H., Hoyland.

[47152.]—**Field-glass.**—How can I separate the lenses of a binocular in order to remove spots which have appeared in the cement. Is it necessary to recement them? If so, is Canada balsam the right thing to use? I would rather not attempt it, than risk injury to the glass, and shall be obliged for instructions.—SPOT-LENS.

[47153.]—**Weston Dynamo-machine.**—Seeing one of the above described in Urquhart's book on "Electricity," will any reader kindly say if a machine constructed on the following principles would generate sufficient current to light an arc or several 20-candle Swan lamps?—A piece of soft iron tube 3⅜in. diam., 9in. long, ⅜in. thick; this to be divided into eight equal parts on the circumference, and at each division a piece of iron ½in. by ¾in. fastened on with screws; in each division No. 16 double cotton-covered wire is wound about 70 yards in each section, making, in the four sections, 280 yards. Also, would it be advisable to build the machine on the shunt principle, or take the current direct to the lamps?—Which is the best? What current (about), if well constructed, will it produce in webers?—ENGINEER.

[47154.]—**To Dr. Edmunds.**—Will you kindly say what is proper diet, &c., for Bright's disease? My wife is suffering from this complaint, and a local medical adviser recommends sedatives—no beer or spirits. Being anxious, I sent her to a West-end physician, who prescribed just the opposite: pint of stout per diem, and gin at bed-time. On stating that she could not take beer or spirits, he replied that she must. Being perplexed what to do, she has asked me to write to you. Her legs swell slightly, and are rather painful;—been so, more or less, about six months. Otherwise enjoys good health—age 40.—CARBON.

[47155.]—**Boehm System.**—Can any of "ours" tell me of a work which embodies the Boehm system for wind instruments? I have purchased Boehm's "Ueber den Flötenbau"; but modern flutes are evidently far advanced beyond his treatise. I want some practical details of the principles, so that I can apply them to a—BASSOON.

[47156.]—**Varnish.**—Please say what sort of varnish is used for dipping small articles, such as hair-pins, &c., that would dry on them without the time lost in heating stoves for that purpose.—W. R.

[47157.]—**Heat.**—Will any of "ours" kindly give the figure representing the ratio of heat lost (by contact with cool air) from substances, with various differences of temperature, according to the experiments and formula of Dulong, and how it is got?—WHEATLEY HILL.

[47158.]—**Oil Immersion Objectives.**—Will some microscopist please give his experience of above in resolving diatoms compared with water-imm. lenses of our best makers?—H. W.

[47159.]—**Heating Greenhouse.**—I have a greenhouse in hand at the present time, which is a source of no little anxiety. It is situate against the back of a very large house on rising ground, and is thus very open. It gets a fair share of S.S.E and S.W. wind. It is fitted up with hot-water pipes, and heated by one of Wright's gas-stoves, about 8in. diam. and 20in. high. All things seem to go well until a down-draught occurs, and then the fumes from the burnt gas become unbearable, as the greenhouse is built round the dining-room window, so as to get in from the house, &c. The vent-pipe from the gas-stove has been taken to the top of the house. This was a great improvement; but still, when a strong wind, the mischief still went on. If any of our readers who have had any experience in these matters will kindly give their assistance, they will be conferring a great favour on—W. R. S.

[47160.]—**Recovery of Silver.**—Will one of "ours" kindly say how the silver can be recovered out of the lead lining of tea-chests? I am sure there must be a good deal of silver in this class of lead, from its behaviour in a galvanic cell, where I have used it frequently instead of silver plates.—POROUS CELL.

[47161.]—**Sulphate of Alumina.**—Will someone kindly describe the process for making sulphate of alumina from bauxite (on a large scale), and also say whether this mineral can be dissolved in hydrochloric acid?—CHROMIO.

[47162.]—**Water Spiders.**—I want some information as to the habits of these interesting insects from one who has kept them. What do they feed on? One of mine once took a fly down into his den. Will they live on peaceable terms with fish, newts, tadpoles, &c., or which fares worst?—JOHN ALEX. OLLARD, F.R.M.S., Enfield.

[47163.]—**Preparation of Bone for Turning.**—What is the proper treatment for bone in order to make it suitable for turning? Is it artificially dried, or simply left in the sun to bleach? How long a time are bones subjected to the drying process, and what means have you of knowing when they are in a condition fit for use?—DRY BONES.

[47164.]—**Microscopic.**—I should be glad if T. J. Sturt, M.D. (letter 20096), or Mr. Lancaster, would give the number and page of the "E. M." in which Mr. Lancaster mentions using a concave lens to increase the magnifying-power of the object-glass, and also if bi-concave means a double concave, or a meniscus spectacle lens? Is the lens above mentioned attached to the eye-piece, or used as an extra object-glass? Please to say in what position in the ordinary student's compound microscope the lens should be placed?—HANDY-MAN.

[47165.]—**Casehardening.**—Many thanks to Mr. Paxton for his answer, but it does not quite explain all I want. He does not say whether I am to immerse box and all in the water, or take out bearings and cool separately. These collars for ball-bearings must be thoroughly hardened, and I want to know how I can harden them so that the casehardened part shall be more than skin deep. Can it be done by heating the collars and dipping into prussiate of potash several times? Also, will the collars scale much in casehardening? If these collars were made of steel, would they be liable to fly in hardening?—CYCLE.

[47166.]—**Glaziers' Diamond.**—Had misfortune to break the spark. Will any correspondent please say if it can be reset?—W. L. P. P.

[47167.]—**Floor.**—In excavating for stores and kitchens under a new shop-floor, I have met with an unexpected and insurmountable difficulty (on account of the great expense)—viz., a solid bed of rough hard stone, judged to be about 4 to 6ft. thick, about 4ft. below the ground-level. Will some correspondent kindly inform me if I could have the shop-floor 2½ to 3in. thick to bear a weight of 3 or 4cwt. being turned on it instead of joist? I think if I had T-iron joist, say about 2½ deep by 5in. wide, but about 4 or 5ft. apart, and filled in between with 2½in. battens tongued or dowelled together, and rest on the inside flange of the T-joist, and screwed from the under side with stout wood-screws. Is this practicable? If so, what thickness should the iron joist be—rolled or cast? Which would be the strongest—battens put straight across from joist to joist, or at an angle? Any hints for a sound thin floor will be thankfully received. Size of floor 28ft. by 20ft. supported under about 14ft. from the end. Will my old friend, "Jack of All Trades" give me advice on the matter?—W. L. P. P.

[47168.]—**Tinning Copper Sheets.**—Will some of our able correspondents inform me how to tin copper sheets on one side? It is required for both common and burnished copper. A sheet measures 4ft. by 2ft. Any information on the above will greatly oblige—COPPERY.

[47169.]—**Throttle-valve.**—I am substituting a small brass "turn-off cock" (about $^3/_{16}$in. bore) for a throttle-valve of my model engine. I mean to affix the lever of the governor to the handle of this cock. I will thank any of "ours" for saying if this will suit as well as the common throttle-valve.—S. MURRAY.

[47170.]—**Blast-Furnace.**—Wanted to know the best method of arranging the charge of ironstone, limestone, and (fuel) coal or coke in a blast furnace in a chemical arrangement, showing each in their chemical order.—BLAST-FURNACE.

[47171.]—**Action in Voltaic Cell.**—Will someone kindly favour me with chemical equations representing the action which goes on in the Bunsen and bichromate cells?—S. H. SALT.

[47172.]—**G.W.R. (B.G.) Engines.**—Will "Clyde," or other correspondent, please furnish dimensions of the following?—Fenton, Gooch, Stag, Sharp, and Dewrance.—J. L. F.

[47173.]—**M.R. Engines.**—Wanted the original dates of the following, also dates of rebuilding and principal dimensions:—2, 3, 7, 23, 29, 41, 110A, 155, 161, 192, 330, and 382A.—J. L. F.

[47174.]—**32ft. Pedal Reeds.**—Can anyone give dimensions of tube-board for 32ft. pedal reeds to be placed under the instrument, and supplied by a separate wind-chest? Could they be made to speak well without percussion?—ARIEL.

[47175.]—**Varnish.**—I shall be thankful for a simple receipt for making photographic varnish. Some of the recipes are too complicated; the ingredients are not procurable except in the largest cities. Nor can I think that there can be much use in such elaborate lists of gums which I find in our textbooks. I want something suitable for preserving gelatine negatives.—VARNISH.

[47176.]—**Broken Tracing-pen.**—My tracing-pen handle having broken off at the brass socket, could you inform me how to get the piece of bone out of the socket?—M. OLLINER.

[47177.]—**To "F.R.A.S."**—Does Loomis's "Practical Astronomy" give the means of finding the true time of new or full moon, together with the elements for projecting a solar eclipse approximately?—A. B.

[47178.]—**Dynamo.**—Will someone give particulars of the "Arago Disc Dynamo," exhibited at the Crystal Palace? Are the cores of armature bobbins wood or iron, and are the F.M.'s on one side of armature all same polarity, or are they alternately N. and S.? Mr. Geo. Tolman promised, a little time back, to give particulars of the little dynamo which he has constructed. I hope he will soon do so.- O.

[47179.]—**Magnets.**—In most of the textbooks the rule is given—the power of an electro-magnet is directly proportional to the strength of the current. Does this mean the intensity or the quantity of the current?—O.

[47180.]—**To "F.R.A.S."**—In Keith's "Use of the Globes," there is a statement that total darkness cannot last longer than 7 minutes 58 seconds; but Dr. Lardner, in his work on "Astronomy," says it cannot last longer than 4 minutes. Will you kindly tell me which is correct?—A. B.

[47181.]—**Boiler.**—I have a steam-engine 2in. cyls., 3½in. stroke. Will some brother-reader kindly inform me what size of boiler I shall require. Also, give me some instructions how to make same.—SLOCUM PODGER.

[47182.]—**G.W.R. Engines.**—Could someone give principal dimensions of No. 1445, wing tank?—N. W., Ealing.

[47183.]—**Brake Trials in Germany.**-Will someone oblige me with details of recent brake experiments near Stuttgart, Germany?—A DRIVER.

[47184.]—**Special Express Train on M.R.**—I shall be glad to know the number of the engine which ran the Prince of Wales special express on Whit-Monday, and the average speed attained.—A DRIVER.

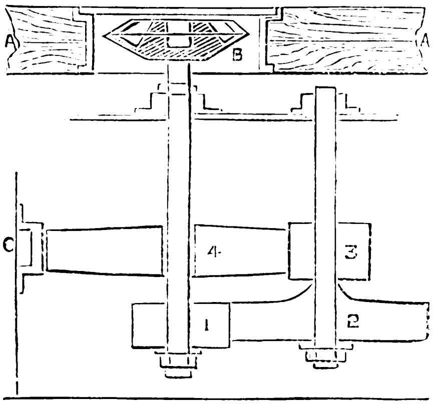
[47185.]—**Embossing Glass.**—To ALFRED W. SOWARD.—I have been trying to emboss glass, but without satisfactory results. I find the fluoric acid eats the glass when dipped in bodily, but can get the ground appearance by placing over the vapour only just sufficient to show the pattern and patchy. Does it matter how close (within an inch or two) it is placed over the acid? Is the common ground or matted glass made in this way, and does the acid lose its properties after using once?—C. W.

[47186.]—**Gum Paste.**—I should be glad of the following information:—1. Preparation of the paste; 2. Treatment when made; 3. Preparation of moulds. Any other information besides the above will oblige—GRECIAN.

[47187.]—**Bacteria.**—Referring to Mr. Thoms' very interesting letter on the above, will he kindly inform me what are the lowest temperatures that the different albuminoids in malt, &c., are coagulated? Also, if prolonged boiling does not take into solution again some of the coagulated albumen? If so, which kind? And also, if such albumen would not encourage the growth of bacteria? A short article on the above, in reference to bacterial life (if convenient), would prove very acceptable to many besides myself.—R. V.

[47188.]—**Medical.**—Will Dr. Edmunds, or some other medical correspondent, kindly inform me what is the handiest and most suitable form of "iron" to take regularly? Suffer from "poorness" of blood, and, as a consequence (I presume), extreme paleness. Digestion rather imperfect.—R. V.

[47189.]—**Bridge Opening.**—Can any reader help me with the following calculation? From the gearing of which I send sketch, I want to find how long it will take to open the bridge (swinging on its centre)—that is to say, how many revolutions of the capstan-head, B, will be required to open the bridge? The dimensions are as follows:—



Gearing: 1st Motion.

	Teeth.	Pitch.	Diameter.
Pinion	11	2¼in.	0ft. 7½in.
Wheel	57	2¼in.	3ft. 4½in.

2nd Motion.

	Teeth.	Pitch.	Diameter.
Pinion	11	3½in.	1ft. 3/16in.
Wheel	33	3½in.	3ft. 9/16in.

Rack:—

Radius	20ft.
Length	40ft.
Pitch	3½in.

In the drawing, A A is a portion of the bridge flooring; B is a capstan-head, and C the rack. The wheels are numbered in the order in which they gear—i.e., 1 gears with 2, 3 (on same shaft as 2) with 4, and 4 with the rack; 4 runs loose on the shaft. The bridge turns on a central pivot, has the gearing in the centre, and is 142ft 8in. long, and 40ft. wide.—RUSSELL.

[47190.]—**Fernery.**—Would somebody give me full instructions for making a small indoor fernery? and oblige—A. HALLETT.

[47191.]—**Loco. Building Shops.**—Will some reader inform me as to whether there are any loco. building establishments at Liverpool or Earlestown?—H. S. P.

[47192.]—**Locomotive Engines.**—I have to thank "Clyde" for drawings and details of L. and N.W. and B.E.R. given by him at my request. I have been noticing lately some of the locos. used on the L. C. D., L. B. S. C., L.S.W., and S.E Railways. The S.E.R. have had some nice bogie-tanks built within the last year or two—Nos. 303-312, 162, 181, &c. Can anyone give details? Also of bogie engines Nos. 19, 36, 176, &c. The small tank locos. built by Mr. Beattie for the South Western are still to the fore. Notwithstanding their low cylinder power, they take seven or eight carriages up Snow Hill in very good style. I notice in my reply to "Netherby" on Caledonian Engines, in No. 890, one or two misprints—e g, "Gamkirk" is printed for "Garnkirk," and "running home" for "running time."—CARSTAIRS, London, S.E.

[47193.]—**Nitrate of Lead.**—What are the most suitable apparatus (and generally adopted) in the trade for the manufacture of nitrate of lead and commercial stannate of soda on a large scale?—LEAD.

[47194.]—**Organ Tremulant.**—Would any correspondent be good enough to give me a description of above, so as to be able to make one and fit it to an organ?—CYMRO.

[47195.]—**Telescope Object-glass Making and Correcting.**—In Vol. XXVI. will be found two interesting letters by Mr. Godfrey on the above subject, and they prompt me to put the following query:—Suppose I buy an o.g. of 3in. or 4in. diameter of the usual focus (say, up to 16 dia.), and on mounting and testing in the manner advocated in back vols. of "ours," I find it not entirely free from spherical aberration. Can this be reduced or eradicated by suitable polishing? and, can it be freed in a similar manner from a slight amount of chromatic aberration? I am led to suppose so from the tentative process employed by Mr. Godfrey as above, and if "Orderic Vital" will kindly read Mr. G.'s letters on page 139, Vol. XXVI., and page 639, Vol. XXV., he will better understand my meaning. I am used to glass grinding, polishing, and correcting, having made a 6in. reflector on equatorial stand, but my terrestrial position is so bad that I am quite shut out from many interesting astronomical phenomena which I could have the pleasure of observing with a smaller telescope on a portable stand used in a front room. My speculum-grinding machine would be useful in the process.—J. C. L.

[47196.]—**Electricity v. Gas.**—Can't you manufacture gas by the action of electricity, and burn the two together in one combination of elements?—FIDDLER.

[47197.]—**Stamping Brass Discs.**—I want a lettered inscription impressed on the edge of brass discs leaving a small space on the circumference to insert small variable device, to be included at one operation. Discs ¾in. diameter, ⅛in. thick.—BARODIS.

[47198.]—**Wet-Bulb Thermometer.**—Having been troubled for a month or so with finding the water evaporated out of the vessel, and the threads and muslin dry in my wet-bulb thermometer, when I went to take my morning observations (the only one my business permits me taking), I have arranged inside the screen a test-tube full 1in. diameter, which is filled with water, having a perforated bung in, through which passes a short piece of glass tube not less than a ¼in. diameter. I tried ⅛in., but it refused to act at all. If the end of the glass tube just passes into the vessel, as soon as the water has evaporated below the level of the mouth of the tube, a bubble of air will enter the test-tube and the water will flow down, restoring the original level. An inverted flask is easier to fix than the test-tube, needing only the ring of a laboratory retort stand, but it has the disadvantage of occupying too much of the air space within the screen. The idea was suggested to me by using the balloon battery—a modification of the Daniell.—JOHN J. GILBERT, F.M.S., &c.

[47199.]—**Winds.**—The usual explanation of wind is that it is the atmosphere rushing from a place of high barometer to one of low barometer, which is so far satisfactory; but what is the explanation of (1) those long howling gusts, and (2) the short chopping gusts which appear to come in turn from all points of the compass? We have had too many lately.—F. M. S.

[47200.]—**Indurated Liver.**—Can Dr. Edmunds or any reader tell me if there is a cure for induration of the liver? I have a relative aged seventy, but of a sound vigorous constitution, who is now suffering from it, and one medical man who has been attending him some time, holds out no hope of his recovery, whilst another who has recently been called in considers he can cure him. Which of them is right? An assurance one way or the other would be esteemed by—AN ANXIOUS ONE.

[47201.]—**Instantaneous Photography.**—I have an apparatus which is said to be specially made for the most rapid work, objects in motion, &c. I have tried it with the instantaneous shutter on some clouds, but the plates were not acted upon at all. I was advised to make a longer exposure; but, as I expected, the movement of the clouds made them almost shapeless in the photograph. Any information will greatly oblige—TYRO.

[47202.]—**Extraordinary v. Otto.**—Will anyone say which is best and safest for a hilly country and rather rough roads?—W. L.

[47203.]—**N.E.R. Locos.**—Can "Meteor" or others give us a sketch and principal dimensions of the passenger engines (Nos. 1160 and 1161) built at Darlington about 1875? They are commonly called Quakers, having square cabs.—CLEANER, York.

[47204.]—**L. and N.W.R.**—Can any readers of "E.M." tell me why the engines on some of the local lines (Stafford to Rugby) have two throttle-valves or starting-levers? An explanation will oblige—CLEANER, York.

[47205.]—**Anemometer Indications.**—What is the meaning of the following passage in the Greenwich Visitation Report?—"The vane of Osler's anemometer made in the year 1881, fourteen revolutions in the positive direction N.E.S.W.N." I understand it that the wind, instead of changing from N. to S., say, went steadily round the compass, and did that fourteen times in the year.—F. M. S.

[47206.]—**Dry Plate Developer**—Will Mr. Parkinson say whether the addition of citric acid added to the pyrogallic acid and water will make the solution keep some time? I prepare a quantity of ammonia solution, and always have to weigh my pyro and mix just before use, and I should like to prepare a similar quantity of the pyro always ready, and Swan's formulæ now adds citric acid. And, how can I make my gelatine so that it will keep for mounting prints?—F.

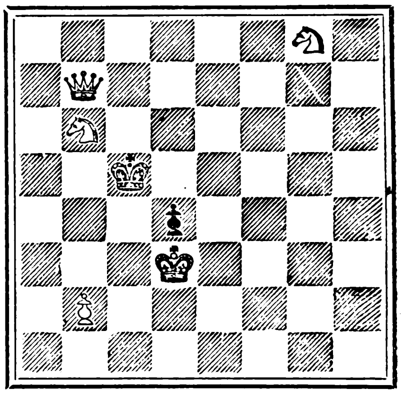
[47207.]—**To "Ll. B. A."**—In letter 20130 you do not say what size the German silver wire which is stretched on Fig. 2 is, and how many ohms resistance. Also, what purpose will the excess of wire on the frames (Fig. 1) which is beyond the point where the copper wire is soldered be for? Am I right to assume that one end of coil and the copper wire connected to same are to be joined as at Fig. 5?—NOSBEDNA.

CHESS.

ALL Communications for this department must be addressed to the Chess Editor, at the office of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCLV.—By W. COATES.

Black.



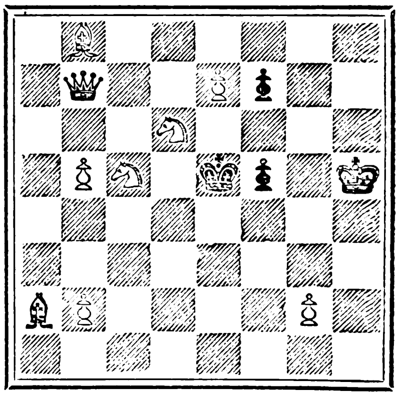
White.

White to play and mate in three moves.

PROBLEM DCCLVI.—By "NUT-SHELL."

From the *Chichester Parochial Magazine.*

Black.



White.

White to play and mate in two moves.

Solutions to above problems are invited.

SOLUTION TO 751.

White.	*Black.*
1. Q to Q Kt 6	1. R or B takes Q (a)
2. Kt takes P	2. Anything
3. Mates	
	(a) 1. Kt takes P, &c.
2. Q to K Kt sq	2. P or K takes Q
3. Kt mates	

This admits of a second solution beginning 1. Kt takes K B P.

SOLUTION TO 752.

White.	*Black.*
1. B to Q B 4	1. K to B 6 (a)
2. Q to Q B 5	2. Anything
3. Q or B mates	
	(a) 1. K to K 5 (b)
2. Q to Kt 4 (ch)	2. K moves
3. Q mates	
	(b) 1. K to K 4
2. Q to Q B 5 (ch)	2. Moves
3. Q mates	

If 1. $\frac{\text{Q to K R 5}}{\text{K to B 6}}$ 2. $\frac{\text{B-K B 8}}{\text{P moves}}$.

WE have been informed that this problem is by Mr. F. Arthur Hill. It was his first composition, and appeared in *La Semaine Française*, the *Illustrated Sporting and Dramatic News*, in Italy, and America.

NOTICES TO CORRESPONDENTS.

Schmucke.—Thanks for the problem, which, if up to the mark, shall be inserted. Your solutions are generally very accurate. Those to 751 and 752 are correct, though that to the former is not the author's.

The following epigrams on "a cooked problem" have won the prize in the *British Chess Magazine* Competition :—

No. 1.—By Mr. W. F. Payne, Abingdon :—

Behold, disastrous fate—a problem cook'd !
'Tis like some castle safe from front attack,
To which, a little loophole overlook'd,
A knight gains fatal entrance at the back.

No. 2.—By Mr. J. A. Miles, Fakenham :—

Like new-laid eggs, Chess Problems are :
Though very good, they may be beaten ;
And yet, though like, they're different far—
They may be cook'd, but never eaten.

ANSWERS TO CORRESPONDENTS.

◆◆◆

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded ; and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, June 14, and unacknowledged elsewhere :—

Prof. Larmor.—G. Bower.—J. Parnell.—J. Robinson.—H. Harris.—Chance Bros.—A. Forster.—R. Lewis.—T. McNally.—F. d'Alquen.—C. Birchall.—Gereb Admi.—Don Carlos.—H. S.—Burette.—Rev. J. J. M. Perry.—A Poor Irish Boy.—J. H. Evans.—G. J. C. E.—Brick Kiln.—Phonetic.—Frank Smith.—Mide.—A. J. Smith.—An Experienced Old Hand.—J. H. A.—Amateur.—Old R'way Grease.—H. Painter.—C. H.—Adonis.—Beta.—J. H. W.—E. Thomas.—R. Kanthack.—Ligurian.—E. L. P.—Orderic Vital.—G. Tolman.—E. W.

W. E. H. (The question was answered with illustrations in Nos. 818, 819.)—D. Packer. (Thanks. Scarcely of sufficient interest to occupy space in our columns.)—Wheatley Hill. (In Vol. XVIII. you will find a series of articles on the Theory and Practice of Coal-Mine Ventilation, which may give you the desired information.)—C. W. (You will find replies to definite questions in back volumes ; but we should recommend you to procure one of the handbooks—say, Gedney's "Parrakeets, Parrots," &c., published at 170, Strand, W.C.)—N. W. Ealing. (The second query is beyond us ; it has nothing to do with the merits of the brakes.)—New Reader. (There are many in back numbers, some even in present volume ; but possibly the best for you was that described on p. 332, No. 846.)—East Anglian. (You understand that much depends on the nature of the ink. Cyanide of potassium will remove the ordinary make, but that is very poisonous. You can try soaking well in permanganate of potash, Condy's fluid, and then go over with hot solution of oxalic acid.)—Handy Man. (Instructions for binding periodicals on p. 377, No. 770.)—Matthew Olliner. (You can only make it thicker. 2. Liquids : all chemists and druggists sell them. Get Valentin's "Lessons in Inorganic Chemistry," Collins, Sons, and Co. ; but if you wish for experimental chemistry, you can have nothing better than Prof. Reynolds's little book, published by Longmans. You will find out about old and new as you go along. It has nothing to do with practical chemistry.)—Stick in the Mud. (Any of the electrical dealers will supply you with the proper covered line wire. The method of connecting up circuits and bells or "calls," was fully described and illustrated on pp. 67, 87, 111, of this volume.)—F. J. A. (We gave the description on p. 77 of this volume. The invention consists in the "solution," which is presumably used in the Bunsen cell. It is doubtful whether it is better than the ordinary solution, and the use of the battery will be attended with considerable expense.) — W. Wright. (If none of those described in back numbers will suit, we are afraid we cannot help you.)—Novice. (If you are to study it for its own sake, get Sprague's "Electricity," published by E. and F. N. Spon, Charing-cross ; if to pass an examination of the Science and Art Department, procure Guthrie's "Electricity," published by Collins, Sons, and Co.)—F. C. (A paper was read last year at the Musical Association, we believe, which was followed by a discussion ; but the general opinion was "both." As to the character of the pieces, that is immaterial.)—One who Wants to Excel. (Apparently a modification of the Daniell, but not an improvement. If you want to make a cheap battery for ringing bells, see p. 308, in last week's number, or p. 5 of this volume.)—Musical. (Both have their appropriate places, but the flute is no doubt the easiest. You should procure a good instrument, not necessarily a high-priced one. See the indices for a full discussion of the subject.)—Core Boy. (Your first query was answered so recently as May 12, and the others in back numbers. See p. 140, No. 864.)—A. E. C. (We do not understand what you mean by "analysis." We know of no book devoted to the branch.)—Agent. (The doctors are right—Dr. Edmunds could tell you no more.)—Wm. Johnstone. (We fear we can give no advice worth taking. Probably you might do well at Sydney, if possessed of capital ; but we hardly think you would much better yourself if a workman.)—Theta. (We never heard of it. There is the *Chemical News*, a small weekly paper, which can be ordered through any newsagent.)—Geo. Powell. (We have a letter in type from Mr. Tolman, giving instructions for the construction of a small dynamo-machine. It anticipates most of your queries.)—Jimbo. (Both queries had been answered in back volumes. Nobody can answer such a vague question as that about the Smoke Abatement Exhibition. The awards were made in different classes, and were duly published at the time.)—A New Subscriber. (Probably rheumatism.)—Electrician. (Pack a carbon plate in a porous pot with equal parts of well mixed gas carbon and binoxide of manganese both about the size of hempseed or peas, but free from dust. It is usual to seal the cells with pitch. Place it in a jar of less height than the porous cell, and pour into the jar a solution of sal-ammoniac, to about two-thirds fill the outer vessel. In that place a zinc rod, and the cell is ready for action. 2. As we do not know the lamp referred to, we can say no more, except that you have decided on very insufficient evidence. 3. How can any one tell the cause of your failure without examining the coil? You say that everything is all right, and yet you get no result. Try again, reading up the directions. See p. 313, last number.)—G. P. Renshaw. (Thanks, but we fail to understand how the brake has been rendered more efficient by the use of a tell-tale gauge : that such a device should be thought necessary is a practical confession that the brake is not altogether satisfactory.)—John Norman. (The best made in this country are composed of emery and water-glass—silicate of potash,—cast in moulds and subjected to pressure, we believe. Never heard of them being used for the purpose, and think them scarcely suited.)—E. Hardcastle. (We believe we have given every tried or proposed process for silvering specula—in some cases many times. See p. 111, No. 863, and the index of the last volume, or any other you have.)—L. H. Jacobsen. (It is not clear what the new discovery is, for the grain of wheat, if there is one, is hidden in a bushel of chaff. We have not space for matter of that kind.)—Ariel. (Castile soap and cuttle-fish bone of each 2oz. in fine powder ; honey of roses, 5oz. Make as liquid as you please.)—Z. 99. (Next time kill the spirits of salts with zinc. It is only of use in its simple state when zinc has to be soldered ; but for the present purpose use rosin, as acid should never be used in soldering electrical connections.)—Heywood. (Ask for dextrin, and dissolve it in water.)—Gilbert. (Carbons for batteries should be cut from the "scurf." It is laborious work, as you say ; but there is no help for it. We believe sticks of the size you mention can be bought for about 9d. each. You can cut them with notched hoop-iron and sharp sand or emery. All this has been stated many times in our columns.)—J. W. Wood. (The carbons used in electric arc lamps are compressed by very powerful machinery. The "ends" you have may be utilised when crushed for battery purposes, or possibly for remoulding, but it depends upon the material to a certain extent.)—Amateur Tinker. (Both queries answered very recently. For japanning tin, see p. 238, No. 868 ; cold soldering, p. 81, present volume.)—R. H. H. (Yes, it will do, the wires as large as you please. See p. 308. You know that you will want a coil. See p. 313, last week.)—Yankee Doodle. (You can easily contrive to see one of the lamps ; but our readers would not thank us for illustrations and descriptions of such well known devices. If you want to make a simple lamp, look through the last four or five volumes, and you can take your choice.)—J. J. W. H. (Dr. Edmunds has answered both questions very fully ; varicose veins on p. 211, No. 867, and indigestion in many numbers.)—H. W. (Only the man who has left the country, according to your account of the case, could bring any action against you ; but you are, of course, liable at any time to interference by him should he return.)—An Old Reader. (The strong probability is that your unfortunate relative is *really* insane, and that you will go mad, too, if you pursue such practices. If your other relatives choose to fill the pockets of "mediums" and other impostors they must ; but surely your Scotch common sense should tell you that you are all being humbugged or swindled.)—H. Lawes. (We replied to you last week on p. 317 under the signature of "Beginner," which was appended to your first letter.)—A Constant Reader. (A fatty tumour, which any surgeon will remove, if necessary—probably its removal is not necessary.)—A Would-be Artist. (Do not attempt it : all necessary for your present requirements can be procured at the colour-shops ; by-and-by, perhaps the merits of your works, like those of the old masters, may partially depend on your colour-mixing.)—C. H. (Mr. Wetherfield is good enough to reply to questions, but we cannot ask him to waste his time and our space with extracts of evidence, &c., which you would probably misunderstand, and which could certainly interest no one else ; (2) query next week.)—Ignorance. (Scores of recipes have been given from time to time in back vols.)—Carino. (We really cannot trace the query to which you send the reply. You give the wrong number, and no heading, and it is evidently some time back.)—A. J. C., E. L. P., C. H. Domaille, J. H. Huxley. (In type.)

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A pair of well-finished **Needle Instruments** in good order, platinum contacts, new coils, thoroughly reliable. Offers.—Logan, St. Cross P. O., Winchester.

Will exchange my beautiful collection of **Conjuring** Tricks cost 15 guineas, for good Flutina or portable Harmonium. Anything in music.—A. Spreadborough, West-street, Farnham.

Landscape Cameras, 8½ Square and half-plate, with dry-plate backs. Exchange for a good perambulator. Stamp for reply.—Wills, 116, Rotherfield-street, N.

Exchange 9 by 7 folding **Camera,** two double dark slides, hardly used, cost £6 6s. ; for Empress of India Sewing Machine, new.—Jeffrey, Cheltenham.

Engine cylinder 8¼ by 3¼, metallic piston, slide-valve and rod. Splendid stop-valve, all fitted ; cost £5. What offers?—F. Houghton, Dogget's-square, Strood, near Rochester.

Two patent **Gas Fires** (Wright's), complete, new ; easily fixed, easily lighted and put out, no dirt, cost 32s. each. Exchange for tools.—W. R. Slater, Sunderland.

Howe Treadle **Sewing Machine,** in good working condition, Duncey Telegraph (new), pair Telephones, large Dulcimer. Exchange any for Tinsmith's Tools, Copper Urns, or offers.—W. R. Slater, Sunderland.

"**English Mechanic,**" unbound, Aug. 22, 1879, to Oct. 14, 1881, clean, perfect. What offers? Want work by Proctor, Huxley, or Darwin.—Grandy, Ringwood, Hants.

Quarter-horse **Engine** and riveted Copper Boiler (loco. type), steam and water gauges, safety valve, &c. ; also ten feet of inch steel shafting, three hanging brackets and three pulleys. Lot £10, or exchange, or would sell separately.—J. H., Box 180, Sheffield.

Lathe, 3in. centres, back-geared, 4ft. 6in. bed, chucks, tools, &c., complete, nearly new. What offers?—W. Buckley, Walter-terrace, Harpurhey, Manchester.

Oil and Limelight **Dissolving View Apparatus** for Screw-cutting Lathe, Twist Drills.—D. W. N., Ernest Cottage, Peyton-place, Royal Hill, Greenwich.

A one-horse **Water Motor** in exchange for a good Perambulator (rubber tires), or offers.—Wm. O'Brien, 113, Haddington-road, Dublin.

Rose Engine **Lathe,** wood bed, slide-rest, universal cutter, overhead motion, tools, drills, &c. Exchange good microscope.—J. Turpin, Drighlington, Bradford, Yorkshire.

Small Six-shot **Pocket Revolver,** in case. Exchange small Coil or Telephone.—T. Burden, Yetminster-road, Farnborough, Hants.

Sociable **Tricycle**, for two or three persons, cost £24, nearly new condition. Exchange good Photographic or Dissolving View Apparatus, or offers.—Wright, Photographer, Northampton.

House, Garden, Outhouses, &c., in healthy situation near London, for House and land in Kent, Sussex, or Surrey.—Newsagency, Northcote House, Sydenham-road, Croydon.

Wanted, new 6in. Screw-cutting **Lathe** in exchange for 2 H. P. New Launch Engine.—"Alpha," Dover.

Insulated Wires. Offers of machinery requested for a quantity of Guttapercha Covered Wires. Copper, 7 wires, No. 22; Gutta, No. 1.—"Alpha," Dover.

Quantity of "**Engineers,**" bound and loose. What offers cash? or exchange machinery.—"Alpha," Dover.

7in. Bourdon Pressure (30lb.) and **Vacuum Gauges** Offers requested, cash or exchange.—"Alpha," Dover.

Wanted, a good **Plane** and Shooting Block for picture-frame making.—Bell, Belbroughton, Stourbridge.

Pulvermacher's **Medical Chain Battery**, with shocking coil, warranted perfect, almost new; cost £4 4s.; exchange for set of Tricycle Wheels, or offers.—John Fairhurst, Deansgate, Hindley, Lancs.

Bicycle (48in.), in thorough good conditon, cost £10. What offers in exchange value above £5.—G. Moore, 59, Westbourne-road, Barnsbury, London.

Will exchange a 19½in. Plate **Electric Machine**, in perfect order, with Leyden jar and discharging tongs, for two good Telephone Transmitters.—Fred. Walker, Hambleton House, Moor Town, Leeds.

Pair of 6in. **Lathe Heads** for 5ft. planed bed, 6in. on face, strong.—Send particulars to 47, Dudley-street, Luton, Beds.

Exchange anything useful. 23 numbers "**English** Mechanic," 22 numbers "Metal World," and six monthly parts "Amateur."—J. D., 52, Park-street, Limehouse, E.

Vertical Copper **Boiler**, 12 by 6, riveted, five tubes, water gauge spring lever safety-valve; exchange.—A. W., 62, Cranham-road, South Bermondsey.

Half-horse and one-horse **Engine Castings**, cylinders bored, &c.; or two-horse ditto. Offers.—James Sutcliffe, Engineer, Princess street, Granby-row, Manchester.

Medical Coil, Galvanic Battery, Engines, and Lathe Castings, Field Glass, Screw Press, "English Mechanic," "Engineer," &c. Offers.—James Sutcliffe, Princess street, Granby-row, Manchester.

Antique Pipe Organ, 3 stops, mahogany case, pedals, good maker: for Tricycle, Lathe, or offers.—Hill-top, Walwood-road, Leytonstone, E.

THE SIXPENNY SALE COLUMN.

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For Sale.

Lantern Photographs, 10,000, with readings, from 6d. plain, 1s. coloured.—A. Pumphrey, Emily-street, Birmingham.

Gelatine Films for photographs, reduce cost and labour of photography to minimum.—A. Pumphrey, Birmingham.

The **Filmograph** carries 100 films or 12 plates. Lightest Photo. Apparatus. Illustrated tests.—Pumphrey, Birmingham.

Filmographic Manual, free 6d., with photograph from Film Negative. Full instructions. Films, Filmograph.—A. Pumphrey, Birmingham.

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Collographic **Photographs** for Machinery and Trade Patterns. Sample and list for 2d.—Pumphrey and Day, Birmingham.

"**The Night-light Clock.**" Illustrated and described on page 370, No. 848. Price, carriage free, 5s. 6d.—F Robertson, 13, Greek street, Soho, W.

Complete **Practical Instructions** for performing Experiments in Mesmerism, electro-biology, &c., free, 5s. Usual price £1 1s.—Hezmalhalch.

Bachelor's **Brace Buttons**. No coming off. No sewing. Last lifetime. Packet free, 14 stamps. Wholesale.

New "Eclipse" **Pipe**. No oil in mouth. No smoking wet tobacco, 2s. free.—J. Hezmalhalch, 1, Fellscliffe, Leeds.

Lathe, 3½in., 3ft. bed, screw-cutting, slide-rest compound, set change wheels, chucks, &c., second-hand, good as new, £11.—Makin, Cupola, Sheffield.

Stocks and Dies, now in extensive use. List one stamp.—F. M. Rogers, 21, Finsbury-pavement.

Electric Lighting.—Inventors wishing to perfect, patent, or sell inventions connected with electric lighting should communicate with F. M. Rogers, 21, Finsbury-pavement, E.C.

Minerals, 100 good specimens, including sapphire, ruby, topaz, emerald, opal, all named, different, 10s. Apply for list. Also many finer, rarer specimens.—Collector, Richard's Library, 42, Tachbrook-street, Pimlico.

The best **Ebony Stain** for wood, sample bottle 6d. —R. M. Hands, Westbourne, Bournemouth.

Tourist ½ **Camera**, slides, lens, shutter, tripod, chemicals, &c., all perfect, £3 10s.—Photo, 51, Legh-street, Warrington.

Metallic "E" **Violin Strings**. Infinitely superior to gut. Four post free 1s.—Smith, 2, Bedford-street, Plymouth

Metallic "A" and "E" **Violin Strings**, acknowledged success. Six, post free, 1s.—John Elarco, 36, Kelvin-grove, Liverpool.

Micro. Photos.—List of 350 one penny stamp.—E. and A. Dancer, 436, Stockport-road, Manchester.

New loud **Violins**. No back or soundpost, 15s., 20s., by "Fiddler," 19, Edward street, Burdett-road, E.

Lathes, Lathes, cheap good screw-cutting, from £10. Easy payments. Hire system. First-class tools.—Makin, Cupola, Sheffield.

Electrical Depot and Manufactory.—Millar's, 126, Chapel-street, Salford. Handiest shop in the trade for amateurs.

Electric Lamps, 5s.; Bells, 5s.; Batteries, 2s. None better or cheaper. Instruments repaired.—Millar, as above.

Slide-rest, 10in., 40s. Engine, about 1-horse, 45s. —231, Swan-road, West Bromwich.

Combined **Engine and Boiler**, cylinder 5in. dia. y 10in. stroke, £19.—231, Swan-road, West Bromwich.

Superior 4½in. **Slide-Rest**, good design, quite new, remarkably cheap.—F. Hodges, 186, St. James-crescent, Gloucester.

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6in. single **Headstock and Poppet**, superior make, new. Cheap.—F. Hodges, 186, St. James-crescent, Gloucester.

Watches! Watches!! Watches!!! 7s. 6d. each, sent free per post.—J. Dalby, 6, Albion Hill, Leicester.

Second-hand **Model Steam Engines**, Scientific Instruments. Catalogue 2d. post free.—John Bateman, 131, High Holborn.

Splendid set of **Gas-Engine Castings**, cylinder 2¼ bore, 4½ stroke, cheap.—T. Warsop, Patterdale, Penrith.

Astronomical Telescope. I will take £1 for a Telescope of great power, 5ft long, with garden stand, made by my late husband.—M., 35, Euston-grove, Claughton, Birkenhead.

Beautiful Instantaneous **Photograph** of Swarm of Bees, 8 by 6, mounted, 2s.; unmounted, 1s.—C. Woodhead, Hitchin.

Safe for Sale, fireproof, 30 by 20 by 18in. outside, cash drawer, patent lever lock, perfect condition, 2 sets keys, price £5, delivered.—Richard M. Lord, Wolverhampton.

Corn Bin, galvanised iron, holds 8 bushels, price 35s. delivered.—Richard M. Lord, Wolverhampton.

A Dallmeyer Triplet **Photo. Lens**, No. 1 by 7in. focus, equal to new, price £2 10s.—F. Clark, Slip End, Luton, Beds.

English **Concertina**, splendid condition, cost seven guineas, for £4. Send for particulars.—Hallett, Sturminster, Newton, Blandford.

Hæmorrhoids.—Internal Piles. Spencer's carefully prepared Pills give immediate and permanent relief from this distressing complaint.

Piles.—Spencer's Pills cure when all other remedies (so-called) have failed. They contain nothing dangerous.

Hæmorrhoids.—Spencer's Pills, 2s. 1½d. per large box post free.—S. Spencer, 26, Dysart-road, Grantham.

Photographs, Scottish Scenery (extraordinary value), 7in. by 4in., price 4d. each.—Finlay, 135, Renfrew-street, Glasgow.

Wonderful **Luminous Watch Box**, 12 stamps. Luminous Stars, 4 stamps post free.—"Photo," 182, Trongate, Glasgow.

Jet Black Quick-drying **Endorsing Ink**, for numbering machines, rubber and other stamps. An excellent article. Sample bottle eight stamps.—William Guest, Ormskirk, Lancashire.

Hydraulic Organ Blower, worth £10, will take £4 10s.—C. Bayley, Cyprus House, Parkstone, Dorset.

Photographic.—Negatives developed, intensified, retouched or printed, or work of any kind done for amateurs on very reasonable terms for good work.—N. Mackie, 2, Derby Houses, West Croydon.

Britannia No. 1 **Lathe and Fretsaw**, with all accessories, £5 10s. Cradle Spring, 10s.—Walters, 50, Watlington-street, Reading.

Microscopic Objects.—Diatomaceæ arranged in groups. Arachnoidiscus Japonica, Heliopeltæ Melli, Ithemia Enervis, and Autacoidiscus, 4 slides best mounts, 3s.—W. White, Warden-place, Nottingham.

6in. Slide and Screw-cutting Treadle **Lathe**, 6ft. gap bed, 6in. Self-acting Treadle Lathe, 4ft bed, 12in. by 14in. Planing Machine with shafting, slotting, and drilling combined; chucks for all. Also one-horse oscillating Engine and Boiler. Lot £80.—C. W., Castle House, Epsom-common.

48in. **Bicycle**, roller bearings, lamp, oilcan, spanner, &c., £3. A bargain.—H. Miller, 1, Manor Villas, Great Berkhamsted, Herts.

48in. **Bicycle** for Sale, cheap, good as new.—Apply (after 7 in evening) at 1, Newlands Cottages, Newlands, Peckham Rye. No dealers.

8in. **Protractor**, with Vernier, in case, 20s.—Grocer, 51, High-street, Stoke Newington, London, N.

Equatorial Telescope, advertised in previous numbers. 9½ Silver Mirror, With-Browning, driving clock, costing over £100, will be sold at Stevens' Sale Room, Covent-garden, this day, Friday, June 16th.

Excelsior **Tricycle**, 52in. driving wheel, cost £14 10s. Easy runner. £5 cash.—Wright, Mercer's-row, Northampton.

Important to Violinists.—Improved **Violin Chin** Holders. List, with engravings, one stamp.—Nicholson, 35, Victoria-street, Sheffield.

Finished steel **Piston Rings** for cylinders, 2½in. to 4in., 3s. to 5s. per set.—"Alpha," Dover.

Propellors, 18in. dia., 7s. Other sizes up to 6ft. dia., equally reasonable.—"Alpha," Dover.

Handsome 3½in. by 4in. **Launch Engine**, £18. Sets of Materials, 90s. Other sizes equally cheap.—"Alpha," Dover.

New 3½in. by 4in. **Launch Engine**, with boiler, shafting, pipings, &c., complete, £41.—"Alpha," Dover.

5in. by 5in. **Launch Engine**, first-class engine, by Yarrow, £18.—"Alpha," Dover.

New 2 H.-P. and 3 H.-P. Cochrane **Launch** Boilers for Sale, cheap.—"Alpha," Dover.

To Electricians.—Quantity of superior thick Gutta-percha Covered Wires, about Half Cost.—"Alpha," Dover.

Three-jaw **Chuck**, suit 4in. to 6in. lathe, Castings 2s. 6d. Drawing, six stamps.—A. Dorrington, West Gorton, Manchester.

Amateur's **Drilling Machine Castings**, 3s. 6d. per set. Working Drawing, eight stamps.—A. Dorrington, West Gorton, Manchester.

Lathe Planing Machine Attachment **Castings**, 12s 6d. Working Drawing, 14 stamps.—A. Dorrington, West Gorton, Manchester.

Half Horse-power Horizontal **Engine Castings**, 32 parts, ports cast in, 12s. 6d. Design.—A. Dorrington, West Gorton, Manchester.

Amateurs and others before wasting money on inferior articles should send for my Lists and Testimonials. All Castings of best quality.—A. Dorrington, West Gorton, Manchester.

½ Horse-power Horizontal **Gas-Engine Castings** and Forgings. Lithograph, three stamps.—A. Dorrington, West Gorton, Manchester.

Blecnum Spicant and Parsley **Ferns**, 1s. per dozen free.—James Dove, Low Fold, Ambleside, Westmoreland.

Organ, 3 stops, mahogany case, pedals; supposed age 100 years.—Hill-top, Walwood road, Leytonstone.

A. **François'** List of Aneroid Barometers, Field-glasses, Model Engines, Steam Boats, &c., will be forwarded free.

Readers of the "**Mechanic,**" will do well to send for François list and compare with others.

A. **François**, while thanking those who have honoured him with their patronage, beg to say he will forward list to them.

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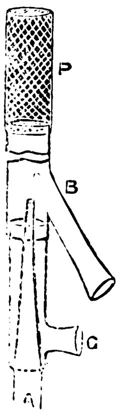
The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, JUNE 23, 1882.

LEWIS'S INCANDESCENT GAS-LIGHT.

By J. T. SPRAGUE.

THIS light, mentioned in "Scientific News," p. 324, was the subject of an article in the *Times* a few days ago which has brought it into considerable notice, and as I have had the opportunity of a complete examination of the apparatus, I propose to give "our" readers full information thereon before the world at large knows anything about the matter. When the experimental exhibition, now preparing, is actually presented to the public between Clerkenwell-green and the "Angel" at Islington, no one who sees the light will believe it is a gas-burner at all, so utterly unlike is it to any gas-light ever yet seen. The burner is not correctly described (as in the *Times*) as a Bunsen burner with a gauze cap. It is a true Herapath's blowpipe, to which air is supplied under a pressure of 6in. or 7in. of water, and which is caused to act also like an injector, so that it induces a stream of air in addition to the supply sent in. The figure will explain the construction.



A is a tube connected to the air-supply, which gradually tapers, and terminates in an opening adapted to the size of burner and air-pressure.
G is a tube connected to the gas-supply, which, together with A, forms an ordinary Herapath blowpipe.
B is a tube which fits on to the blowpipe, and has a side tube and mouthpiece, up which the induction air-current passes, and in the upper part of which the air and gas mingle.
P is a tube half an inch wide, and one and a half high, formed of a gauze of platinum wire of about 35 gauge, and closed at the top with a similar gauze.

When the gas and air are turned on and a light applied, an extraordinary effect is produced; at first there is a roaring flickering blue flame, which in a few seconds disappears, the platinum glows with intense lustre, and appears to enlarge (this being, however, only an optical illusion) and we have a glowing pillar of solid light without a sign of flame.

The light is, in fact, an incandescent one, just like the electric incandescent lights, derived, not from actual combustion directly, but simply from the high temperature of a solid unchanged body. The combustion produces no light itself, but simply heats the platinum, just as the electric current heats the carbon thread.

The burner, as at present arranged, consumes about ten feet of gas per hour, giving a light of over 50 candles. But light is a function of temperature, and, therefore, by increasing the pressure of air and the consumption of gas, a much larger ratio of light can be obtained, and it is said that in this way 20 feet will give 180 candles.

In the pamphlet which I published on the electric light in 1878, I suggested the probability that the time would come when, owing to the demand for heating, cooking, and engines, the gas companies would "undertake the making of a much cheaper heating gas, and trust to a carburetting process at the point of combustion to render it illuminating." This new gas-burner, if largely adopted, would bring this about, because it does not require illuminating gas to furnish light. Now, ordinary gas only contains about 4 per cent. of illuminating materials, rich hydro-carbons whose office it is to decompose and charge the flame with particles of carbon, which become incandescent while they are being consumed. But this 4 per cent. is the great element of cost in gas. To get it, cannel-coal has to be used, and the retorts drawn when only 8 or 9,000ft. of gas are extracted. To obtain heating-gas only ordinary coal need be used, and that need not be drawn from the retorts until some 15,000ft. of gas are produced per ton; this, in itself, is an important saving in fuel, as well as increase of gas, but even then the coke need not be drawn at a white heat, but by passing superheated steam, it can be cooled, and a large further production of gas obtained.

As a set-off to this and to the increased light, however, the new system will involve either a second set of mains and services to supply the compressed air, or else local mechanism to compress it on the spot. In the burners, as at present arranged, about four volumes of air are supplied, and the induction effect brings in the other four or five volumes needed for perfect combustion; but this is with a pressure of 6in. By increasing pressure and diminishing the orifice, the proportions may be largely modified, so that only two volumes need to be supplied; this is, of course, simply a question of mechanics and relative convenience and economy, as to which practice will determine.

The light itself is very pleasant; it is perfectly steady, and without any of the flickering of ordinary gas-burners. It is whiter than ordinary gaslight, owing to the higher temperature, and this whiteness can be carried much further than it is. It is more penetrating than the electric lights, because its quantity is greater, and its intensity less; that is to say if equal lights were given, according to the photometer, by the two lights, the gaslight issuing from a larger surface than that of the carbon thread which furnishes the electric light, would be more practically useful, and the difference would become more evident as distance from the light increased. For the same reasons the light is less trying to the eyes.

There is no smoke arising from the burner, because the gas is perfectly burnt; and, of course, there is less heat for a given quantity of light, because less gas is consumed.

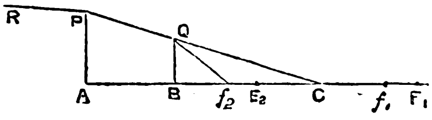
It is evident that gas does not mean to be blown out yet, and that the electricians will, by their exertions, stimulate those concerned in gas, and it is to be hoped that both will succeed and contribute to the public benefit.

A CROWN GLASS ACHROMATIC TELESCOPE.—II.

Spherical Aberration.

BEFORE proposing a pair of lenses which will diminish the spherical aberration, it will be well to explain the method which I have used for finding the aberration of the pair, since, in Dr. Parkinson's "Optics," the book chiefly in use, nothing is said upon the subject, except a few words when the lenses are in contact.

I suppose, then, a pair to be aplanatic when all rays, after emergence, converge to the same point. Let a ray RP be incident upon the first lens at P, and suppose that F_1 is the geometrical focus to which it would be refracted if there were no aberration, and suppose that it is actually refracted so as to meet the axis in C, so that F_1C is its aberration. Suppose, also, that after the second Refraction, it is refracted in direction Qf_2; then if F_2 is the conjugate focus of F_1, it is the point to which all rays would be refracted if there were no aberration, so that the aberration of the pair is F_2f_2.



If now, we suppose, as is often done in optics, the course of the rays to be reversed, a ray from f_2 to Q would, when produced backwards, coincide with QC; and if f_1 is the geometrical focus of f_2, f_1C is the aberration of the reversed ray.

Now, it is easily seen by the formula for congugate foci that approximately $BF_1 - BF_2 = Bf_1 - Bf_2$, or $BF_1 - Bf_1 = BF_2 - Bf_2$, that is, $f_2F_2 = f_1F_1$. In other words, the aberration of the pair is equal to the difference of the aberration of the first lens, and the second when the rays are reversed; but if we neglect products of aberration we might suppose the reversed ray to start from F_2 instead of f_2.

The rule, therefore, for finding the aberrations of the pair is this—Find the aberration of the incident ray for the first lens, and then that of a ray starting from the conjugate focus of the second towards it, and the difference of the two aberrations will be the aberration of the pair, taking care of the proper signs.

Suppose, for instance, that we had a plano-convex and a plano-concave of equal focal length, and their curved surfaces in contact. Then parallel rays incident upon the first emerge parallel from the second, and there is no aberration; but the aberration of a ray upon the first is toward the lens. Also, if the emergent rays be reversed, their aberration is also towards the lenses, and, being equal to the former, satisfies the condition of aplanation.

Again, suppose the rays emerge parallel from the second of any two lenses (convex), the aberration of the reversed rays is towards the lens, hence, also the aberration point, as we may call it, of the first lens must coincide with the second, that they may be aplanatic. In fact, the first lens must bring a ray to that point from which it would be refracted parallel to the axis by the second. One more example: It is well known that Mr. Wray's glasses are admirably corrected. If I have rightly estimated the curves and refractive indices which he has used, the aberration, according to the method here proposed, amounts only to $\cdot 0076\ y^2 / f$, and is less than a 200th part of the convex lens alone.

Proposed Telescope.

We may now propose an arrangement of glasses. The first thing to be done is to find a convenient relation between the focal lengths of the two, and in doing so we may distinguish between the two cases of achromatism mentioned in the last number—namely, when it is supposed to mean the making rays emerge parallel, or the bringing them to the same point, and thus destroying the chromatic aberration. I shall confine myself at present to the former, which is the idea of achromatism to which alone we have been accustomed, and which will, perhaps, therefore, be generally preferred, though I confess I do not do so myself.

The focal length, then, of the concave must be greater than that of the other, and not in a much greater ratio than 3 : 2, or in a much less than 4 : 3. For, in the former case the spherical aberrations would be extremely intractable, and in the latter there would be loss of magnifying power.

These two ratios, therefore, are the ones to which I shall confine myself, and each of them will give admirable combinations for aplanatism, and there is a very curious relation between the best forms of lenses to be used in the two cases. Thus, if we take the ratio 3 : 2, the best form will be a plano-concave, flat side outwards for the second lens, and a convex with radii in proportion of 11 : 4, the flatter side being inwards; but if we take the ratio 4 : 3, the first lens will be plano-convex, curved side outwards, and it will be the concave one which has its radii as 11 : 4, the flatter side being turned outwards; the ratio 11 : 4 appears in both of them, as it does also in one of Coddington's combinations.

For the first ratio, then, we have as follows:—Distance between optical centres of lenses = $\frac{1}{4}$ focal length of first lens.

Magnifying power or focal length twice that of first lens alone.

Length of instrument, or distance of the image from first lens = $7/4 f_1$; radius of first surface = $15/22\,f$, of second $15/8\,f$.

Aberration of ray incident on first lens = 1·1429 t, and of reversed ray incident upon second 1·1406 t difference, or aberration of pair = ·0023t. The pair, therefore, is highly aplanatic. The value of μ used in finding the above was 1·5, but if we put it at 1·5330, the value for the mean, say, in Parkinson, it becomes very much smaller even than this.

A plano-convex lens will give a respectable correction, though not near so exact as the above, giving an aberration of less than 1-62nd part of the front lens alone.

We need say nothing about the other ratio further than this: that the distance between the lenses being smaller, the red and blue rays will not have diverged so far before they meet the second lens; consequently the converging parallel rays will be closer, and the objectionable quantity mentioned in No. 1 will be smaller; but, on the other hand, when the first ratio is that used, the instrument, as I shall try to show, will bear a larger aperture in proportion to its length.

I may mention that I have found some most excellent combinations, as it would seem, for a telescope made upon the other plan mentioned in No. 1, but these I do not purpose at present to publish.

W. G. Penny.

(*To be continued.*)

THE ACHROMATIC OBJECT-GLASS.—II.*

By W. Bradbury ("Orderic Vital").

(*Continued from page* 298.)

HAVING thus indicated the object of these papers, and of those more important ones which will emanate from another pen in connection with them, I proceed to consider the development of the object-glass.

In the earliest instruments, the object-glass was a simple double convex lens. It was found, by making a metal tool of a concavity equal to a portion of a sphere of given radius, and working both sides of a piece of glass in it until they fitted, that such a lens formed an inverted image behind it, somewhere about the centre of the sphere of which its surfaces were parts. This image was defective in many respects, which became much more apparent when the instrument was used on celestial rather than terrestrial objects. The light from a bright object was not accurately condensed in one focus, but more or less scattered; and the image, instead of being one distinct formation, was really the result of the superposition of a multitude of images, and consequently wanting in sharpness. Also, instead of there being a bright image on a dark background, it was surrounded with a halo of colour.

But as the study of optics became extended, various minds were exercised in the attempt to remove or lessen these troublesome deficiencies. The laws of optics were brought under mathematic treatment; Snel discovered that the sine of the angle of incidence bore a constant ratio to that of the angle of refraction. To a mind of the calibre of Huyghens, it was at once obvious that under this law a spherical surface must act unequally on different rays of light, and that an aberration or diffusion must take place whenever it was employed. Possessed of high mathematical abilities, he deduced an equation by which the amount of this aberration might be calculated, and showed that an equi-convex was not the best form of lens to use as object-glass. To give the least possible aberration with spherical surfaces required a lens whose back radius was six times as long as its front one; but to rid it entirely of that error required the curves of its surfaces to somewhat approach those known as the conic sections. Finding that the aberration increased as the square of the diameter of the lens, he recommended the use of object-glasses of long focus and small aperture, thereby increasing the magnifying power without largely increasing the aberration. Such instruments were denominated aërial telescopes, and though a tolerably distinct image might be obtained, it was faint from loss of light, and there still remained the troublesome halo of colour, which no alteration of form could destroy.

It was left for the illustrious Newton to explain how this outstanding colour was caused. He discovered that a ray of white light, instead of being simple, was really compound, and resulted from the union of a number of coloured rays. A prism of glass acted as an analyser, and a ray of white light entering it was, during its passage, split up into its constituent colours. The ray as a whole was refracted or bent in accordance with the law of Snel, though each colour was differently affected, in regular order, but not in a regular degree. Violet was the most deflected, and red the least; while the other colours were intermediate between these extremes. When two similar prisms were fixed with their bases in contact, rays through each were bent in opposite directions, and by their intermixture, a partial reunion was effected. But the extreme colours were not wholly combined, for the colourless image was the result of the overlap of the greatest number of coloured rays. Similarly a convex lens, being a circular prism with an infinite number of plane faces, formed a colourless image by the condensation of the greatest number of coloured rays.

Finding that dispersion always accompanied refraction through a transparent medium, there seemed no possibility of producing a pure image by such means, and Newton turned his thoughts in another direction. A ray of light, reflected from a mirror, is not chromatised; and as the same effect can be produced by either a convex lens or a concave mirror, the latter offered several advantages in the construction of a telescope. Besides the freedom from colour, there was only one surface to fashion, and the instrument could be made very short and compact, and of any desired aperture.

But while the development of the reflecting telescope proceeded rapidly, the refracting instrument was not allowed to remain stationary; acute minds were at work endeavouring to solve the problem of producing a pure image by refraction. Newton concluded that a certain amount of dispersion always attended a certain amount of refraction, and that consequently the one could not be destroyed without destroying the other also. For if the two were in a definite proportion, action and counter-action would be equal, and the course of the ray, in the end, would not be altered.

This was a natural conclusion to arrive at, for at this early period the number of translucent substances was not large, and attention was directed more to the phenomena of dispersion in its relation to the nature of light than to the means by which it was made visible. The manufacture of glass was then in its infancy, and though we read of several kinds, they were chiefly of one species—viz., crown or plate glass, and were tinged with colour, green, blue, pink, or straw colour. The manufacture of flint-glass appears to have been little understood; the firm now known as Powell, of Whitefriars, was apparently the most advanced in the art. But the action of all kinds of glass on light was similar, and it was not till many years after Newton's time, that the discovery was made that it differed in degree. The ratio of the sines of incidence and refraction had been found to be, as nearly as possible, 3 to 2; and this, though correct for the species of glass then in common use, was erroneously supposed to apply to all kinds. Even after it had been found out that the refractive power varied with the density of the glass, this simple but confusing number continued to be employed in optical formulæ.

In 1747 the giant intellect of Euler was employed in optical investigations. His experiments and deductions led him to doubt the truth of Newton's dictum regarding dispersion; and though he could not enunciate a satisfactory theory, he saw that a certain amount of refraction was not attended with equal dispersion in all substances, and suggested the possibility of counteracting dispersion by means of two media of unlike refractive powers.

His memoir met the eye of John Dollond, who resolved to put the theories of the great mathematician to the test of experiment, in order to ascertain their practical value. First, he tried whether equal refractions produced equal dispersions. By arranging a prism of glass to act in opposition to a variable prism of water, he adjusted them so as to make the emergent ray fall in a line with the incident one. In this position refraction was balanced; but he was surprised to find that the colour was not at the same time subdued. Such a result made it very evident that one of the media had a greater dispersive power than the other; but, as the opposing prismatic angles were not equal, there was also a difference in refractive power. The prism of glass could produce the same deviation as its neighbour by a much more acute angle. Continuing his experiments, Dollond found that when refraction was balanced, the dispersion of the glass overpowered that of the prism of water. By increasing the refracting angle of the latter, the outstanding colour was reduced; and, eventually, a position was reached, in which the emergent ray was practically free from colour or achromatised. When this took place, the deviation due to the first refraction, was very far from being wholly destroyed; and the persevering artist saw that the action could be imitated, by means of a double convex water lens and a double concave of glass. Such a telescope was made in 1757, which gave an achromatic image.

Dollond continued his experiments with the object of finding a suitable medium, less unstable than water. On making a trial with some flint-glass, he discovered that a similar relation existed between it and crown glass, as he had previously found between crown glass and water. It was superior to either in refractive and dispersive power. A prism of this material was able to correct the chromatism of one nearly double the size of crown glass. This discovery was the foundation of the achromatic telescope, and Dollond constructed an instrument, giving a colourless image by correcting a double-convex crown lens by means of a double-concave flint lens, in 1758.

Dollond protected his invention by letters patent, and the Royal Society, in acknowledgement of the eminent services he had rendered to science, bestowed on him their Copley Medal.

When the principle of construction became known, it appeared that another investigator had been working on the same lines, even earlier than John Dollond. This was Chester More Hall, an Essex gentleman, who had undertaken experiments in correcting dispersion about the year 1729. He appears to have actually constructed an instrument similar to Dollond's, but no account of it was published at the time of the discovery.

(*To be continued.*)

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THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURAL, AND LODGMENT.[*]

By John Watson Warman,

Associate of the College of Organists, London.

f. HAVING done the preceding, see what is said (at *q q q q*, next) with respect to the Coupler Swell to Pedale's being made of the *Part* kind.

g. The only Defects which the Faringdon Treatment can be said to possess are the following:—(1) There is a slight Friction at the contact of the Square-Nose with the Key-Tail, such friction being caused by the lateral Traverse of the one across the other. (2) The Keys of the Swell-Section cannot be regulated from the front or outside of the Organ. (3) The Removal of the Great-Section Stickers is rendered a little less easy. (4) There is possibility of a "sticking", through the casting of a Backfall of the Great-Section, or of a Coupling Backfall, or of a Great-Section Sticker, or of two or more of these in contrary directions as one time. (5) A Clear Coupler Man.-to-Man. (see *r* next, 2nd parag. and on) is rendered less practicable, by reason of the non-correspondence laterally between the two sets of Keys, and because of the Fanning and Raised position of the Great-Org. Backfalls. (6) There is, at the fore Nose of the Coupling Backfall, a Friction, not only by its legitimate Traverse, but possibly also against its own or its adjoining Sticker. (7) The Coupling Action Man.-to-Man. cannot be Regulated from the front of the Organ. (8) There is no Participation (see *n*, ante) of the Swell-Org. Key-Tails when the Great is played upon with the Swell Coupled to it. (9) It is exceedingly difficult to Remove those Swell-Org. Keys which are Couple-able to the Pedals, because the Noses of the Action-Squares—not detachable like Stickers—placed on the Tails of such Keys, prevent the latter from being lifted free of the [long] Wires of the Stickers of the Action Swell to Pedale.

The foregoing have been stated in regular order of their importance, the *least* weighty being placed *first*. A few additional Remarks are, however, necessary.—No. 1 is of no real consequence whatever, for the very slight friction existent is much more than counterbalanced by the facility gained (with a proper treatment in the Contact of the Coupling to Pedals; see at *p*, ante) for the taking out of the Key, and because there is thus no Sticker,—the latter not only adding to the cost, but rendering Key-Participation less easy: see here at *s*, next, 1st parag.; at *o*, ante; and also again at *p*, ante, for other points there mentioned. No 2 also cannot be regarded as a fair objection. See now first at *h*, next (9th parag. and on) for a method of Front Regulation: to this it is to be added that the writer's *Cranked Sticker* (see *z*, ante) favours such a Regulation; but that such Cranking was not at that time known, and is also never required for the Skewed Key. There is, in the present Instrument, no difficulty whatever in Regulating the *Swell* Manual from the Organ interior, because the Pulls of this Section are close to the space between the two Manual Wind-chests (see at *d*, ante, 1st parag., for the posit of the *Great*-Section Pulls). No 3 also is of little moment, for, provided the Great Section Stickers be long enough, and the Coupling Backfalls be set sufficiently high (both of which points are properly observed in the Faringdon Organ), there can exist little difficulty in Removing such Stickers quite as freely as there is ever likely to be occasion for. No. 4 is of course of more weight in the abstract; but with properly seasoned material, and the Coupling Backfalls not too long (they are correct in such respects in the present Instance), the risk may be considered almost non-existent. Here see what is said at *k*, next, as to not having these Backfalls too *short*. No 5, though important in itself, is also not a fair objection: the writer's Clear Coupler was not invented at the time when the Faringdon Instrument was constructed; and in addition to this the comparatively ample size of its Pedale Section—*i.e.*, two 16ft. Registers and a Super-Octave Coupler to them—materially lessened the need for any supplementation of the Bass by aid from the Great-Organ. No. 6 is of course real. The Transverse of the Block-top must be tolerated, but it is too slight in amount to be of any practical importance whatever: any friction of the [Coupling] Backfall Nose against its own Sticker can be avoided by the simple expedient of slightly Bevelling the side of the said Nose: and the remaining risk—that of friction against the neighbouring sticker—can be got rid of by very slightly Sloping both the under side of the [Coupling] Backfall Nose and the [upper] face of the Driving-Block,—so that the tendency in the said Nose is to continually slide towards its own Sticker. No. 7 is the first real defect that presents itself. There is some difficulty in gaining access to the Regulating Buttons with which the Coupling Stickers are provided,—such difficulty arising from the fact of the Great-Organ Pulls being set at the front of the Instrument (see again at *d*, ante, 1st parag.), and, therefore, causing the rear ends of the Swell-Organ T-Squares to be at some little distance from the accessible space between the two Manual Windchests (see *Summary*, at *l*, next, 3rd parag.). And although it is quite practicable to employ a form of Regulating Mechanism for this type of Coupler which shall be properly workable at the Organ Front (see *h*, next, 3rd parag.), such working will require the aid of a regular Tool. No. 8 is a real, though easily remediable (see *o*, ante) blemish, but there is here this to be said in defence,—viz., that no other Organ-Builder, not even excepting Willis himself, seems so far to have realised this. No 9 is the most serious point of all, because the Removal of a Key, or even of an entire Keyboard, is liable to be urgently required at any moment, and in any Manual which has another Manual beneath it there is obviously the additional requirement of access to this latter as well. There exists also the consideration that whenever (as has already been seen to be the case here) such Wired-Sticker-driven Key-tails have Action Noses resting on them, and such Noses are set behind such Sticker-Wires, then the Actuation by the Pedal Key of such Manual Key has a tendency to tilt up the fore end of the latter (see *r r*, *Bis*, ante). This No. 9 Defect is the more unhappy because it is one so easily to be avoided (see *h*, next, 5th parag.), and this, too, *without* sacrificing that Participation (see *h*, next, 4th parag.) which constitutes the only merit of having the impulse of the Man.-to-Ped. Coupling to be given directly against the Key-Tail.

[It should be here observed that the writer is not absolutely, though being all but absolutely, certain that the last-named defect actually exists in the Faringdon Organ: a letter to Mr. Nicholson has elicited no reply.]

Here again collate the present with the Hoddesdon Design (comm. at *m*, next).

As a *Summary* of this No. 1 Treatment we may say that although it is, considered as a whole, a good one, yet that the presence of the three last named Defects should prevent its *literal* adoption under any circumstances whatever. For the corrections desirable we now proceed to the next.

h. *No. 2 Treatment.*—This virtually consists, as just intimated, in a Correction of the preceding Three last-named Defects, the Six first-named being generally inevitable with such particular [No. 1] Treatment (see, however, what follows at a little on, commencing two paragı. before *i*, next).

With the present Treatment the Arrangement and Structure of the Clavier-Involved portions of the Organ, and of the Manuals themselves (see, however, as regards latter, at *k k*, next) are assumed to be exactly as in Treatment No. 1.

Seventh Defect (stated at *g*, ante, 1st parag.). This may be obviated by applying a Regulating Button to the fore end of the Coupling Backfall, such Button being affixed on the lower end of a Screw-Wire, which passes vertically downward through such Backfall Nose. By simply Turning this Wire the desired Regulation can obviously be at once obtained. The [Coupling] Backfall itself should always, when it carries such Button, be so modified in its general form as to still ensure the proper Crossing of the Line of *Centers* (see on this matter in *Departments* Coupling - Action, and Key - Action). The Driving-Block will be Buffed, and also slightly Sloped as previously directed (see *g*, ante, 2nd parag.). The Button should be large enough in its [area] diameter to keep its Backfall-Nose clear of its own Sticker—thus avoiding the having to Bevel the *side* of the said Nose (see again *g*, ante, 2nd parag.)—, and will also be made convex at its bottom face in order that it may, as when *non* Regulating,—*draw* itself towards its said own Sticker; and the Regulating Wire will be formed at its top end into an Eye suitable for being clutched by a proper Regulating Tool. Of course the *Coupling Sticker* will not now receive any Regulating appliance. An easier way of obtaining Front Regulation of the present Coupler, so far as the making of the Backfalls is concerned, consists in applying the Regulating Button—in such cases Convexed at its *top* face—to the *Driving Block* attached to the Sticker,—the Screw-Wire of course then passing *up* through such Block, and having its clutching Eye coming below the latter, and its Button turned upwards and carrying the Backfall-Nose (see again *Departments* Coupling-Action and Key-Action). But remember that this last arrangement will probably be not quite so favourable to the Regulating—even with the said Backfalls set as *high* as possible (see *d*, ante, 5th parag.)—, because the Tool cannot be so easily inserted.

—*Eighth* Defect (also stated at *g*, ante, 1st parag.). This is easily and effectually got rid of by the method already given (at *o*, ante) of cutting each Key-tail of the *Coupled* Manual (here, the Swell) into a Fork, and inserting into latter the Nose of its Action Square.

—*Ninth* Defect (also stated at *g*, ante, 1st parag.). The method of remedying this also has been already described (at *p*, ante), as consisting in simply Wiring the Man.-to-Peds. Sticker-Head into the Square-Nose instead of into the Key-Tail,—of course securing *Participation* (see *n*, ante) either by the Nose-in-Tail-fork treatment (see *o*, ante), or, if the *Front Regulation* of the Swell-Org. Keys be insisted on (see next parag. but two), by the *Clip* device to be directly described (at *j*, next). It is, remember, only the *Swell* Org. Keys which will thus have the aforesaid Wiring entered into their Action instead of into their Tails. For the exact treatment of the Key-Tails and Square-Noses see as given in the shortly following Design (at *m*, next, 2nd parag.).

See at this point with respect to the Coupler Swell to Pedale being made of the *Part* kind (ref. *q q q q*, next);—in which event the just-mentioned entering of the Coupling-Sticker of course becomes *inevitable* for and in *one* of the two Noses which rest on the single Key-tail of such Swell Manual.

Before speaking of the Front-Regulation just indicated, it is as well to observe that it may be considered best, on the whole, to here keep each Great-Org. Sticker of one same *width* throughout its whole length (see now at *m*, next), because of the presence of the Coupling Backfalls between such Stickers, and of the consequent Blocks attached to the side-faces of the latter. But be careful that such width actually adopted be really sufficient to prevent the possibility of an unbidden sounding through any Sticker's becoming turned askew or across in the Cutting in in such a way as to be *jammed*. Here see (at *zz*, ante) how that the *Cranked* Sticker—described at *z*, ante—renders absolutely impossible any such jamming,—of whatever form the Sticker be.

It is now desirable to explain the manner of the said Front Regulation of the Swell-Org. Keys;—although it is to be distinctly understood that such Regulation is not, by the writer, advocated for the present Treatment, and has, therefore, *not* been included in the regular Defect just Corrected, but added here instead,—as a point of additional or extra information.

The most simple method of Front Regulation for a Manual, when its Action Noses—whether of Backfalls, Levers, or Squares—are in direct contact with its Key-tails, consists in providing each such Nose with a *Screw-Wire and Button*, of the kind which has just been described in connection with the Coupler Swell to Great. Here, see the description given with latter (at *h*, ante, 3rd parag.), the *first* form of which Regulation may be faithfully copied for the present Key Regulation, *excepting* that now the Button needs not to be convex at its under face, and that such *face* should here preferably receive the Buffing,—in the form of a little circular disc of soft Cloth glued thereto, so that the Key-tail (on which such Clothed face, of course, rests) shall not itself require such Buffing.

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[*] All rights reserved.

In the present Treatment No. 2 it will, remember, be necessary that the said Action Noses do extend far enough forward for their Regulating Wires to be at any rate not in *rear* of the line of the Great-Org. Stickers, or else the Regulating Tool will not be able to properly operate between these last. It is required here only to add that in all cases where (as in Treatment No. $5\frac{1}{2}$; see at *u u*, next, 4th parag.) there exist *no* Stickers or other obstructing portions in front of the point of such Regulating Wires, the Clutching-eyes of the latter should preferably be made large enough to allow of being Turned by the Finger and Thumb.

(*To be continued.*)

PRACTICAL NOTES ON PLUMBING.—XXXVII.*

By P. J. DAVIES, H.M.A.S.P., &c.

(*Continued from page* 322.)

FIG. 220 A is a small diaphragm basin bib valve-cock, generally silvered; it is made in sizes from $\frac{1}{4}$in. upwards, $\frac{3}{8}$in. being generally use, and is one of the neatest designs yet introduced. For rerubbering the valve unscrew to top *b*. B is an end horizontal screw-down diaphragm basin valve-cock, also suitable for urinals, butler's pantry, sinks, &c.; C is the ordinary spring-valve, generally made to close with the stream; when such is the case a water cushion should be formed at the back of the valve to prevent concussion (see Closet Valves). D is the ordinary standard for screwing the basin-cock A into where the pipe passes through the slab, this is very handy when the basin-cock has no other fixing; F is the ordinary lengthening piece for bringing the nose of the cock forward, and over the basin when the cock is too short.

FIG. 220.

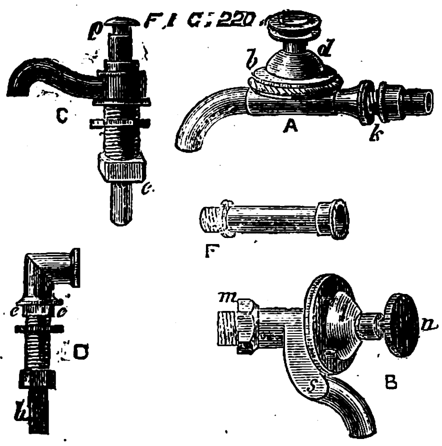
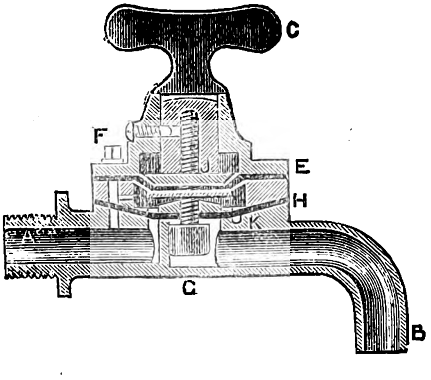


Fig. 221 is a diaphragm waste preventing basin-cock, suitable for schools, &c. For the action of this cock see valve 161.

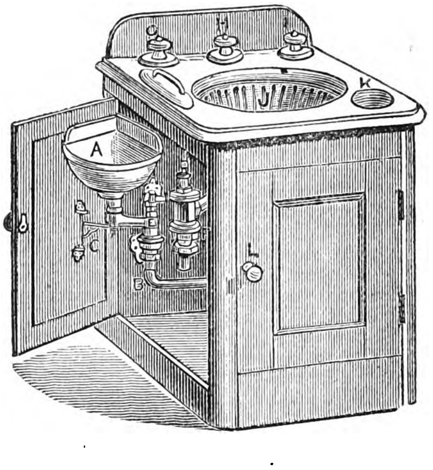
FIG. 221.



Lavatory and Urinal.

Fig. 222 is a lavatory basin and urinal combined. The basin has the usual pull-up knobs for actuating the valves from below; the urinal is made to swing with the door, and in such a manner that by the action of opening the door the water supply is opened, when the water runs full-bore to flush out the urinal.

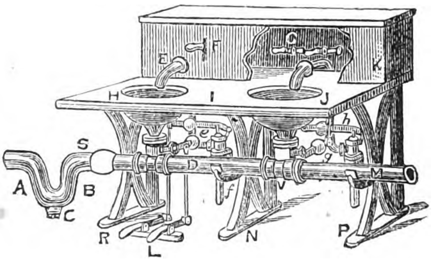
FIG. 222.



Lavatory Range.

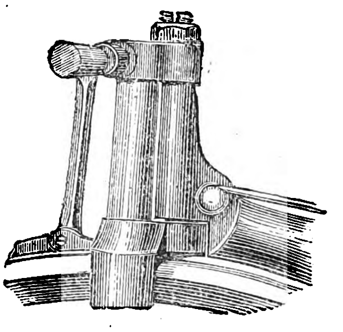
Fig. 223. This is nothing more than a number of lavatory basins, such as before described, fitted in a line; most of the preceding fittings may be used. This range is fitted up as follows:—First decide upon the number of basins, then have the top I.J, in which make the holes for the basins so that the rims will be flush with the slab, or if the basins are to be supported on a separate top (generally made of wood) then the rims must be let flush into the wooden top, and the slab bedded down with red-lead upon the rims of the basins, so that the water cannot get between, for if it does these basins will be a continual nuisance. In this diagram (223) the top slab is shown, supported upon three standards R, L, P; but it is not always necessary, for the slab J may be supported by letting it into the brick-work, say $4\frac{1}{2}$in., and making it good with Portland cement, or the slab may rest on wooden bearer, say of $4\frac{1}{2}$in. quartering, let into the wall between each basin or allowed to rest upon a frame, as shown at Fig. 222. Having all this settled, see about the waste M D S A. Sometimes this is done as shown in the diagram before us, that is, a pipe running along the entire length of the range, with lever-valves *g*, *h*, *e* discharging direct into the large waste-pipe, or instead of lever-valves, simple washers and plugs will answer; but when the washers and plugs are used, fix a trap below, because the plugs are nearly always left open, and the stink from the waste has every chance to come up; this not so much the case with the lever arrangement, because the valves are nearly always closed. Of course, I do not say that the waste-pipe A S D N is to be fixed of such large size or in such a manner that it will contain a lot of dirt; but, on the contrary, it must be constructed to be as self-cleansing as possible; but with every care there is sure to be filth collected in these long ranges of horizontal pipes. Lately, I have met with several fitted up with 4in. iron waste-pipe, this, for the small-waste generally fitted to wash-basins, is a mistake, for such large pipes cannot be expected to be washed out. In reason, the smaller this pipe the better. Say the outlet-valve from the basin is $1\frac{1}{4}$in., then the horizontal pipe should not exceed a $1\frac{1}{2}$in. smooth leaden pipe, with a fall of at least 1ft. in 10ft.; the trap A, should be fixed as near the end basin H as possible, with a pipe to insure fresh air from the outside of the building, but keep its end above the tops of the basins, or this pipe may some day act as an overflow pipe—that is, when the trap A becomes blocked. I have fixed such pipes to act as warming and fresh air inlet; but it must not be done so as to become a nuisance. Of course, from the other or top end of the waste pipe at Q, a ventilating pipe must, or at least should, be taken to above the level of the first air inlet, so as to induce the fresh air to be siphoned through the waste-pipe.

FIG. 223.



A SELF-STEERING BICYCLE-HEAD.

IN the accompanying engraving, we illustrate a new form of bicycle head, which possesses several novel features, which render it superior to other forms, as our readers—especially bicyclists—will readily perceive, one great point being that it is self-steering. In this head the centre of the neck is removed back from the centre of the head, and is held at the top and bottom in snugs. When a bicycle is ridden, the alternate pressure upon the pedals causes the front wheel and, necessarily, the head and handle-bar, to oscillate, and with the ordinary head, if the rider wishes to move in a straight line, and not follow a serpentine course, he must hold the handles quite rigid, and keep them square. With the new head the front wheel and head are kept straight and square by the pressure of the neck upon the snugs. The slightest swerving of the front wheel out of line with the backbone, throws the centres out of line with centre of the head and the back wheel, which causes the spring of the backbone to be exerted to pull into the line again, and so keeps the front wheel perfectly straight.



Again, when turning, the action of the centres throws the back wheel in a circle, and thus prevents the side-slipping always observed when commencing to turn a corner, which is the cause of the back tire wearing away so soon. This head is much longer than ordinary from centre to centre of neck. The usual length is 3in.; but this is $5\frac{1}{2}$in., at the same time the head in itself is no longer over all. It is also stronger, on account of the head being a perfect tube, which in ordinary heads is half cut away to allow the neck to enter, thus frequently causing the tube to break: it is also much lighter, as the barrel is hollow and thinner. This head permits the machine to turn in a small circle, and it cannot lock. The neck not being confined inside the barrel of the head, can revolve two thirds of the circle, whilst ordinary heads only revolve about one fourth of the circle. It can be taken to pieces very quickly, and, being made of hardened steel, the wear of the parts is greatly reduced. This head is the invention of Messrs. W. Gorse and Son, of the American Works, Icknield-square, Birmingham, by whom it is applied to the bicycles manufactured by them.

ELECTRICAL ACCUMULATORS OR SECONDARY BATTERIES.*

By Prof. OLIVER J. LODGE, D.Sc.

(*Continued from p.* 279.)

TO understand fully the action going on in a Faure cell it is necessary to know something about the salts of lead; for at the present time lead seems by far the most suitable material for secondary batteries. The protoxide of lead is called litharge, and is of a yellow or puce colour. Its constitution is PbO, and its atomic weight therefore 223. The intermediate oxide is red-lead, or minium, and its constitution appears to vary from Pb_2O_3 to Pb_3O_4; but it is most commonly the latter, and its atomic weight therefore 685. The peroxide, or black oxide, or heavy lead ore, is PbO_2, atomic weight 239; and it differs from the two preceding oxides in being a conductor of electricity, just as the peroxide of manganese MnO_2 is. The sulphate of lead, $PbSO_4$, is also important in the present connection. It is a dirty white non-conducting substance, slightly soluble in strong sulphuric acid, but quite unsoluble in dilute acid and in water. It will be formed, of course, as soon as red lead or litharge are put into dilute sulphuric acid; and unless there is an excess it may happen that all the acid gets used up in this way, leaving only water, in which case the liquid will cease to conduct. A Faure cell must therefore contain a considerable space for the acid liquid in addition to the space occupied by the plates and their coatings. But even then the strength of the dilute acid will become gradually weaker if a new Faure cell is allowed to stand for some time before a current is sent through it; and its resistance will accordingly be pretty high when you begin to charge. While the current is passing, however, the $PbSO_4$ formed while standing will be gradually decomposed, the lead being either reduced or oxidised, and the acid being reformed; so that the resistance of the cell will gradually diminish for this reason. It will also diminish for two other reasons, one of which is that the liquid is warmed by the current, and the average number of dissociated atoms thereby increased; while the other is that the spongy lead formed on the − plate, and the peroxide formed on the + plate, are both conductors; and hence the acting surfaces of the plates are practically slowly advancing to meet each other all the time the current is charging the cell, and the layer of non-conducting oxides and sulphate is gradually diminishing in thickness. Hence the urgent necessity for the flannel or felt between the plates. For, if ever, in the process of charging, any portion of the peroxide were to reach across to a portion of the spongy lead, a bridge of metallic conduction would be completed, and the cell would be short-circuited. It would be as reasonable to try and charge up a bit of copper wire as such a cell.

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* From the *Building News*. All rights reserved.

*From the *Engineer*.

We perceived in the last article that a current of one ampère was able, in 108 hours, to oxidise a pound of litharge to peroxide on the positive plate of every cell through which it is passed, and to reduce a pound to metallic lead on the negative plate in the same time. The oxidation of a pound of minium (Pb_3O_4) to the peroxide can be effected by a rather less quantity of electricity, namely, by 48,000 / 685 = 70 ampère-hours; there being four bonds joined up when Pb_3O_4 is oxidised to $3(PbO_2)$. But to reduce minium to metallic lead requires a greater quantity—eight bonds having to be loosed — namely, 96,000 / 685 = 140 ampère-hours. Hence, provided there is no waste and no gas given off, twice as much minium will be oxidised in each cell by a given current as is in the same time reduced. But with litharge the quantities oxidised and reduced are equal. When minium is used, therefore, either the coat of it on the + plate must be considerably thicker than the coat on the negative, or else the + plate itself must be expected to be eaten into somewhat before the reduction on the other plate is finished, and must be made of sufficient thickness to stand it.

Every pound of metallic lead thus oxidised to peroxide will require 48,000 / 207 = 230 ampère-hours of electricity.

If any gas is given off, every pound of hydrogen collected accounts for 12,000 ampère-hours; or, as a pound of hydrogen occupies about 180 cubic feet under ordinary circumstances, we may reckon the electricity necessary as 67 ampère-hours per cubic foot of hydrogen. If any free oxygen is detached, the electricity may be reckoned at the rate of 134 ampère-hours per cubic foot, or 1,500 Ampère-hours per pound.

Now let us take a single Faure cell charged with minium, and pass through it a measured current of C ampères for an observed time of T hours. Let the gas evolved be collected, and found to consist of h cubic feet of hydrogen and g cubic feet of oxygen. Let the weight of minium reduced to metallic lead on the negative plate be called x, and the weight oxidised to peroxide on the positive plate be called y, both being expressed in pounds avoirdupois. Further, let z pounds of the + plate itself be oxidised to peroxide; let a small quantity, say u pounds, of hydrogen remain associated with the negative plate, either mechanically as bubbles, or as a sort of alloy; and let v be the weight of oxygen likewise liberated but unable to escape, or else used up in some indirect way. Then the following two equations render a full account of all that has gone on, as far as electrical laws can express it:

$$C\,T = 70\,y + 230\,z + 1500\,v + 134\,g$$
$$C\,T = 110\,x + 12{,}000\,u + 67\,h$$

The quantity g is probably zero if a properly weak current has been used in charging. The quantities u and v will also probably be small;[*] and, therefore, perhaps, for practical purposes it may be sufficient to write

$$C\,T = 70\,y + 230\,z$$
$$C\,T = 140\,x + 67\,h$$

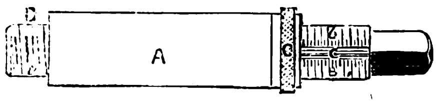
Now h, the volume of gas evolved, can be easily collected and measured. There remain then the three unknown quantities $x\ y\ z$. The above two equations are, of course, not sufficient to determine them; but they show us the kind of relation which must exist between them, on the hypothesis that u and v are negligible. Especially we learn how much the + plate will have been attacked at any time after the whole of its minium layer has been reduced.

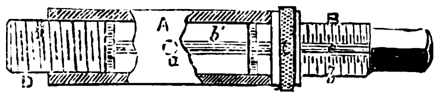
The most direct way of determining C T is to insert in the circuit some kind of voltameter, say a couple of large copper plates immersed in a solution of sulphate of copper; then by the time that one of the plates has gained, and the other lost, P pounds in weight, the quantity which has passed will be

$$C\ T = \frac{24{,}000}{63{\cdot}5}\,P = 377\ P \text{ ampère-hours.}$$

HANDY NUT MANDREL.

ANNEXED diagrams represent a handy tool for holding nuts while being squared up in a lathe. The holder consists of a thimble A, provided with a pin or spline, *a*. B is a mandrel made to fit snugly in the thimble, although not too tight to prevent its moving easily in same; *c* is a recess in which the pin *a* plays and prevents the thimble from turning on mandrels; *b*, *b*, are threads cut on either end. C is a nut for determining the distance that the nut (which is to be squared up) can be screwed on mandrel at the end D.





In operating the holder the milled nut, C, is moved back or forth until the nut, which is screwed on end D, and against thimble A, will sufficiently overhang the end of mandrel to allow of being squared up. By this arrangement any thickness of nut may be had without injuring the threads on mandrel. The threads on mandrels, as commonly made, are soon cut up and rendered useless.

The tool just described having proved itself time-saving and valuable, is, I think, entitled to a little space by which it can make itself known. As far as I know, it is not patented, and is, therefore, free to all.—C. C. Abbe, in *American Machinist*.

ELEMENTARY LESSONS IN DRY-PLATE PHOTOGRAPHY.—XII.[†]

(*Continued from page* 303.)

Printing.

IT will be noticed that the prints as they come from the frames are of a more or less unpleasant colour. The operation which is to be described, and which is called toning, is intended to correct this defect, and to give them the pleasing colour which we are accustomed to see. Toning may be said to be at once the easiest and the most difficult photographic process. Nothing is easier than to tone, nothing more difficult than to tone well. Anyone can change the colour of a print to a sort of slatey grey; there are not very many who can be sure of getting at all times a pleasing tone and the exact tint required. The difficulty lies in the direction so common in photographic operations. A certain result is gained, but the after-processes modify this result, so that great experience is necessary to know beforehand what will be the final appearance of the subject.

The toning solution mentioned in the last lesson (p. 303) is too concentrated to use as it is: it must, therefore, be diluted. The common practice is to use a large quantity of toning solution, and, if it is not exhausted, to keep it for after-use. This is very well for the professional who tones at regular intervals, but in the case of the amateur we think it is not advisable. The solution once used is very liable to "go bad," the gold being deposited at the bottom of the bottle. We therefore recommend that beginner estimate the amount of toning that will be necessary, allowing a little margin, and after he is done, throw it away. The waste will be very small—so small that it will not be found worth while to keep the liquid as residue. If the prints be trimmed before toning, one grain of gold is amply sufficient for each sheet of paper measur-17in. by 22in. Let, therefore, one ounce of the stock toning solution be taken for every sheet of paper, and let it be diluted with six or seven times its amount of water.

Now let the prints be taken one by one, and placed in any dish which is suitable for washing them in; a common small wooden tub is the best of all. Let the prints be kept from sticking to each other, and be moved about by hand. It will be seen that the water becomes milky from the nitrate of silver in the paper forming chloride and carbonate of silver with the salts in the washing water. The water must be changed several times till this milkiness disappears entirely, or almost so. The washing is best done by the light of a candle or lamp, as such will not affect the paper. The toning must be done in feeble white light, as it is difficult to judge the colours by yellow light. It is best performed in a flat white dish at least an inch larger each way than the prints. Let one print be taken from the washing water, and placed in the toning, first face downwards, then turned face up, then down, once or twice, so as to allow the solution to act evenly on it. Now let another print, and perhaps two or three more, be similiarly placed in the solution. It will be noticed that the prints, during washing, turn to a brick red. In the toning they will turn to a brown, and gradually to a sort of violet or purple. They must be kept in constant motion. The best plan is to keep continually lifting the undermost print, and placing it on the top. At first only a few prints should be attempted; after some practice, a dozen or two may be in the solution at once. When many prints are toned together, it is a good plan to have two dishes of toning, side by side, and keep lifting the prints out of one into the other, the whole of the prints being turned over in a mass when they are all in one dish.

The difficulty is the one indicated before—viz., at the time of toning to discount the change which will take place during the after-processes. The difficulty is greatly increased by the fact that every brand of paper acts in a somewhat different manner from any other. Very few ready sensitised papers will stand being pushed to the purple stage; that is to say, if the toning is continued to the purple, the final result will be disappointing, although the prints will look beautiful before fixing. It is usually advisable to remove the prints from the toning solution whilst they are still of a very warm brown in the shadows. It is a good test to watch the half-tones, and when these begin to become purple or violet, to remove the print. The prints when removed are placed in another dish of clean water. They must be moved about for a short time after first placing them here, so as to get rid of the greater part of the toning solution which is in the pores of the paper, and which would make the toning proceed after it was desired to stop it. When all the prints have passed through the toning bath they must be washed in several changes of water, being kept moving for about five minutes during each change. Now comes the fixing: the prints are removed from the washing water, and are placed in a flat dish. Sufficient fixing solution to quite cover the prints is poured in, and they are kept moving for about twenty minutes; more than one change of colour will be noticed during this time. The first will be an almost total loss of tone; afterwards the colour will return to something like its former self. A further change will take place when the prints are dried. After fixing, it is necessary to wash the prints most thoroughly for not less than twenty-four hours. Is is best done in running water, but if this cannot be had, then frequent changes will do. The smallest trace of hyposulphite in the prints will cause them to fade. The prints, after washing, are allowed to dry spontaneously, being placed on any clean surface; or they may be mounted wet on cardboard. In either case they should be afterwards rolled. A rolling press is an expensive article; but the amateur can generally find some neighbouring photographer who will roll his prints for a small consideration.

The great convenience of ready-sensitised paper is that it will keep for a very considerable time, either before printing, or between printing and toning. The means of preparing such paper is at present a trade secret, and when the amateur prepares his own paper, he will find that it will turn brown after about twenty-four hours. He must therefore do his sensitising and toning all in one day. If he has time to do this, he will probably be rewarded by superior results. We shall therefore describe the process of sensitising. "Salted" albumenised paper is purchased—that is to say, paper coated with albumen which is impregnated with soluble chlorides. A "silver-bath" is prepared by dissolving nitrate of silver in distilled water. The strength of the bath varies with the paper used. Every dealer in albumenised paper will state what strength of bath is best to use for the particular brand. One containing sixty grains of nitrate of silver to each ounce of solution will suit most papers. Enough of this must be prepared to cover the bottom of the flat dish to be used in sensitising to a depth of at least ⅛in. The dish should be half an inch larger than the paper in each direction. If much paper is to be used, it is best to sensitise in large pieces, and cut it into sizes before printing. Professional photographers usually sensitise a whole sheet at a time.

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[*] They are multiplied by large coefficients though, and I am by no means sure how far it is practicable to neglect them. I believe the reduced lead is alloyed pretty strongly with hydrogen.

[†] Condensed from the *Photographic News*.

A room lighted by a lamp or gas is the best to carry on the sensitising process. Strings should be stretched in convenient positions for hanging the paper on to dry. American clips are useful for fixing the paper to the strings. Let the silver solution be poured into the bath, and let a piece of the paper be taken by opposite corners, and with the albumenised side downwards. Let the paper be so held that it will first touch the surface of the solution in a line between the two corners not held by the hands. We again take the simile of a printed sheet. Suppose the paper held by the right-hand upper and the left-hand lower corners. Now let the left-hand upper corner touch the surface of the solution, and let the paper be lowered till it touches in a line from the left-hand upper to the right-hand lower corners. Now let the two corners held in the hands be dropped, first one and then the other. If it be carried out properly, there will be no air-bells under the paper, but it is best to lift it from the solution after about a minute and look, to make sure. If there are any, they can be broken by gently moving about the paper whilst one-half is held out of the solution. The time of floating varies with different papers and different strengths of baths. It should be ascertained when the paper is purchased. With a sixty-grain bath from three to five minutes is usually ample. If the paper curl out of the bath at the edges, it may be caused to lie flat by blowing on it. After the specified time has elapsed, let the paper be removed from the bath by drawing its surface over one edge so as to drain off most of this silver solution. It is only necessary now to bring it up by one corner to dry. A small fragment of blotting-paper should be caused to touch the lower corner immediately that it is hung up. This will adhere by capillary attraction and collect a drop or two of solution which would otherwise fall on the floor.

If the room be warm, the paper will dry in ten minutes or a quarter of an hour.

USEFUL AND SCIENTIFIC NOTES.

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Corn Cures — Dissolve 1 part of salicylic acid in 40 parts of collodion: apply several times a week. The corn dissolves with little trouble. For hard corns, apply at night a mixture of 1 part of carbolic acid, and 10 parts of distilled water, glycerine, and soap liniment. Envelop with gutta-percha tissue, and the corn may generally be removed the next morning. For inflamed and swollen joints, proceed in the same manner, but use, instead of the above mixture, liq. plumbi dil., 100 parts, and tinct. croci, 5 parts.

Fast Atlantic Steaming.—A bill, submitted by Mr. Robeson to the United States Congress, in regard to a fast mail steamship line, authorises the United States Postmaster-General to contract for and establish a weekly mail service between Fort Pond Bay on Long Island, and Milford Haven, Wales, by means of a line of first-class steamships, and provides that the vessels shall be iron or steel screw steamships, capable of making at least 18 miles per hour, and shall be wholly of American construction. They shall be allowed to carry passengers and their baggage in addition to the mails, and do an ordinary express business, but shall not engage in any freight traffic. The Government shall have the right, in case of war, to take for the use of the United States any or all of the vessels employed on the line, on paying a reasonable compensation to the owners, not to exceed in any case the original cost of the vessels. The compensation proposed for the mail service is graduated as follows:—12,500 dols. for each outward bound trip made within six days; 10,000 dols. for each trip made within seven days; 7,500 dols. for each trip made within 7½ days; 5,000 dols. for each trip occupying more than 7½ days. The project referred to will be recognised as the Corbin-Lorillard line of six-day steamers.

The number of hours of bright sunshine recorded by Campbell's sunshine instrument at the Greenwich Observatory during 1881 was 1,301, which is more than 100 hours above the average of the four preceding years.

SCIENTIFIC NEWS.

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As Comet Wells will be again visible in this country at the beginning of next month, the following ephemeris for Greenwich midnight may be found useful. The brightness is now decreasing, and on July 15 it will be equal to what it was on April 19:—

	R.A.			N. Dec.	
	h.	m.	s.	°	′
July 1,	9	35	58	11	57
July 5,	10	4	21	10	50
July 9,	10	28	2	9	47
July 13,	10	48	1	8	49

At Greenwich the comet sets on July 1st, 1h. 44m. after the sun.

Dr. Bergsma, who lately resigned the post of director of the Batavia Observatory, died on his way home while passing through the Red Sea.

The Council of the Society of Arts have awarded the Albert Medal to Prof. Louis Pasteur, for his researches in connection with fermentation, the preservation of wines, and the propagation of zymotic diseases in silkworms and domestic animals.

The annual general meeting of the Society of Arts will be held on the 28th inst.

Mr. R. S. Newall has issued a pamphlet (Spons) entitled "Facts and Observations relating to the Invention of the Submarine Cable," &c. It is written by way of reply to a paper by M. Bede, addressed to M. Dumas, in his position as President of one of the juries in the Paris Electrical Exhibition. Mr. Newall claims to have been the first to suggest laying telegraph-wires under water, and also to have laid the first submarine cable.

The Rev. E. J. Warmington, of Dengie Rectory, Maldon, says, apropos of the article on utilising the motions of the sea (p. 279), that the method of utilising the tides and wind combined was anticipated by him, and described in two letters to the *Times* (not inserted), and in one to Sir W. Thomson, whose remarks at the last meeting of the British Association gave rise to them. Mr. Warmington considers that a proper system of floats could be readily made to gather up the forces at present wasted on our coasts. Tidal power, with a rise of 6ft., can, he says, never give more than its theoretic maximum of 1-2117th of a horse-power per square yard, whereas if wave-motion were utilised by means of floats and levers it would give at least 1-15th. Floats could be fitted at many places where reservoirs would be impossible, and as they could be used at many points around the coast, the power could be transmitted by the shortest route. From the papers received by us, it is not clear how the motion of the waves is to be transmitted in such a manner as to drive a dynamo-machine.

Mr. C. Chevallier, electrician at Aden to the Eastern Telegraph Company, has modified some of the arrangements of Sir W. Thomson's siphon recorder. He dispenses with the large electro-magnets excited by a Daniell battery, and uses, instead, a powerful permanent magnet made, we believe, of steel containing from 2 to 3 per cent. of tungsten. With one of these improved magnets good signals have been obtained on the recorder through the Aden and Zanzibar cable.

Mr. G. W. Webster has discovered a method of correcting over-exposed gelatine plates. He adds to the developing solution a little citrate of soda, about four grains, presumably of a saturated solution, for every drop of ammonia. The effect is to check devolpment while allowing intensification to proceed. The best proportions are unknown: those given have yielded good results in Mr. Webster's hands.

The largest gas-lamp in the world is said to be one used at the Darlington Art Industrial Exhibition, made by Mr. Heron, of Manchester. It gives a light equal to 2,000 candles. It is 8ft. high by 6ft. broad, and has 50 duplex burners, each consuming 10ft. of gas per hour.

Some experiments on the conducting power of the earth for tremors, have been reported to the Seismological Society of Japan by Prof. H. M. Paul. He uses a vessel containing mercury slightly thickened with tin, which is screwed on to a post sunk about four or five feet into the ground. An express train passing at a distance of three-quarters of a mile set the mercury vibrating for three minutes, and a one-horse vehicle passing along a gravelled road 500ft. distant sensibly agitated the mercury whenever the wheels passed over a stone.

The report on the incandescent lamps exhibited at the Paris Electrical Exhibition has been published, and from that we find that the maximum efficiency cannot be assumed to exceed 300 candle-lights per horse-power of current. Edison's lamp takes the first place in these experiments; but since they were made considerable improvements have been effected in some of the other systems.

A splendid conversazione took place at the Royal College of Physicians, in Pall Mall, on the 14th inst. The Prince of Wales was present, and examined with great interest some fine stained specimens of the bacilli of tubercle, which were exhibited by Miss Watson Cheyne and Mr. E. M. Nelson. The greater part of the Prince's visit was, in fact, devoted to these specimens, which were shown to him by Mr. E. M. Nelson, and which excited also much interest among leading physicians as being now supposed to be the primary cause of consumptive diseases. Professor Tyndall also exhibited, by means of the electric light, his new experiment upon the interference and reflection of sound; also some curious phenomena of colour, due to exhaustion of the retina when the eyes are continuously directed upon discs of brilliant colour, and by consequence a white ground appears to be of the complementary colour. Many objects of artistic and scientific interest were exhibited.

Mr. Michael Reynolds' long-promised book on the important subject of "Continuous Railway Brakes," will be published this week by Messrs. Crosby Lockwood and Co., of 7, Stationer's Hall-court, Ludgate-hill, London.

Some interesting physical methods were described at the séance of the French Academy on 5th June. One is for ascertaining the specific heat of mineral substances, which it is difficult to get in large mass. It is devised by MM. Thoulet and Lagarde, and is on the following principle:—Suppose two thermo-electric junctions in two small tubes containing a liquid of known specific gravity. The substance under examination being heated to a known temperature and put in one of the tubes, the deflection of the galvanometer measures the rise of temperature. This result is compared with that obtained from a typical substance—*e.g.*, pure copper. Water or oil of turpentine was the liquid used. A comparison of the numerical results for several minerals whose specific heat was measured by Regnault, with the numbers got by that physicist, proves the exactness of the method. Again, a hygrometer, acting by condensation, was described by M. Crova. It consists of a nickelised tube, brightly polished interiorly, and closed at one end with ground-glass, and at the other with a lens. The observer looks through it towards a source of light, applying the lens to the eye. The air to be examined is drawn slowly through the tube, entering and leaving by tubulures at the ends. Round the tube is a cooling arrangement, a cylinder holding sulphide of carbon, through which air is passed. When the dew-point is reached, striking changes occur in the interior aspect of the tube, the dew appearing as dark brown spots. By raising and lowering the temperature several times, these are made to go and come, and a thermometer-bulb being inserted in the sulphide, the dew-point can be estimated very accurately. M Violle described a new calorimeter.

It has been recently announced by Herr Hermann, that germinating seeds (*e.g.*, peas), in water or moist surrounding, show a regular and strong electric current, the radicle being negative to the cotyledons. The strength is often over one-tenth of a Daniell. He is investigating the phenomenon.

From a comparison recently made by M. Pfarski it appears that the new Volga Bridge, near Syssran, 1,485 metres, is the longest in Europe; but it is exceeded by several in America —viz., the Victoria Bridge over the St. Lawrence; the Delaware Bridge, Philadelphia; and a bridge over the East River, each 1,500m.; Ohio Bridge, near Louisville, 1,615m.; St. Charles Bridge, over the Missouri, 1,993m.; and Parkersburg Bridge (the longest), 2,147m. After the new Volga Bridge, rank, in order, the Hollands-Diep Bridge, near Inverdyk, 1,479m.; bridge over the Pongabuda, near Gooty (India), 1,130m.; Dniester Bridge, near Kiew, 1,081m.; Rhine Bridge, near Mainz, 1,028m., &c.

While a considerable degree of comfort is now realised in railway travelling, there is still room for improvement, and we may invite attention to a new system of interior suspension in carriages, by M. Delessert, lately reported on with approval in the French Société d'Encouragement. It has been employed a few months in twelve first and second-class carriages of the Chemin de Fer de l'Ouest. Not only does the body of the carriage rest on springs, but the seats, backs, and (cut-out) foot-boards form one whole, which is supported on steel springs connected with a standard near the sides of the compartment. Thus a double suspension is obtained. The prevention of vibration, usually experienced through the floor, is of great advantage to invalids and nervous persons. The cost of alteration is about £38 for a first-class compartment; which would be somewhat high, it is remarked, were it not that there is compensation in increased durability, through reduction of shocks and vibrations. (Illustrations of the system will be found in the Society's *Bulletin.*)

In view of the large use now made of hempen straps for driving-gear, means of transport, slaters' chairs, &c., Herr Weinlig has recently made experiments with a variety of those straps (from a manufactory in Halberstadt), with reference to rupture. While cotton straps stretched about 6 per cent., the double hempen ones stretched 11 per cent., and the four-fold 9·5 per cent. It appeared—(1) That Russian hemp is superior to Italian, about 10 per cent.; (2) that cotton straps bear scarcely more than half the breaking load of hempen straps per square millimetre of cross section. (3) Straps broke quite gradually one thread after another. There was first a slight crackling, then the threads broke with distinct sound. (This property is valuable, as it insures great safety, if the straps are often tested). (4) The considerable uniformity of breaking loads in each case proves that these straps can be woven of great regularity and perfection. (5) In use of the straps for slaters' chairs and lifts, 8 to 10-fold safety could be attained; so that, on an average, 0·4 kg. per square millimetre cross section (not counting vacant interstices) may be taken as the permissible load.

For demonstration of the third pendulum law, Prof. Mach, of Prague, uses an arrangement whereby the plane of oscillation can be variously inclined to the vertical (the time of oscillation increasing with this inclination). The pendulum-bob is supported by two divergent rigid bars within a rectangular frame, which can be tipped and fixed. If the tipping goes as far as 90°, the time of oscillation becomes theoretically infinite (∞). The pendulum does not return to a position of equilibrium, but goes on in one direction till its kinetic energy is destroyed by friction.

The immigration to New York in April reached the high figure of 70,376, showing an increase of 9,100 over the same month last year. The total arrivals from January 1st were 142 716. As compared with April last year, the Norwegians show the greatest increase (2,332 against 317). The Danish immigration is increased nearly 100 per cent. The immigration of Russian Jews was increased more than 200 per cent., but there is a greater proportionate falling off in the Polish Jews.

In a paper recently read to the French Society of Civil Engineers, M. Cœne expresses surprise that the Seine is not better utilised for traffic between America and Europe. Rouen, with its new quays, has had an increase in tonnage of merchandise from 400,000 to 1,500,000 in five years, and is the fourth port in France. But it should be made possible (M. Cœne holds) for the large ships of modern build (some of them 5,000 tons) to come to Rouen; and the first thing to be done is to form, in the bay of the Seine, an embankment of large size, giving a better direction to the principal channel of the estuary. The estimated cost, 25 million francs, would be diminished by 15 millions for recovered land. An immense sheltered roadstead, 4,500 metres long by 2,200 broad, would be formed before the port of Havre capable of accommodating the largest fleets.

A curious fact in connection with instantaneous photography is noted by a correspondent of *La Nature*. In the photograph of a vehicle drawn by a trotting horse, all the parts are given with irreproachable distinctness, except the wheels, which, in their upper part, are less distinct than in the lower. The reason is (as can be easily shown), that the spokes of the wheel have a much greater velocity when at the upper part than when their extremities are near the ground.

By reason of improvements in the telephone, M. Van Rysselberghe, director of the meteorological service in Belgium, lately achieved the remarkable result of telephoning and telegraphing on the same line at the same time. A Morse telegraphic message was sent from Brussels to the engineer-director of telegraphs in Paris, and an oral message was sent by the same wire, which was heard while the Morse receiving apparatus was in action.

One feature of the interesting scheme for high-speed railway travelling, developed by Mr. Le Van in a paper to the Franklin Institute (and in which he aims at ninety miles an hour), is construction of the permanent way, so that stations shall be located at summits, and the force of gravity of the train assist the locomotive both in starting and stopping, it being important to lose as little time at the stations as possible, either in stopping or starting; to keep up a high speed to a point as near the station as possible, and in starting to get the train under full speed in the least possible space of time.

LETTERS TO THE EDITOR.

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[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

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ζ HERCULIS.—Σ 1888 AND Σ 1884.—Σ 1555.

[20179.]—The following are some of the latest measures of ζ Herculis (letter 20122, p. 305):—

Hl.	120·75°	1·498″	(4 nights)	1879·46.
β	122·0	1·52	(3 ,,)	1879·45.
Seabroke.	120·7°	1·62	(2 ,,)	1879·65.
β	114·1°	1·34	(5 ,,)	1880·49.

The angle and distance at the present time are about 103° and 1·55″. Next year, the distance will be 1·65″ +, and the *comes* will remain at about this distance until 1888, when the stars will gradually commence to close up. Mr. Simms ought to see it with even a smaller aperture than 4in. Dawes saw it well with 3·8in. when the central distance was about 1¼″. The late Mr. T. W. Burr found "the pair well separated" with his 3⅜in. Ross; and I notice that Mr. Gardiner says on p. 278 of the volume of the English Mechanic referred to by Mr. Simms, that it was seen by him in June, 1880, with a 3½in. telescope reduced to 3¼in. The reddish colour of the companion is striking. I saw it last year, but with difficulty, with the 3¼in. Sheepshanks equatorial belonging to the R.A.S., the companion appearing as a reddish dot not perfectly separated from the large star. The object-glass of this telescope is, however, not a very perfect one, and the power used was not high enough to divorce the components.

Σ 1883. This star is probably a binary, and is now closing up. The latest published measures are, Hl. 257·17°: 0·730″: (3 nights) 1879·46. The principal star of Σ 1884 is brighter than that of Σ 1883; but the difference between the two components is greater. Σ says of his 1883, "*at prior minor.*" Σ 1884 is a naked eye star, and the components have been relatively fixed since 1829.

With regard to one star, Σ 1555, in Mr. Perry's letter (20070, p. 260), I would remark that Smyth's measure of C is "Smythian." I have noted in the "Appendix" to the "Handbook of Double Stars" two measures of C by De. and Eng., and in a recent communication to these columns I suggested a correction to Eng.'s distance, which brings it into excellent accord with those of De. and Mr. Perry. H. Sadler.

P.S.—Would Mr. Perry, kindly measure the third companion of ξ Böotis? There is only one measure in existence, viz., Mä's, and that is probably 100° in error, or else it belongs to Σ 1893. If this faint star is not physically connected with ξ it is probably now in about 350° + 24″ +. The discoverer, Sir J. Herschel, says it is almost the "minimum visibile" with his 18¼in reflector.

H. S.

WELLS' COMET.

[20180.]—Soon after writing letter 20036, page 237, containing the elements of an orbit for Wells' comet found by projection, I began strongly to suspect that the comet had been disturbed in its path about April 23rd, so that all observations prior to that date used to find an orbit would throw the results in error. I was confirmed in this opinion by the comet getting before the places I had assigned for it. In finding the orbit, I had used an observation of April 8th, before the supposed disturbance took place; and to make the orbit agree with that position, it had to be altered a little, making the perihelion distance too great, causing the predicted places, while on the same apparent path, to be behind those occupied by the comet. I have since found an orbit from observations since the supposed disturbance took place, which agrees well with all the positions, but which cannot be made to agree with the observed places before April 23rd, the place for the comet on the orbit and the observed place differing more than a degree and a half in apparent position for April 8th, the difference getting less as the observations approach the 23rd. This orbit agrees very closely with that given by Dr. Openheim, in your "Scientific News" column (page 258), except that I make the perihelion passage a few hours earlier, and distance a trifle less.

It may seem very bold to make this announcement, and I have hesitated to do so, while I have investigated and tested the matter in every way I can think of, and I have not been able to come to any other conclusion, the graphical method I adopt being very favourable to the discovery of any inequality in the motion of these bodies, while, from the mathematical method, though causing great difficulty, it might remain long undiscovered. Such, I think, has been the case with the present comet.

It seems to me there is nothing very improbable in the supposition that the comet may have passed through a dense portion of some meteor stream, and so have been deflected a little from its previous course.

I should like to direct your readers where to look for the comet when it is again seen above our horizon. My last observation was on June 3rd, and four weeks is a long way ahead, around so close a perihelion passage, to predict with accuracy. Asking, then, for the indulgence of your readers in this matter, I would say, search for the comet about 10° to the left of the planet Venus, at 9h. 30m. on July 1st, R.A. 9h. 40m., Dec. N. 14°, this point setting a few minutes after the planet. On subsequent nights the comet will be a little more distant from Venus, and set a little later. It seems that the comet will pass near the Earth's orbit about July 10th, near the place occupied by our planet on April 12th.

J. Lane.

29, Wyvis-street, Bromley, E., June 17th.

WORK DONE BY AN 8·5in. BROWNING-WITH REFLECTOR, 42 COMÆ BER., 25 CANUM VEN., Σ 1772, Σ 1819, β 224, ζ BOÖTIS, ε BOÖTIS, ξ BOÖTIS, 1 (B) CORONÆ BOR., η CORONÆ BOR., μ² BOÖTIS, δ SERPENTIS, O.Σ. 298, β 619 SERPENTIS 55, β 355, λ OPHIUCHI, Σ 2062, ζ HERCULIS—THE ORBITAL MOTION OF SIRIUS—OBSERVING WEATHER IN NORTHUMBERLAND.

[20181.]—I think Mr. C. Gaudibert (No. 898, p. 305, letter 20120) must be congratulated on possessing an exceptionally fine instrument if he can clearly divide 42 Comæ Ber. and 25 Canum Ven. It is a With-Browning reflector of 8·5in. aperture. Now, according to Dawes, the least separable distance of an object-glass of that aperture is 0·536″. Of 42 Comæ Ber., Dawes writes (quoted by Gledhill):—"It is one of the closest of Σ's discoveries. It requires the finest and largest telescopes." O.Σ. found it single in 1870, and the same observer gives the distance of the components at 0·30″ in 1874. Dunér measured it in 1875, and gives the distance 0·32″. The Washington observers in 1876 give the distance varying between 0·38″ and 0·42″, and Jedrzejewicz, in 1880, found it "oblong," but β, in 1879, gives the distance 0·68″. I have measured it on three nights this year, and find the vacancy 0·5″, 0·3″, 0·4″ respectively, giving a mean of 0·4″. I do not think the distance, as it is at present, is understated. Smyth could never fairly divide it, and Chambers's note on it is: "This binary is as remarkable for the closeness of its components (even when at their maximum distance), as for the shortness of its period, which is certainly no more than about 25 years. Observations of it are at all times very difficult." Now, assuming that Dawes' rule as to the least separable distance of an 8·5in. object-glass holds good for a mirror of that aperture, this star ought to be beyond the reach of Mr. Gaudibert's instrument; and if he sees a "black division between the discs (which he doubtless does), I think, in any case, his mirror must be a very fine one (which we should expect as Mr. With's handiwork), and it also raises the question whether a really fine mirror does not possess superior defining power to an object-glass, equally good, of the same aperture?

In regard to 25 Canum Ven, he merely elongates this difficult and unequal pair; but if he really sees the companion (which I do not doubt), I consider it a very wonderful feat, both for his aperture and eye, for this star is far more difficult than 42 Comæ Ber., and a much severer test. From 1856 to 1875 Secchi, Dembowski, Dunér, Wilson, and Seabroke, the Washington observers, and Gledhill found it "elongated" or "single." Schiaparelli measured it in 1876, P = 161·03°, D = 0·42″. β also measured it in 1880, P = 155·0°, D = 0·60″. I did not see the companion in 1881. Indeed, during the apparition of the star there was no night good enough to give me a chance of doing so; but I have made six measures of it this year, with the result stated in my last letter.

From 1833 to 1841 the angle was from 70° to 72°, and "O. Σ's." interesting note (quoted by Gledhill), says:—"The feeble angular motion from 1833 to 1841 indicates that the satellite was in aphelio in that period. The apparent ellipse is evidently very narrow. We shall probably see the companion emerge from the rays of the principal star under an angle of position between 180° and 90°. If so, the period of revolution does not greatly exceed a century." Doberck has assigned a period of 124 years. The inequality of the components (5, 7·6) as well as their closeness, demand that telescope, eye, and atmospheric conditions shall all be of a high order. I should certainly have thought it was beyond the reach of Mr. Gaudibert's aperature; but I am glad to see he is able to deal with it.

If you can spare the space, it will doubtless add much to the interest of my measures if I give comparison ones at intervals of a few years—at least in the case of rapid binaries—together with brief explanatory remarks. For these I shall be indebted almost entirely to Mr. Gledhill's "Handbook of Double Stars."

In continuation of my measurements, we have:

Σ 1772. R.A. 13·37. Mags. 5·8, 8·2.
P = 236·0° D = 2·65″ Ep. 1882·40

Gledhill truly calls this "a beautiful pair." He says it is a binary, and gives the colours of the components, A, yellow; B, very blue; remarking that the colour of B probably changes. I find it a purplish blue.

Σ 1819. R.A. 14·9. Mags. 7·9, 8.
P = 199·0° D = 1·3″ Ep. 1881·39
P = 198·6° D = 1·2″ Ep. 1882·38

A slow-moving binary discovered by Σ.

β 224. R.A. 14·7. Mags. 8·9, 9·3.
β, P = 71·0° D = 0·67″ Ep. 1875·7
Perry, P = 60·0° D = 0·41″ Ep. 1882·38.

One of Burnham's discoveries. There appears to be a diminution of both angle and distance, if my measures are correct. It is by no means difficult.

ζ *Boötis*. R.A. 14·35. Mags. 3·5, 3·9

P = 297·0° D = 0·72″ Ep. 1880·50
P = 294·3° D = 0·65″ Ep. 1881·39
P = 298·0° D = 0·57″ Ep. 1882·38

ε *Boötis*. R.A. 14·39. Mags. 3, 6·3

P = 329·0° D = 2·82″ Ep. 1882·37
P = 328·1° D = 2·58″ Ep. 1882·41
P = 327·5° D = 2·27″ Ep. 1882·42

H_2 says of this very beautiful binary—if it be such—that it is "one of the most difficult stars to measure correctly, Rigel excepted." His father, H_1, remarked that it "has the appearance of a planet and its satellite, both shining with innate, but differently coloured light."

ξ *Boötis*. R.A. 14·45. Mags. 4·7, 6·6

P = 269·0° D = 4·24″ Ep. 1880·52
P = 273·0° D = 4·7″ Ep. 1881·40
P = 271·0° D = 4·1″ Ep. 1882·39

1 (B) *Coronæ Bor*. R.A. 15·14. Mags. 5·6, 6·1

P = 302·5° D = 1·0″ Ep. 1881·39
P = 304·5° D = 1·1″ Ep. 1882·38.

η *Coronæ Bor*. R.A. 15·18, Mags. 6·7, 7·3

Dembowski	P = 44°0	D = 1″04	Ep. 1870·38
Gledhill	P = 44·6	D = 1·1	,, ·44
Dembowski	P = 66·0	D = 1·86	,, 5·41
Gledhill	P ≐ 71·6	D = 0·7	,, 6·34
Doberck	P = 92·6	D = 0·61	,, 8·40
Burnham	P = 114·3	D = 0·46	,, 80 62
Perry	P = 119·1	D = 0·46	,, 1·40
Perry	P = 133·4	D = 0·34	,, 2·38

This is a rapid and remarkable binary. Its period appears to be about forty-three years. From the above measures it will be seen that it is now closing up, and its change of angle is very rapid.

μ^2 *Boötis*. R.A. 15·20, Mags. 6·7, 7·3.

Dembowski	P = 166°·1	D = 0″62	Ep. 1870·39
Wilson and Seabroke	P = 151·0	D = 0·45	,, 3·25
Dembowski	P = 141.9	D = 0·69	,, 5·41
Wilson and Seabroke	P = 147·6	D = 0·7	,, 7·44
Doberck	P = 137·7	D = 0·63	,, 8·49
Jedrzejewicz	P = 122·5	D = 0·6	,, 80·65
Perry	P = 122·0	D = 0·7	,, 1·41
Perry	P = 115·3	D = 0 4	,, 2·39

H_2 says: "This star is a severe test for a telescope," and delares that "none but the finest are competent to deal with it." Dawes says, "It requires a superb night." Chambers tells us that "the recent values for the period of this star differ widely." They range from 314 to 182 years.

The published measures seem to show that the distance between the components has varied (since its discovery in 1781) from the greatest, 1·69″, given by H_2 and South in 1823, to the least 0·31″, given by Mädler in 1851.

δ Serpentis. R.A. 15·29, Mags. 3, 4.
P = 191·5°. D = 3·8″ Ep. 1880·59.

Gledhill says that one of the components is probably variable in its light.

O Σ 298. R.A. 15 31, Mags. A, 7; B, 7·3
A B. P = 176 0°. D = 0 31″ Ep. 1881·40

A difficult star, the published measures of which appear to be somewhat remarkable.

β 619 Serpentis. 55 R.A. 15·37, Mags. 6·5, 7
Burnham, P = 359·7°. D = 0·57″ Ep. 1878·3
Perry, P = 0·0°. D = 0·41″ Ep. 82·38

One of Burnham's discoveries.

β 355. R.A. 16·4. Mags. 7·3, 8.

Burnham	P = 279°·3	D = 0″34	Ep. 1876·3
Perry	P = 267·5	D = 0·31	,, 82·40

Also one of Burnham's discoveries. It was clearly and neatly divided.

λ *Ophiuchi*. R.A. 16·24. Mags. 4, 6·1.

Washington observers,	P = 36°·1	D = 1″·45	Ep. 1876·44
Perry,	P = 38·0	D = 1·41	,, 81·39

H_1 says of this star:—"The object is uncommonly beautiful; but it requires a most excellent telescope to see it well. . . . The appearance of the two stars is much like that of a planet with a large satellite or small companion." It is a binary, but its period is variously computed at 88, 95, and 233 years. Chambers says the latter is most correct.

Σ 2062. R.A. 16·28. Mags. 8·3, 11.

P = 112°·0 D = 2″·6 Ep. 1881·38

In the "Observatory," Vol. III., p. 381, Mr. Gledhill makes an appeal to amateur astronomers possessed of large telescopes to examine certain stars, a list of which he gives. This is one of them. He says:—"Dembowski could not see the companion in 1865; Burnham saw it in April, 1874, but it was invisible on a very fine night in June of that year. He saw it well in May, 1875; distance, 2·8″."

ζ *Herculis*, R.A. 16 3; Mags., 3, 6·5.

Dembowski,	P = 190°·8	D = 1″09	Ep. 1870·49
Dembowski,	P = 149·0	D = 1·41	,, 1875·52
Doberck	P = 124·9	D = 1·28	,, 1878·61
Perry	P = 111·5	D = 1·2	,, 1880·67
Perry	P = 108·8	D = 1·0	,, 1882·41

A very remarkable binary, discovered by Sir William Herschel, who remarked:—"My observations of this star furnish us with a phenomenon which is new in astronomy; it is the occultation of one star by another." This was in 1803. It describes an orbit whose plane is nearly coincident with the visual ray. From 1828 to 1831 it appears to have been single; but in 1834 the companion was plainly seen again by Σ. Gledhill says:—"The sudden reappearance of the *comes* at first led him (Σ.) to suspect that variability was the cause of the difficulty he had so long experienced, and he was much surprised to find the companion in almost the same straight line as that in which he saw it eight years before. Great was his delight, on copying the observation into the book containing mean results, when he found that the *comes* was in the same line nearly, but in the opposite direction. There had been an occultation, and all the difficulty which had so often vexed him for eight years was completely explained." Σ. says this star "offers the astounding velocity of an apparent and very elliptical orbit revolving in little more than 14 years." Other computers, however, make the period from 31 to 36 years.

Your readers will not have failed to notice the exceedingly interesting item in your report of the Greenwich Visitation (No. 898, p. 802), in regard to the motion of Sirius, by which it appears that the spectroscopic observations on this star "reveal a progressive diminution from about 22 miles a second, in 1877 and 1878, to about seven miles a second, or less, this year; and, as other stars do not show anything similar, it appears likely that the change is due to the orbital motion of Sirius."

I am sorry to say the observing weather here has been very little, if any, better than it was last year, and my opportunities of taking measurements are rare.

Jevon J. Muschamp Perry.
St. Paul's Vicarage Observatory, Alnwick.

HOW TO MAKE A FLAT FOR A NEWTONIAN REFLECTOR.

[20182.]—I WILL describe a method that will suit the amateur better than the usual trade method, which is hard work, and, as 20 or more are made at once, is, of course, economical, but is beyond the requirements of the amateur. I can speak of its results being highly satisfactory to myself. Plate-glass (polished) offers a good start for flat-making. Any sort will do; I prefer, however, the St. Gobain or Union plate. Supposing that a flat 1in. in the minor axis is required, a circle 4⅛in. in diameter and not less than ¼in. thick must be obtained. This should be cut well away from the edge of the sheet. This is important, as the edges of plate-glass are much rounded off, and that would prove detrimental in this mode of working. If the operator has a pair of "shanks," or makes a pair, and he will require them further on in the process, he could get a square of glass and chip it round himself.

The "shanks" are very simple and useful tools, made of wrought-iron rods 7-16in. square. I give a sketch, Fig. 1. Length from rivet A to thumb-loop B, 7in., the loops 1⅛ by 1½ inside measure. There is no great nicety required about them; the rivet should be loose and easy. The mode of using the shanks is to hold them like a pair of scissors, then nibble off very small chips until the glass is nibbled into the required shape.

FIG. 1.

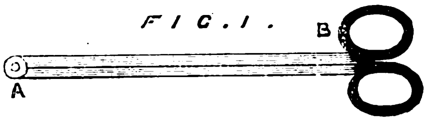
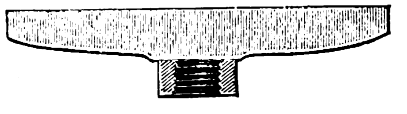


FIG. 2.



Three tools of brass or iron are required for grinding the surface; the diameter the same as the glass disc to be worked; these tools should be ¾in. thick in the middle, furnished with a screw-boss. Fig. 2 will give an idea.

The surfaces of these tools should be turned true across in a slide-rest lathe, then scraped and ground to fit together accurately, in any order; I will call them respectively, Nos. 1, 2, and 3. 1 and 2 must fit, 1 and 3 must fit, and 2 and 3 must fit—thus, each is a perfect plane. The mode described for specula tools will fulfil all the requirements of this set of tools.

It should be borne in mind that the absolute flatness of the tools in the first place is of the first importance. Any attempt to produce a perfect plane by using one surface only must fail. When the grinding-tools are got to perfect fitting, No. 1 serves the purpose of holding the disc of glass throughout the grinding and polishing processes. A mixture of 1 part resin and 4 parts beeswax is suspended inside an earthen pot in a piece of cambric—an ordinary jam-pot will do. This should be melted and strained through, by being placed in an oven if possible. A cover of card, or tin—no matter what, in fact, to keep out grit—should be placed over it while the double process of melting and straining is going on.

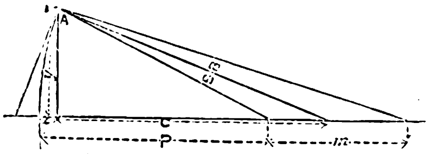
The tool, No. 1, now heated sufficiently to melt the cement into flowing, should be placed, when covered with cement, in a level position over a gas-stove or spirit-lamp. The glass circle, warmed, must be placed on the tool, and gently and evenly pressed down as close as possible. When the tool and glass are perfectly cold, tool No. 2 is secured on the "bench screw" or post, described in the letters on specula working.

No. 2 emery, or the flour emery of commerce, should now be used with water, and the glass ground "up" or made to fit the surface of No. 2 tool. This is best done with straight strokes in grinding of a length equal to half the diameter of the tool; that is, you expose the middle of the tool at each rub. Care must be taken to rotate the glass by a uniform motion, one revolution in 50 strokes is enough. When all the polish is ground off the surface being dealt with, the flat can be smoothed in the same manner as specula, with this difference; tool No. 3 must be used for the last emery's, the No. 6 described in my letters on specula working. As there would be a lot of travelling over old ground, I must ask our readers to refer to the letters mentioned many times yet, to save valuable space. **Prismatique.**

(*To be continued.*)

PARABOLISATION OF SPECULA.

[20183.]—I TRUST the following investigation will suit Mr. Wassell in his experiments on the parabolisation of specula (letter 20142). Referring to the accompanying diagram—



$$\frac{2x}{y} = \frac{y}{c} \therefore c = \frac{y^2}{2x}$$

$$\tan.\ A = \frac{P - x}{y}$$

$$\tan.\ (A + B)\ \frac{y}{2x}$$

$$\tan.\ B = \frac{y^2 - 2x\,(P - x)}{2\,xy + y\,(P - x)}$$

$$\therefore \tan.\ (A + 2B) = \frac{3xy^2 + y^2p - 4x^2p + 4x^3}{4xyp - y^4}$$

$$\therefore P + m - x = \frac{3xy^2 + y^2p - 4x^2p + 4x^3}{4xp - y^4}$$

$$\therefore m = \frac{2y^2p + 4xy^2 - 2y^2x - 4xp^2 + 4x^4}{4xp - y^2}$$

Now, $y^2 = 4fx$, where f = the focal length, or $\frac{1}{4}$ the parameter—

$$\therefore m = \frac{32f^3P + 8f^2y^2 - 16f^2P^3 + y^4}{16f^2P - 16f^3}$$

This equation holds for any values of m, p, and y.

If, therefore, we make $p = 2f$, then P will be the radius of curvature, and we get—

$$m = \frac{2p^2y^3 + y^4}{2P^3}$$

Perhaps some of our friends will kindly verify the above result.

W. H. G., Braintree.

ON THE ABERRATION OF A PARABOLIC SPECULUM.

[20184.]—Now that the aberration of reflectors is being discussed in these pages, I am glad to be able to contribute the following particulars, which have been supplied by your esteemed correspondent, Mr. J. A. Brashear. He, having brought the subject before the notice of Dr. Hastings, received from him a very explicit letter, confirming my algebraical analysis. As Mr. Brashear has kindly given me permission to publish this letter, I now do so; and I think it will be admitted that it contains the best and clearest explanation of this abstruse matter that has yet been given. I quote the following passages from Mr. Brashear's letter to me—they will be read with interest:—

"Dr. Hastings writes me that you are correct, which I had concluded some time ago from practical experience, though I never give any of my specula quite so much aberration as in your formula, for the evident reason that it is impossible to get the focus of the exact centre. One must take a zone large enough to yield light enough to test it, and that is, generally speaking, about as large as the flat. Secondly, one cannot depend on the extreme edge, as it, with the best workmanship, usually 'rolls back' slightly; so the formula of Dr. Draper, used in this way, is not far from correct; but it is plainly evident that in mirrors of small angular aperture, your formula is correct if the curve of the mirror is taken from centre to extreme edge.

"Two 10in. mirrors of Calver's make, tested by me, had a spherical aberration at centre of curvature, only half your formula. I studied them many hours, and speak from actual tests; they were beautiful in regularity of curve."

Dr. Hastings says:—

"Your perplexity concerning the aberration of a parabolic mirror at the centre of curvature is a natural, but amusing one. It affords a capital illustration of the difficulties which 'theoretical' and 'practical' opticians have in understanding each other. I give you a graphical explanation, which, I hope, may help you.

"Let V P (Fig. 1) represent a spherical mirror, with centre at C and V F = ½ radius = ½ R. Let ray S P, parallel to axis, fall on element P, then it will be reflected so that S P C = C P F′, and F F′ = V P² / 2R* (this is true to first approximation, which is as far as our assertions hold good). Now, if we wish that P F′ should correspond to P F; in other words, that there should be no aberration for parallel rays, we must rotate the element P by an angle equal to one-half of F P F′. This will make the element P correspond practically (if the rotation be accompanied by an almost infinitesimal displacement outwards rigidly) with the element of a parabola, having its vertex at V and centre of curvature (= centre of osculating circle at vertex) at C. By the rotation of the element P the direction of its normal has been changed from P C to Pn_1 such that angle C Pn = ½ angle F P F′. If, now, we make C a source of light, we are in a position to calculate the aberration of the parabolic mirror at the "centre of curvature." It must be observed that the quantative statements which follow are only true to the "first approximation"; or, in other words, practically true when V P is small compared to V C.

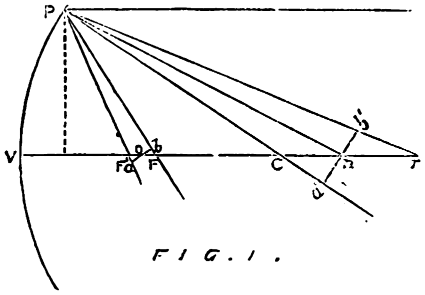


FIG. 1.

"Evidently any ray diverging from C and incident very near V will be reflected back again to C; but as the point of incidence is removed from V, the point of intersection of the reflected ray with the axis will fall farther and farther to the right of C. Consider the ray C P incident on the element P of the *parabola* P V; it will be reflected in the direction of P r, so that angle r P n = angle n P C; and the distance C r will be the aberration of the parabola with semiaperture V P at the centre of curvature. It is evident that $a'\,b' = 2\,a\,b$, since angle b' P a' = angle b P a and P n = 2 P o; but F′ F = $a\,b$ / cos. $b\,o$ F = $a\,b$ / sin. P o V = $a\,b$ / sin. S P o, and in the same way C r = $a'\,b'$ / sin. S P n = $r\,a\,b$ / sin. S Pn. From the law of reflection, however, we see that angles S P o = 2 angle S P n, and, since the angles are small by supposition, sin. S P o = 2 sin. S P n and Cr = 4 F F′ = V P² / 8 R = V P² / 16f.* Possibly you are not as accustomed to think in the language of Trigonometry as in that of Geometry, in which case the following demonstrations may be more acceptable, remembering always that the equations are only true when angle P F V is so small that it may be regarded as equal to P O V, &c.

"O F : ob = F P : P A ∴ oF = ob × F P / P A. F F′ = ab × F P / P A; nr : nb' = Pr : P A ∴ nr = nb' × Pr / P A = nb' × 2 F P / P A. Cr = 2 $a'\,b'$ × F P / A P = 4 ab F P / P A = 4 F′ F.

"Thus we see that the mathematical optician is right; *but* it should not be overlooked, that by no purely experimental method can one find the point C. What Dr. Draper and you find in experiment is not the centre of the circle osculating at V, but what might be called the *average* centre of curvature, which lies nearly midway between C and n (its exact position depends upon the manner in which average is defined, or, in terms of experiment upon the *method* by which it is sought). If it be assumed as lying exactly midway between C and n, the aberration corresponds practically with Dr. Draper's formula, and with your experience; since the precise focal distance for rays very near the centre is of no consequence. True, it may be urged that Dr. Draper ought to have protected himself against such criticism by properly-chosen limitations; but it seems to me that one could condemn with equal or greater justice a procedure which offers as a practical guide laws referred to a point which is absolutely incapable of a physical definition."

I think the above explanation will make it quite clear that the theoretical quadruple ratio is correct, which is, of course, all I contended for. Dr. Draper's double ratio may be a more convenient "working" formula—that point must be settled by practical men; but it seems to me that the objection which applies to the greater ratio, applies with equal force to Draper's ratio. The correctness of the former depends upon the accuracy with which the point C is ascertained; that of the latter upon a point lying midway between two extremes, of which C is one. Now, if neither of these extremes can be accurately fixed, by what method can we assure ourselves that we have hit on a point midway between them. Unless the place of the radiant point can be unerringly decided upon, this method of parabolisation is totally useless, for a very slight change in position may give either double or quadruple aberration. But if the mirror is made accurately spherical, before parabolisation is attempted, the position of the centre must be better known, than any other succeeding point can be known, and it must be the standard by which alterations must be made. The place of the lamp aperture is quite as important a matter as that of the sliding shutter, for unless we work from a fixed radiant point, no accurate judgment can be formed of either shadows or aberration.

Dr. Hastings has done good service in bringing forward the importance of the position of the radiant point; his letter is the most authoritative that has yet appeared on the matter, and Mr. Brashear deserves the thanks of all the readers interested, for allowing it to be published. I earnestly commend this subject to the consideration of Mr. Wassell, and other adepts in the use of the Foucault test. While a variation in the position of the lamp equal to one-half of the quantity sought either diminishes by half or doubles that quantity, I am inclined to think this method is not so easy to apply as the simplicity of the ratios would lead one to think.

There is this practical consideration in favour of Dr. Draper's rule: that as the margin is apt to "roll back," we can generally depend upon the mirror having more aberration than what is reckoned upon. When we know the tendency of any mechanical process, it is better to allow a slight margin in favour of under-correction rather than run the risk of overdoing it. However correct a rule may be theoretically, we cannot be certain of working up to it mechanically: where we have to judge one error by another, definite comparisons are not easy.

Orderic Vital.

NEW COMBINATION OF ALTAZIMUTH AND EQUATORIAL MOUNTING.

[20185.]—MR. GODFREY'S criticism (p. 328) of Mr. Grubb's combination mounting would have been more satisfactory had he indicated the "mistake which an optician should avoid," and also explained the principle of Smeaton's block. I am sure that many, besides myself, would be greatly pleased by a sketch of the latter arrangement. So far as my examination of Mr. Grubb's telescope went, it seemed quite steady, and I cannot imagine an optician of his eminence falling into such an error as Mr. Godfrey seems to think. Perhaps, however, I am the cause of a misunderstanding. It is due, however, to Mr. Grubb to state that he is in no way responsible for my description and sketches of his instruments, and that they were only the outcome of an afterthought.

More Light.

ASTRONOMICAL EYEPIECES.

[20186.]—"PAUGUL" has an excellent opportunity of establishing his position as a teacher of practical optics, by explaining in these pages how the crossing of the rays may be *experimentally demonstrated*. He has already been kind enough to offer me a private demonstration "by the help of lenses, how the rays go," but this I cannot accept. I hope, therefore, he will allow me to transfer my interest in the description for the benefit of our readers. **Aldebaran.**

ON THE ACTION OF EYEPIECES.

[20187.]—I RECOGNISE in "Aldebaran" a very able practical correspondent, and though he seemed to have got into a little difficulty about his imaginary cone, I do not see much of the "paradoxer" in him. Disregarding the mere literal meaning of this word, I imagine a "paradoxer" to be one who is so stupid that he neither can nor will see that anyone but himself is right. "Aldebaran" is certainly *not* one of this objectionable but fortunately insignificant class. The eye acts as a very perfect convex lens, and the curved form of the retina is admirably adapted for receiving the image. Were it not for this, our field of view would be very limited and distinct vision attained only about the visual axis. But owing to the adaptation of the retina, rays—or rather pencils of rays—crossing the axis are more or less perfectly focussed.

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* There must be a slight mistake here: the focal aberration F F′ is V P² / 4 R or V P² / 8f. Hence the central aberration 4 F F′ is V P² / R or V P⁴ / 2f.

There is nothing in the phenomena mentioned by your correspondent inconsistent with the theory of parallelism of incident visual rays; on the contrary, it is in precise agreement. I do not see that there is need for much explanation, and as no good can arise by prolonging the discussion, with a few general remarks I will conclude my notice of this subject. Does not "Aldebaran" know that images formed by natural vision are inverted? Hence, an inverted telescopic image will be erect on the retina. The image seen by the bystander is a reflected one; it is caused by the cornea acting as a convex mirror. If he could simultaneously see the retinal image, he would find that was erect also.

"Aldebaran" said very truly (p. 263)—"A re-inverted or erect image may be rendered visible by holding a screen to receive the rays after they have crossed." Precisely the same effect occurs when the eye is used; the image is modified, not altered, in character, only the rays must have a certain disposition to enable it to do this.

Orderic Vital.

GRINDING AND POLISHING GLASS SPECULA.

[20188.]—"Orderic Vital" is quite right in supposing that a round luminous point is usually used for testing in the trade. The very ingenious iris of our much-esteemed contributor, Mr. Wassell, is very convenient, and my judgment leads me to suppose the shape of the point is not so important in zone-testing as it is in testing from centre of curvature with an eyepiece. The extreme smallness of the hole, I should say, is what is required in the shadow test, as there is no magnification of the objective itself in the usual sense.

Prismatique.

OHM'S LAWS OF ELECTRICITY.

[20189.]—Your correspondent in letter 20171 is, no doubt, bothered with the meaning of the term I in the formula $I = E / R + r$, generally known as "Ohm's Law." The true meaning of this formula is that $R + r$ stands for the whole resistance of circuit, E for the electromotive force, and I for the magnetic effect in the galvanometer, which used formerly to be called quantity. It does not mean intensity. What the old electricians called intensity is now named electromotive force, but this term I is at present often called intensity, which is true only for the magnetic, but not the electrical action.

Ohm's law would be better understood if it were stated that the magnetic action of a current of electricity, or the chemical action in a proper voltameter, is in direct proportion to the electromotive force, and in inverse proportion to the whole resistance of the circuit.

If the experiments supposed (page 331) were tried, a galvanometer would read in accordance with the calculations; but the readings would not show the amount of power used unless you also consider the chemical action in the batteries. For in the case where $R = r$, then $6\,E / 6\,R + r = {}^{6}/_{7}$; but the work in the battery by chemical action is ${}^{6}/_{7}$ for each cell, and for six cells will be $6 \times {}^{6}/_{7} = 5\,{}^{1}/_{7}$ total work in battery for ${}^{6}/_{7}$ work in the outside resistance; and when $1\,E / {}^{1}/_{6}\,R + r = {}^{6}/_{7}$, the chemical action in the battery is still ${}^{6}/_{7}$ for one cell, although the surface is six times the size; so that in this case we obtain the same work as before at six times less cost of zinc and acid. I trust this will explain the matter to your correspondent's satisfaction. He can, no doubt, work out the cost in the other cases in the same manner.

J. Sutcliffe.

[20190.]—All the calculations given by "Stud. Inst. C.E." (letter 20171) are correct. If the external resistance r is equal to the resistance R of one cell, the best arrangement will be either by twos or threes; but if the external resistance is one fourth of the resistance of one cell—then the best arrangement of the six cells is in series. It may easily be shown from Ohm's Law that the best arrangement will always be that which makes the internal resistance of *the battery* equal to the external resistance. In the examples given, this is *most nearly* the case, when the internal resistance is 6 and the external resistance 4 in the first case, and in the second when the internal resistance is either $2 \times \frac{1}{3}$ or $3 \times \frac{1}{2}$, the external resistance now being one.

X.N.X.

[20191.]—It is not easy to see what difficulty the writer of letter 20171 has in reading the formula given. In the second case, where the cells are coupled two abreast, the resistance of each is thereby halved, and we, therefore, have $I = 3\,E / 3 \times \frac{1}{2} + 4 = 3\,E / 5{\cdot}5 = 6\,E / 11$. In the case where the cells are arranged in two three-fold elements, the resistance of each element is only one-third of the original value, and we have $I = 2\,E / 2 \times \frac{1}{3} + 4 = 2\,E / \frac{2}{3} + 4 = 6\,E / 14$. There is an error in the formula as given, $\frac{1}{2}$ being written instead of $\frac{1}{3}$; but, of course, I do not know whether the error is in the book or the letter, or has occurred in the composing-room.

In the last case, where the cells are joined in multiple arc, the resistance is only one-sixth; therefore, $I = E / {}^{1}/_{6} + 4 = 6\,E / 25$. The querist should have mentioned the book he referred to, and given the page he wanted explained, and then he might have saved himself the trouble of writing so much, saved you the expense of engraving the very commonplace diagrams, and economised space.

Wm. John Grey.

Elswick Science School, Newcastle-on-Tyne.

PRIMARY AND SECONDARY BATTERIES.

[20192.]—Years ago, when I observed the waste of power arising from the blowing off of steam through the varying work upon which it was employed, I used to think that means might be devised for storing up the wasting power, by means of an electro-magnet engine automatically attachable to the engine's safety-valve, so as to act reversely upon a galvanic battery, and thus to redeposit the zincoid element which had been previously oxidised. I considered also that this principle might be applied to economise the uphill locomotive power required for vehicles by storing up the wasted downhill gravitating power for use when required.

I had these ideas long before secondary batteries were ever heard of, and am of the same opinion still as to these ideas.

But it is not every kind of battery which would answer the required conditions for success, for it is only one class of battery which would suit; and, practically, only one, and that is Daniell's. The batteries at present in vogue all give off gas, and by so doing, one of the elements—a combustible substance—is lost, thus preventing a recomposition, and the zincoid from being redeposited; and not only so, for a certain amount of energy is lost in the latent heat required to form hydrogen as gas, from its fluid state, as an element of water.

But in a Daniell's battery, after working, we have all the original elements still present, enabling us to recompose, to the extent it had been spent, by restoring the same amount of power as it had given out in working; and this we may do by reversing the motion of the e.m. engine (previously actuated by the battery), and applying the power of another motor—say, a gas-engine.

There is, however, one circumstance which would require to be provided for, and that is, that whereas in using the battery for work, our store of crystals was at the top of the fluid, so as to effect saturation by means of gravitation, when we are putting work into the battery, the reformed crystals (or granulations) would naturally fall to the bottom, and, unless roused up by some contrivance, saturation would be imperfect and the chemical conditions imperfectly attained. This, however, in no way affects the correctness of the principle of working a battery backwards, and could easily be provided for.

In order to make clear the chemical and electrical relations of Daniell's battery at work, and in being recharged, and to show the case as parallel with what takes place in the secondary batteries as now used, I will put the matter thus:—

First, the batteries side by side at work.

Battery's Cr. by
——> x-power ——>
Pb + 0 Pb − 0
——> x-power ——>
Zn + 0 Cu − 0

Recharging thus—

Battery's Dr. to
<—— x-power <——
Pb − 0 Pb + 0
<—— x-power <——
Zn − 0 Cu + 0

Any intermediate chemical action which may possibly be taking place, may be disregarded, seeing that the decompositions are exactly balanced by like recompositions; and the effect will be practically, therefore, as above shown, which is meant as an equation both ways.

To put the matter, now, in a practical way; suppose I employ a Daniel's battery to propel a vehicle by means of an electro-magnetic engine, and arrive at a descent, and desire to moderate the speed, there are three resources—1st, moderating the current; 2nd, cutting off; 3rd, reversing, and allowing work to be put into the battery with a current more or less modified to suit; the power being supplied by the vehicle through its descent; therefore, when arriving at home again, the cost of materials will be practically the same as if I had travelled all the way on a dead level. I next connect the electro-magnetic engine to the gas-engine, rotating it the reverse way, or instead, reversing the connections, and restore zinc to the zinc plates, and redissolve the deposited copper: this is of course effected by a reverse polarising of the plates; and thus my battery is as good as new again, and the expense, due only to the working of the gas-engine at home; and my apparatus is ready for another trip.

I am aware that there is some loss of power in the using of secondary batteries; but as this does not diminish the materials of the battery, the little extra expense would be for coal or gas.

The principles I have here put forward with a view to the construction of a Daniell secondary battery seem to me so obvious that "I should not be surprised to hear" that somebody had known it before, and that I am "teaching my, &c." But if so, why are people seeking to do the thing in another form, when they have (as it were) a Daniell at hand. Be this as it may, I shall be glad to find in these pages that trials have been made, and the results success.

Barry-road, S.E. **J. H. Huxley.**

P.S.—To save amalgamation, perfectly pure zinc should be used in the first instance, and as the redeposits are also pure, amalgamation need give us no concern, as there would be no local action in that case.

LECLANCHE BATTERIES WITH AND WITHOUT MANGANESE.

[20193.]—In reply to "Arch Key," I can mention a case where I was called in to see about eight batteries of three and four cells each, which had failed in about a month. These contained manganese and carbon, identical with the old Leclanché. Now, had these been made up without manganese, you would certainly have laid it on the absence of that mysterious manganese. Is it by virtue of its presence that it acts? I have had 100 cells of the Company's make to maintain, and quite 10 failed entirely every month. Remedy:—Take to pieces and well wash. Two cases here by would-be electric bell fitters'. They cannot get new cells to work. Another case: a gentleman divided a pennyworth of sal-ammoniac between three cells filled up with water—failed next day. Had the latter few cases contained no manganese—jump at the conclusion. I could cite a great many cases more. I only wish the addition of a few lumps of manganese would make some cells as strong as others are; some are 50 and some 90 per cent. stronger than others, although manganese cells. Manganese after 10 years in a sal-ammoniac cell is just as clean as the first day, not the slightest reduced; there can, consequently, be no action. Then why do these cells fail?

George Tolman.

ELECTRIC MACHINES, SYMPIESOMETER, AND CROWN-GLASS ACHROMATISM.

[20194.]—With a view to help amateurs, I wish to say that I have constructed a thoroughly efficient frictional machine, at a very trifling cost, by making the wheel of stout sheet (32oz.) instead of plate; it is 14in. diam.

The advantages of the sheet are:—Cheapness, facility with which it is cut round and made passable on the edge. I did mine with an American glass-cutter and a piece of whetstone; then the hole does not take so long to make, it also warms up quickly, being only ⅛in. thick; and, finally, if it does break, it does not cost much more than 9d. and the labour to put another on.

The drawback is its crookedness. To remedy this, I used a modified rubber, which consists in mounting the rubber on the end of as long a rod as the stand will take; then, with a screw at the other end, the rod is both fastened and pivoted, to allow the rubber to wag with the crooked plate, which plate must be selected to be as flat as possible.

My plate is mounted on an iron spindle, supported on wooden standards, and I find that the only place where there must be first-rate insulation is the stand of the collector or prime conductor, which must be an ebonite or glass rod, or a glass tube closed hermetically at the ends.

I have for some years noticed a phenomenon in sympiesometers which I should like a little explanation of, with the object of making the instrument more perfect.

The phenomenon is a gradual rising of the fluid in the tube. My tube is about 30in. long, and very carefully graduated, in accordance with the laws relating to the compression of gases, so that it gives accurate exhibition of every change of pressure on a scale of about ·9 to 1 of the mercurial, but after some months I find all its indications two or three-tenths higher than they ought to be. I then let in a bubble of air, which lowers the column to a correct height, only to find it too fast again by-and-by. I think my present instrument gains about ·1 in three months. I have seen the occurrence in a water and in an oil column. If any of "ours" can tell the reason of the above, I will, as a return, send a method of dividing the scale so that the readings are very true indeed, as compared with the mercurial column.

Allow me just here to state that although a "Robinson Crusoe" is at present writing to "ours," he is not "Rob. Crus.," and I wish to sign myself thus because I always have done so, and I am now writing on the old subject. Letters will be found in back volumes on optical matters, more especially on economical micros.

I there set forth pretty clearly what could be done with crown or plate lenses; I now should like to say a word on what cannot be done—viz., a combination of lenses cannot be made to produce achromatism in the way suggested by Mr. Penny, p. 273.

1. Then Mr. Penny says, that in order to compare the ordinary dialyte and his proposed dialyte "with regard to its achromatism, all we have to do is to write down side by side the conditions necessary for it in the two cases," then follow a long and a short equation, which I shall not need to notice.

2. In explanation of the equations, Mr. P. says "they are the equations used for making rays of different colours *emerge parallel*, and this is what is commonly meant by achromatism."

Now, to my mind, parallelism and coincidence are very different things, and it certainly is the latter which is required for achromatism; for, let an o.g., by its refractive action, disperse the colours to an extent $= x$, by the time they get half-way to the focus, it is plain that at the focus they will be dispersed to an extent $= 2x$. If, however, at the half-way point x the rays be received by a concave of half the focal length of the o.g., the dispersed rays will not come to a focus at all, but will emerge and go on in parallelism, retaining its dispersion $= x$. But clearly enough this arrangement is useless as an o.g., for it is a complete Galilean telescope; it is also plain that if the refraction of the concave be reduced, so will the dispersion be, and when our focal point is reached, the disperson will, on account of its parallelism, be nearly equal to what it is at the point of insertion of the concave.

My practice and experience bear me out. A microscope is but a reversed telescope, and in the micro. I have had an o.g. of two lenses so arranged as to give perfectly *aplanatic vision* and perfectly *parallel chromatism*, and by using parallel and central illumination of the object, and that object to be infinitely thin, I have had *exceedingly* little colour—some people saw none; but just let the light be displaced, or the object have appreciable thickness, then came the colour, and I never saw a colourless image produced by lenses until they were helped out by a *flint* concave. Nor will Mr. P. succeed in doing so either. **Rob. Crus.**

WILDBAD AND ITS CURES IN THE BLACK FOREST.

[20195.]—The frequent inquiries I have seen in your valuable journal respecting rheumatism, gout, and similar complaints, and especially lameness from accidents, induces me to send you the following account of this celebrated spa.

I am now staying at the Belle Vue Hotel, one of the most charming and well-conducted retreats I have ever seen, and so gratifying by a month's visit a desire I have long felt to visit this deservedly popular resort. Surely, the pine-scented air, the murmuring—I might say sometimes the rushing—river, the Enz, the mountain elevation (1,400ft.), the delicious waters, and *recherché* music must contribute mightily to work some of Nature's most wonderful restorations.

The history of this place, as its name declares, teems with a wild and ancient interest. Count Dillen, who forty years ago greatly enriched this place, actuated by a cure effected here on the countess, informs me that he then brought their own beds! What, then, must have been the reception of princes five hundred years ago? The archives go back to the 12th century. Innumerable fires and inundations have destroyed the village. There are traces still left of the Romans. Diana's altar is a few leagues hence. These luxurious hot springs were doubtless frequented by them, for which they had a passionate love.

Eberhard (called the great) had a medal struck in the 12th century to celebrate and perpetuate the values of the Wildbad springs. Formerly, the arrival of a stranger was signalised with all the pomp of welcome the little *cur-ort* could muster. A procession conducted him, presents were exchanged, and he was surrounded with honourable attentions. In 1513 Dr. Widman published the first treatise on Wildbad. But in 1525 when the place was full of princes, cavaliers, and abbés, 23 houses and the church were burnt down, owing to a singular custom—all the *hostels* were decorated with the arms, plumes, and banners of the noble guests, which served as fuel for a *conflagration*, a custom forbidden in future. Passing over the names of the noble worthies who have visited this place, I shall now relate the effect of the baths upon Duke Christopher in 1543. To demand the hand of the daughter of the Margrave of Brandenburg, the young duke braved the rigour of a terrible winter. The intense frost seized all his limbs. His father opposed his desire for Wildbad, as it was considered unfit for stout persons of a sanguine full habit like his son. (In this account is recorded a valuable experience, still in full effect in 1882.) He declared that contrary to the physician's advice to repair thither, many examples there were that even old healed wounds were attacked by the waters, and in the forcible *language* of the day compared his son's obesity to that of a fat hog which entirely forbad the use of these baths. But May 2nd, 1545, the duke wrote to his father—he had taken a hundred baths, and loved to refresh himself in the water. On his ascent to the throne he constructed new buildings, and the reputation of the Wildbad waters rapidly spread. Chemistry first displayed the composition of the waters in 1801, then they were *successively* analysed in 1824, 1830, and 1836. Great ravages were inflicted upon the valley in 1816 by the furious inundation of the Enz; a catastrophe now guarded against by the deepening and graving of the river bed, protected by massive stone walls. In 1837 a greatly increased stream of visitors followed the glowing description of the bath by Dr. Granville, and in the same year Dr. Fricker, who had 23 years' experience at Wildbad, introduced the use of whey (le petit lait) in conjunction with the waters.

Some of the most remarkable effects have been recognised among military invalids. In 1840, the inauguration of the Belle Vue Hotel replaced the old Bath Hotel. Wildbad owes an immense debt of gratitude to the King of Wurtemberg, and the inhabitants illuminated the place on his visit. In 1843, his queen and princess arrived, the latter afflicted with paralysis of the feet. The waters again demonstrated the truth of their ancient reputation. Their well-beloved queen testified her gratitude by munificent gifts devoted to the poor visitors, in order to signalise the wonderful recovery of the princess, her daughter. A long list of crowned heads, princes, and nobility elaborates the Wildbad records. Her Royal Highness the Princess of Wales stayed two months at the Belle Vue Hotel, attended by Sir James Paget. As for the sources of these hot springs, inasmuch as they principally rise in deep clefts of the granite, these crevasses were formerly dangerous from their width and depth. At different points the waters are collected and conducted to the baths and drinking-fountains. An immense advantage that Wildbad enjoys over its first cousin, Gastein, is the constant temperature of the water, its natural heat requiring no artificial heating. The supply appears inexhaustible. The water is constantly being renewed, and all the baths, including the spacious open baths, are perfectly purified three times a day. But to me the most astounding of all is the virtue or healing quality of these thermal springs, so apparently unaccountable. About four or five grains of various matters are dissolved in a pint of the water, but it is enriched with gases. Granting the cures—how are they effected? The water seems utterly tasteless, yet its action is often profound. Are the elements in a nascent form? Indeed, as we know oxygen has two forms—in one called ozone, which, as soon as developed, has an electric odour—can we imagine that the chemical elements are held, as it were, lightly combined by great pressure and heat applied for ages, bubbling up from great depths and, perhaps, cooling as they rise? In the bath, myriads of gas-bubbles rise from the sand, some very large; and this compound gas is extremely rich in nitrogen—nearly 96 per cent., the rest consisting of carbonic acid (champagne gas) and oxygen.

Again, the recent discovery of the *storage of electricity* suggests the possibility of these and similar waters possessing the power of storing the earth's electricity, and in some degree giving it forth to the bather. I myself received a storage of electricity from the Faure Company, contained in some leaden rolls placed in a box. This electricity had been derived from the earth by means of rotating magnets forcibly driven by steam or gas engine. All electric lighting is ultimately derived from the earth, and again this world derives it from the sun. But the Wildbad waters have been thoroughly tested for electricity by means of the galvanometer. Herman and Krebs found a deviation of 75 degrees for Wildbad. If, then, stored electricity is set free by the conducting power of the body of the bather, here we have, perhaps, some mysterious explanation of that *action* of the water which many persons perceive. Minute currents at myriads of nerve fibrils spread over the skin during the liberation of nascent gases probably *enter* the system and promote systemic changes of considerable power. Further, just as we experience at the sea side the subtle influences of minute saline particles charged infinitesimally with traces of nascent oxygen, ozone, bromine, and iodine, besides other matters, where there can be no question of quantity, so the traces of potent agencies cannot be ignored here. Fehling (about 1859) analysed the water mixed from ten different springs, and found traces of arsenic, nitric acid, boracic acid, phosphates, ammonia, lithia, baryta, strontian and manganese, and even tin. Indeed, at the sea side the air is often said to be too strong, and many persons are peculiarly affected by these minute atmospheric doses. Another thing is noticed, that the purer waters as contrasted with what are called *mineral waters* are more easily absorbed or assimilated than the latter. Contrasting, then, these two kinds, my surprise at the sanitary powers of the Wildbad hot springs is only subdued by such considerations as these:—The application and inhalation of nascent gases or other elements, the natural heat, whether latent or telluric; the free electricity and the *abundance* of chemical elements presented by the waters most delicately combined, instituting radical constitutional changes, supplying elements which are required by the patient, and eliminating those which have banefully accumulated in the system *in special cases.* True, it may be objected that the electricity is very feeble in quantity. It is a well-known fact, however, in electrical science, that feeble electric currents enter more easily as the conducting surface is larger. The human body exposes a surface of more than fourteen square feet, everywhere studded with minute pores. Sir E. Wilson calculates the minute tubing of the perspiratory glands of the human skin to be 25 miles in length. Supposing then these waters store electricity in a weak form, the amazing amount of *conduction* may enable it to penetrate and unite with the electric nerve currents constantly traversing the nervous system. The belief of electric action in the water I find rooted completely in the minds of every intelligent person here that I have conversed with. Dr. Granville was here one day. I do not find a fortnight nearly sufficient to gather the interesting facts daily presenting themselves to my notice. Granville was enraptured with a single bath. Eight have convinced me that there is something very different in the natural heat of these deep springs to an ordinary hot bath. I should be loth to realise the effects of simple water at the same temperature. The water, though not quite so blue as Buxton, has (contrary to Granville) a deep colour, without odour or taste, but it nevertheless makes one's eyes smart considerably. Tranquillity and exhilaration are certainly combined effects, but hardly is produced Dr. Granville's "*ecstatic state of a devotee blended with the repose of an opium eater.*" The baths, however, have great charms, perfect freshness and cleanliness, being thoroughly changed alternate hours, besides being constantly supplied with running water at the rate of several cubic feet per minute.

Our own Faraday showed long ago that the separation of the elements of a single drop of water disengaged as much electricity as, *in quantity*, would produce a thunderstorm; that no chemical changes were without electric action. There is no end to the constant development of this omnipresent agent in every change in matter. The human body is constantly traversed by electric currents coursing along the nerves. They promote vital actions, and often have a highly curative action. Electrician for two years to the Cambridge Hospital, I used to administer them by measurement with a galvanometer above 30 years ago—a system lately re-invented. The extreme purity and mystery of the Wildbad waters make one glad to revive the extraordinary powers of electric action. It seems probable, indeed, from their rapid effects on sensitive persons, that the tingling and pricking, the excitement and peripheral action (by which the waters seem to drive offending matters outwards by stimulating nature to relieve herself), all point to some subtle action, which may be electric, and therefore also magnetic. The old theory of undulation — vibration of the ether — during the play of heat, light, or electricity, is most probably destined to be swallowed up in the gorgeous theory of universal electro-magnetic action, so profoundly developed by Clerk Maxwell. I am not at all sure that the direct electro magnetic action of the sun upon the earth does not regulate the earth's electricity and magnetism, and thus even charges the earth's oceans and springs with its potent forces.

G. W. Royston Pigott, M.D., F.R.S.

(*To be continued.*)

SMALL DYNAMO MACHINES.

[20196.]—According to promise made a few weeks back, I send you drawing and description of small dynamo weighing, without gearing, 6lb. 14oz. I cannot say that there is anything new or remarkable about it (at least the field-magnet is a little out of the common); but as there have been three or four columns devoted in back numbers by the theorists, on the impossibility of *small* machines working, owing to the absence of *heavy masses* of *cast-iron* (I suppose they were like "Dr. Lardner on Steam Navigation,"—wrote what they thought, and no more, without reading "Montaigne's Essays"), I thought the inclosed particulars might be useful to intending makers of such apparatus.

From private letters I receive, I know several who had given up the idea of making a *small* one on account of the former misstatements. I hope this will restart the subject once more. Speaking of *smallness*, one I rigged up a few months ago was only 3lb. 8oz., and it worked first-class; sorry I cannot send a description, as I intend to secure it; am sure one would work under 2lb. weight. No doubt very small ones have been made, but have not seen any description of them.

The inclosed sketch, Fig. 1 is exactly one quarter full size. The armature is 3 by 1, have wound them with 24, 22, 20, and 18 wire. Field-magnets can be wound with any size wire. If of the same resistance as armature for working in the circuit for "shunting," should be 12 or 15 times greater than armature.

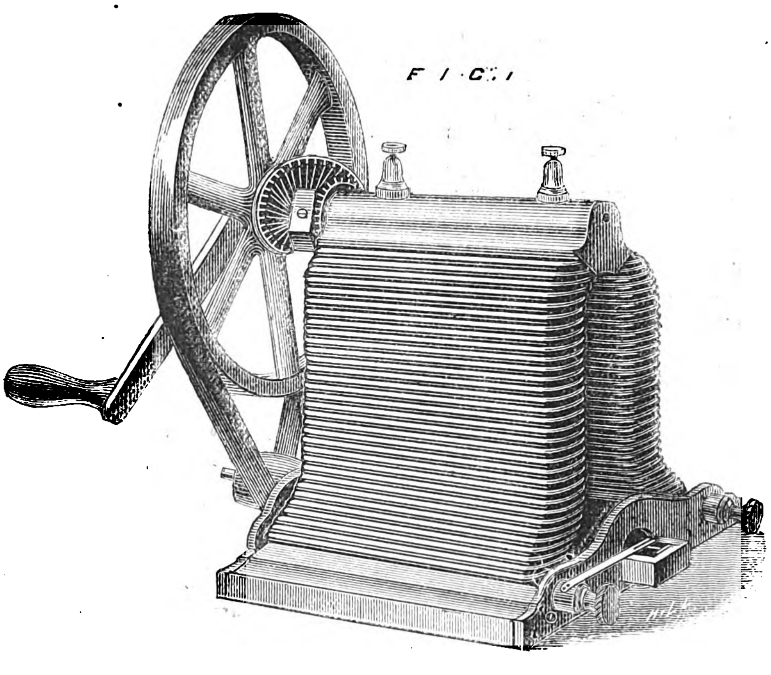
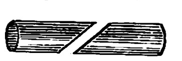
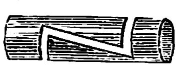


FIG. 1

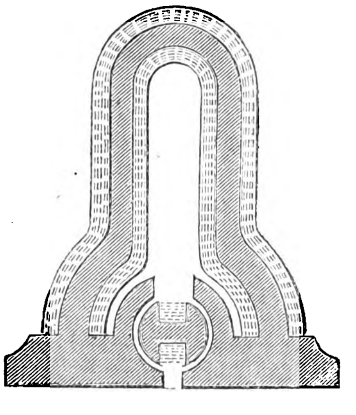
Commutator is made of four pieces of brass tubing ⅞in. long, ¼in. diameter, cut across thus—


or like this—


Brushes, two pieces of sheet brass, split to give springiness. The "Jack in the Box" gearing is old; has been used for this purpose years ago: being the best form, have adopted it for hand-machines.

The field magnet (section shown in Fig. 2) is of common cast-iron direct from the foundry, and requires no further preparation than winding on the wire, except, perhaps, boring out, facing the ends, and a little filing.

FIG. 2.



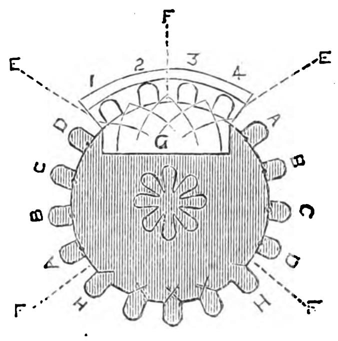
When wound, connect up to a Bunsen cell, and place a soft iron keeper across the poles; leave it so for five minutes, disconnect, and this heavy mass of cast-iron will sustain from four to eight ounces, quite sufficient to cause it, when in action, to bite. A piece of ¼in. square iron may always be left on as a keeper when in action and otherwise, as it gives *steadiness* to the machine, prevents sudden disappearance of magnetism when the springs cut the armature out of circuit. This is an immense advantage in large machines. The current can be regulated by placing on larger keepers.

I would strongly advise any one to make a larger machine while they are about it—say a 4 by 2 or 6 by 3 armature, as they will be amply repaid; any form of armature will do with this F.M.; the latter being all in one piece, requires no fitting, must consequently be stronger than one in several pieces, with the *grain* in all directions. I think it will be unnecessary to take up any more space in describing minor details, as this has been done before, but shall be quite willing to give further advice on any part I have not made clear.

Wolverhampton. **George Tolman.**

FITTING NEW TEETH TO WATCH AND CLOCK WHEELS.

[20197.]—As a continuation of my former letter upon the above subject, I have the pleasure to present my readers with an accurate and simple mode of dividing off new teeth, where several have been broken out of either clock or watch wheels, and a blank piece of metal has been soldered or dovetailed in. It is of my own devising, so it will have the merit of novelty, if nothing else. I, however, have proved its practical utility, and in the hope it may likewise be of service to others, I now, for the first time, make it public. As I have intimated, the principle is applicable to either watch or clock wheels, the mode of dividing being the same, but the tools used being a little different in size or kind. For watch wheels, or small clock wheels, as in the figure, the depthing-tool is best; for large clock-wheels, either a clock depthing-tool or a pair of compasses. On reference to the figure it will be seen that a piece of metal, G, has been fitted, out of which it is desired to cut four teeth. This piece of metal is, presumably, finished off to the actual thickness of the wheel, and faced down. Set the wheel up in two of the poppets of the depthing-tool, and adjust one of the others to the base of the teeth, so that when the wheel is revolved the point will describe a circle round the wheel F. It is necessary only, though, to mark from four teeth on each side of the blank where four teeth are being divided, and three if for three, and so on. Then set the point to the extreme tips of the teeth, and score off the blanks from E to E. Now, on the line F, in the centre of each of the four teeth on either side, make a small drill-mark—it must be exactly central. This mark is to receive one of the points of the tool. Then set the other point so that when one is placed at A the other intersects the angle of the tooth H. Now, if this point is brought round to the blank it will strike off one side of the tooth, 1. Now place the point in the tooth A on the other side of the wheel, and score the blank. This will mark the other side of the new tooth 1. No. 2 tooth is produced in the same way by putting the point in the drill-marks B B and scoring off on the blank, 3 and 4 being likewise scored off. A mere scratch is sufficient to determine the position, and if the dividing is accurately done the teeth cannot fail to be set out right. The line E determines the exact length of the teeth, so the blank can be filed away to that, before the spaces between the teeth are cut out. The line F will determine the depth of the spaces. Although the wheel, figured here, has only a few teeth, and is not a "bar" wheel, the same principle will hold good in dividing off, whatever the number of teeth, or the make of wheel. Where the teeth are exceedingly fine, as in watch wheels, the scoring off must be correspondingly so. In *small* wheels, it will be found necessary to score off from, say, the 8th or 10th tooth to the sides of the blank, for the reason that the poppets of the depthing tool could hardly be set sufficiently close to each other. When once a correct idea of this principle of marking off for teeth has been got by the workman, a wheel may be scored off in about three minutes, so that it may be justly called a simple plan, and, as such, I commend it to your notice. **Alfojoe.**



THE TURKISH OR HOT-AIR AND VAPOUR BATH, AND THE SCIENTIFIC PRINCIPLES ON WHICH IT SHOULD BE CONSTRUCTED.

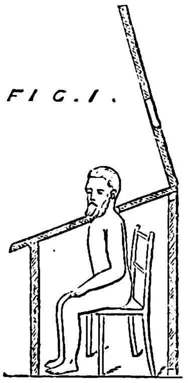
[20198.]—Some years ago I stopped in my travels at an hotel in ——, tired and dusty, and in want of a good wash, when a cheery English voice said, "Have a Turkish bath, sir?" "All right," said I, and I was shown into a comfortable room and requested to undress; at one side of this room was a tier of rows of boxes in a frame, numbered and lettered as in London clubs. My attendant handed me a key, with number and letter on it, which corresponded with that of one of these boxes. "If you have any valuables or money with you, sir, you had better place it in the box and hang the key round your neck when you undress and put on your bathing-suit." No sooner said than done; five minutes found me divested of my clothes, my watch, keys, and purse deposited in the said box, and myself dressed in a flannel suit which covered me from my neck to my heels. I remarked that this room was comfortably warm, and had a Turkish carpet on the floor. A thermometer hanging on the wall near the door showed a temperature of 70° Fahr.

My attendant opened a side door and admitted me into what appeared to be a small dressing-room. The temperature in this was rather higher, about 80° Fahr. On one side of it was an ordinary sitz bath, and also a portable shower-bath. On the other side of the room there was what appeared to be a monster wardrobe with door reaching nearly to the floor. My attendant handed me a thin blanket sheet of flannel, which is known to all East Indians as a coarse Rampu Chudder; so I divested myself of my flannel suit. Rolling this round me, I stepped inside the wardrobe, and very soon the temperature began to rise. I seated myself comfortably in an easy-chair, and in a quarter of an hour I was bathed in sweat from every pore. My attendant opened a slide, and passed into me a basin of strong soap suds and a sponge with which he advised me to rub myself all over as quickly as possible. Ten minutes more, still sweating from every pore and soap-sudded all over, I was brushing myself with a bath-brush and had peeled considerably; the temperature had been attended to by him, and had now fallen to 100° Fahr., which was also the temperature of the small-room. "Sitz and shower-bath both ready for you, sir," said my attendant. Throwing open the door of my bath, I stepped out and seated myself in the sitz bath for a minute or so, when I stepped into the shower-bath, and was well soused with water about 110° Fahr., and felt myself thoroughly clean. "Now we must save you from taking cold, sir," said he. "Look out!" No sooner said than he pulled a string, and down came on me torrents of cold water. Before I could recover myself from the shock, he said, "Come out, sir—you have had enough." I stepped out, and he covered me with a large blanket-sheet of twilled cotton, and set to work to rub me dry. In a couple of minutes I had again donned my flannel suit, and felt comfortable. On looking at the thermometer, I found the temperature had fallen to 80° Fahr. He handed me a pair of slippers and a dressing-gown, which I put on over the flannel suit, and at his invitation I stepped into the next room, and lay down on a couch and drank a cup of delicious coffee. A few minutes sufficed to get me into my own clothes, and "Gereb Admi" was himself again.

I cannot describe how light and comfortable I felt after this. It was as good as a night's rest, and I felt inclined to start off homeward again. A few days took me to my own house, where I was welcomed by wife and bairns by very nearly, though not quite, a round dozen, and on detailing my experience, we began to think what was good for the *Bap* (father) would be equally so for the *Ma* and *Batcha log* ("children folk" literally), pronounced Butcha loque.

So *Bap* set his wits to work and tried to make a Turkish bath for use in his own house. He began by making inquiries, and found that in one of the hotels in the town he was living in, it was said visitors could have hot air or vapour-baths. A visit to this hotel showed him the plan adopted. He was shown at the head of the landing a box 3ft. 6in. square standing on its end; one side was shorter than the other, which we call the front side; it was 3ft. 6in. high; the back side was 5ft. high, the upper end consequently was sloping; the back side opened like a door; the upper end of lid was hinged at the upper side, and could also be opened; it had a hole in it, through which the bather's head protruded. The box was just large enough to admit a cane or rush-bottomed chair, on which the bather sat. Through a small hole, which had a door to close it, was passed in a common gas-stove; it was said to answer perfectly, but I was not sufficiently credulous to submit myself to a bath in this ingenious, simple, but very primitive arrangement, which is illustrated in Fig. 1. I did not like the idea of leaving my head outside while my body was being plotted. It had one great defect—there was no ventilation; the heating arrangement was not under the control of the bather, and there was no means of reducing the high temperature gradually, and I thought that, while bathing, the occupant would be possibly subjected to partial draughts from defects in the woodwork, or from badly-fitting doors.

FIG. 1.



Section of hotel vapour-bath closet, with bather in it: 3ft. 6in. by 3ft. 6in. = plan; 3ft. 6in., front side, high; 5ft., back side, high. Back opens like a door below framing. Top shown both shut and open.

I began to think the matter over, and came to the conclusion that a vapour-bath for home use must be built on the following principles:—

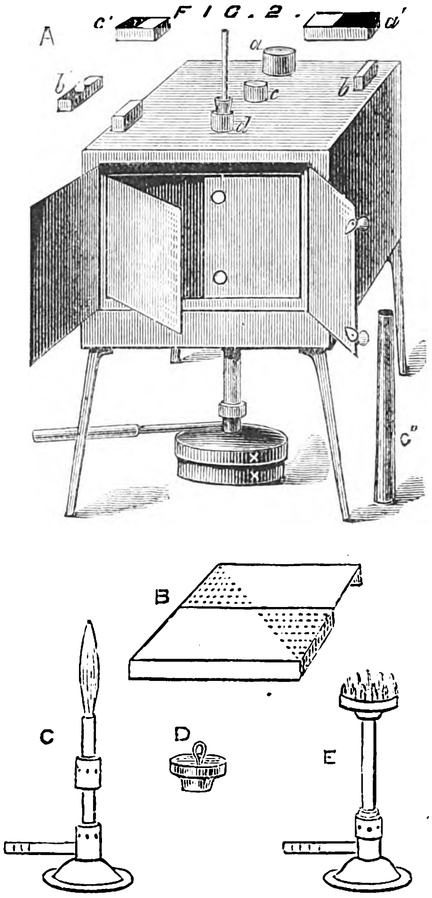
1st. It must be sufficiently large to admit the whole body, head included, and to admit of the bather scrubbing himself well with hot soap-and-water, as I did when I had my first Turkish bath, just described.

2nd. The heating apparatus must be under the control of the bather, who must have light, so as to be able to consult a thermometer hung in the bath beside him. He must have some arrangement of valves or slides communicating with the cool atmosphere outside, so that he can gradually reduce the temperature when he desires to do so.

3rd. The heated air supplied to the bath must be pure air specially heated for that purpose, and the burnt air by which this heat is produced must be utilised to carry off the impure air of the bathroom, contaminated by the products of respiration and the exhalation from the body—perspiration, &c.—produced by the heat to which the body has been exposed.

It struck me at once that in my student days I had seen such an apparatus in the laboratory of the late Dr. Thomas Clark, and that I had seen a description of it in Griffin's "Chemical Recreations," a book which had some twenty years before delighted my young heart. On searching for it it was not to be found, so I proceeded to Griffin's establishment and at once recognised the apparatus in question. I found that they had just published (in 1866) a most interesting work which was not a mere trade catalogue, but a highly scientific description of chemical apparatus of all sorts, and on pages 131, 132 I found a drawing of the apparatus, and a full detailed account of the principles of its construction. It was the very thing I wanted to guide me in arranging a domestic hot-air bath for my own use. As many of your readers may not be able to consult this work, I show the apparatus in question under Fig. 2, attaching to each Griffin's own reference numbers, and herewith I copy his description, which will make the principle of it plain to all.

FIG. 2.



A, Griffin's hot-air bath, 1281; *a*, chimney for escape of hot air; *a'*, cap to put on the chimney; *bb*, openings to admit fresh air; *b'* cap to cover *b*; *c*, escape tube for hot pure air; *c'* chimney foot from copper chamber; *c''*, long chimney for increasing draught; *d*, escape tube for hot pure air, sometimes utilised to take temperature with a thermometer as shown; B, false bottom to copper chamber where the air is heated; C, Bunsen burner, single flame; D, rose burner to insert in above to distribute the flame; E, the rose burner complete.

"No. 1281. GRIFFIN'S HOT-AIR BATH, for drying substances in a rapid current of hot air, kept within a few degrees of any desired temperature up to 500° Fahr. See the drawings, Fig. 2 A.

"This apparatus consists of a copper chamber, measuring 12in. from left to right, 9in. from top to bottom, and 8in. from front to back. This chamber is inclosed in a case made of stout sheet iron, which measures 14in. from right to left, 12in. from top to bottom, and 11in. from front to back. There is consequently a clear space of at least an inch all round between the copper chamber and the iron case. Hot air rising from a rose gas-burner (shown separately at C, Fig. 2) is made to pass continuously through the space, while a rapid current of heated atmospheric air is made to pass through the chamber containing the objects that are to be dried. The arrangement for carrying out this plan is as follows:—

PRODUCTION AND REGULATION OF HEAT.—The bottom of the iron case has a round hole in the middle, rather wider than the head of the rose gas-burner (shown separately at 974, see Fig. 2). This burner being lighted and applied there, air rushes up through the flame into the space between the copper chamber and the iron case, and passes out by a chimney on the top marked *a*. If it is desired to diminish the draught, the cap *a'* is put upon the neck *a*. This cap has an oblong form; when pulled to the right it opens the chimney *a* entirely, when pushed to the left it closes it, more or less, as may be desired. Attention to this chimney must be combined with due attention to the burner; the latter can be fully or only partially supplied with gas, and it may be pushed up close to the copper chamber, or be lowered two or three inches from it, the clay plates shown in the figure × being used to regulate the height of the burner. A ledge or partition of copper runs along the front lower edge of the copper chamber, and closes the space between that chamber and the iron case; a similar ledge runs along the back upper edge of the copper chamber. The former is intended to prevent the rising of the flame from the gas-burner into the copper chamber when the front doors are opened; the latter seems to prevent the flame passing directly from the gas-burner up the back of the chamber and out of the chimney *a* The effect of these obstructions is to force the hot-air to rise up on each side of the chamber, and to pass over the top to make its way to the chimney *a*. On applying a chimney such as *c''* to the neck *a*, and removing the flame, the whole apparatus is rapidly cooled.

CIRCULATION OF HOT-AIR THROUGH THE COPPER CHAMBER.—The copper chamber has a false bottom, which is divided into two compartments, as shown by Fig. 1282. It is a sort of shelf or stool that lies about an inch above the solid bottom of the chamber. Each half of the space included between the true and false bottom is open at one end and closed at the other, and the surface is perforated in the manner shown by the figure. Air passes into the inclosed spaces by two flat copper tubes, the upper ends of which are marked *b b* in Fig. 1281, and the lower ends of which communicate with the open ends of the spaces marked by arrows in Fig. 1282. These air-tubes are fixed in the space between the copper chamber and the iron case, and being exposed to the hot-air that rises from the gas-burner, while the flame of the burner acts directly upon the solid bottom of the chamber, the air supplied by these tubes becomes rapidly and strongly heated, and is delivered in that condition through the holes in Fig. 1282 into the hot chamber from which it escapes by the two openings *c d*, after passing over the objects that are placed in the chamber.

REGULATION OF THE CURRENT OF AIR.—When a strong current of air is required, the tubes *b b* are both left open, and the chimney *c''* is placed upon the neck *c*. When less air is required the chimney *c''* is taken off, or is replaced by an oblong cap *c'*, of which the chimney *c* can either be entirely obstructed or opened to any desired degree. The draught of air *into* the chamber can also be regulated by two caps of the form of *b'*, which are adapted to the openings *b b*, and can open or shut the passage to any necessary degree by merely sliding along them. The neck *d* can be closed by a cap, or it can be used for the insertion of a thermometer to indicate the temperature of the hot chamber. The four pipes, *b*, *b*, *c*, *d*, shown in Fig. 1281 are all in communication with the copper chamber, and have through holes in the top of the iron case. The chimney *a* alone communicates with the space between the two chambers.

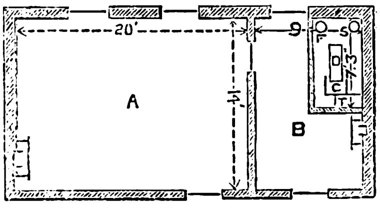
This construction of the apparatus enables the operator, by attention to the gas-burner and the chimney *a a'*, to regulate the amount of heat applied, and by attention to the ventilators, *b b'* and *c c' c''*, to regulate the circulation of air through the drying chamber.

For operations which do not demand a drying heat beyond 300° Fahr., the small rose gas-burner No. 973 is sufficiently powerful; but when a higher temperature is required, and especially when a large quantity of air is to be forced through the chamber, the rose burner No. 974 is requisite.

The iron case and copper chamber are separately opened by double doors in front, as represented in Fig. 1281. The copper chamber contains two movable stools to sustain capsules, crucibles, &c.

I have copied the whole of this out, so that there may be no difficulty in the principles of its construction being thoroughly understood. Some days elapsed before I could make up my mind what to do.

FIG. 3.

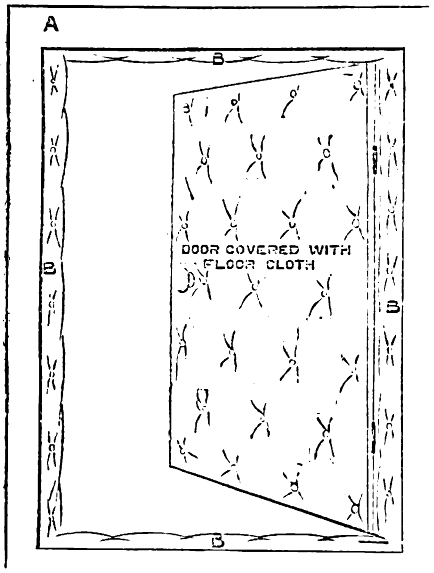


A, large bedroom, 20ft. by 14ft.; B, dressing-room, 14ft. by 9ft.; D, chamber for vapour-bath, 7ft. 3in. by 4ft. 6in.; F, vapour-bath furnace as described; S, shower-bath; C, chair; T, table for basin, &c.; all rooms 10ft. high.

The house we resided in was a roomy one; but as I had a large family every room was occupied except a dressing-room adjoining the paternal and maternal bedroom, and appropriated to my use. I therefore decided to devote this to the bath.

In Fig. 3 you have a plan, A being the bedroom and B the dressing-room. After thinking the matter over, I decided that I must make the little dressing-room as nearly air-tight as possible; fortunately both doors opened outwards, so a very simple arrangement made them draught proof. I covered both doors with a piece of felt floor-cloth, so as to close keyhole and cracks, if any; and I lined the framing sides top and bottom with a piece of pantile lath 2in. by ¾in., covered with the same floorcloth which, when the door covered with the drugget was closed against, prevented the slightest passage of air. This arrangement is shown on Fig. 4. The next step was to cover the floor with oilcloth, so that no air could pass in from below; in place of a carpet the oilcloth was covered with two or three pieces of cocoanut matting, which could be taken up readily, and removed for drying if they became wet.

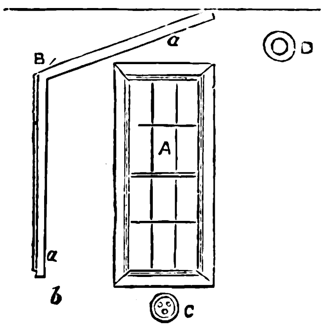
Fig. 4.



A, door-frame; B, inner sides of frame lined with drugget, and padded.

The next thing to be attended to was the window. I should have liked to have a double window, or to have had a single window with double panes of glass, so as to induct between them a space filled with air, which would have prevented that loss of heat by radiation, which constantly goes on in our dwelling houses, but that would have been expensive, so I treated the window-frame as I had the doors, with an inner frame of lath covered with felt floor-cloth. I then made a strong wooden frame, which I hinged to the upper part of the inner framing of the window, and by a cord and pully pulled it up against the ceiling, where it was out of the way when not required. It was also at the sides and edges lined or covered with felt, so that when placed over the window it jammed against the felt lining and prevented any passage of air. This frame was not glazed, but was covered with stout blind-cloth, which I rendered semi-transparent by varnishing with Canada balsam dissolved in turpentine. To provide for fresh air from without I made a hole under the window-ledge through the brick wall, into which I passed a piece of conical iron tube, which I bought for a shilling at a scrap iron and metal store; it had a flange on it inside, where it was about 8in. in diameter, being about 4in. at the other end. This arrangement is shown on Fig. 6 A, which is a rough sectional sketch of the window-frame and wall underneath it, showing the conical tube and its fittings in situ. Before putting it in place, I turned up the face of the flange true on the lathe, and fitted to it a flat piece of boiler-plate, fixed by three small nuts and bolts. Between the faces of the iron was a canvas washer, well covered on both sides with white-lead; the centre of this plate was bored with three holes, and tipped to take four short pieces of iron pipe. This arrangement is shown roughly on an enlarged scale on Fig. 6 B, in section showing only three for the pipes; one of these pipes had a tap, so as to admit fresh air direct into the dressing-room, if required. The other three pipes were closed by boxwood junctions, screwed on and connected to the tubes by white-lead; these had the form of a nipple, as shown on Fig. 6 C, to take an indiarubber tube to connect them with the heating arrangements, to be presently described; it could be closed, when the rubber tube was removed, by a plug. I had now the means of admitting fresh air directly into the room, or by attaching pipes to any of the iron pipes to convey fresh air to any apparatus I might wish.

Fig. 5.



A, window; B, section; C, perforated iron plate for giving fresh air to furnace; D, flue to carry off foul air; *a*, inner window shown shut and open. This window is a frame of calico made transparent, the sides of frame being covered with felt; *b*, frame described under *a*; *c*, fillet covered with felt round the frame of window proper.

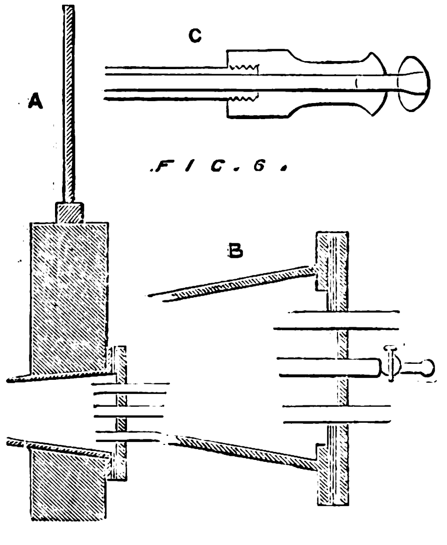


FIG. 6.

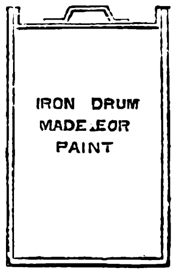
Now, all I had to do was to design a cheap and easily-constructed double chamber, like that of Mr. Griffin. This I did in an inexpensive manner. My chambers were constructed from two small iron drums used for holding oil-paint. These drums can be purchased from vendors of oil-paint, when empty, at prices varying from 4d. to 3s., according to size. I give here a list of the ordinary sizes:—

A	To hold	7lb.	white lead.	6in. high.	5in. diam.
B	,,	14	,,	8 ,,	6 ,,
C	,,	56	,,	10 ,,	7 ,,
D	,,	112	,,	14 ,,	9 ,,
E	,,	?	,,	17 ,,	12 ,,

I give the sizes to enable anyone to construct such a bath furnace as will suit his own requirements. I used C and D.

I began by preparing D to receive C. These drums are cylindrical vessels of iron, with a lid which shuts in the top, as shown in Fig. 7.

FIG. 7.



Gereb Admi.

(*To be continued.*)

THE CONCENTRIC MICROSCOPE.

[20199.]—Speaking from my own knowledge of the origin of the main principle embodied in this microscope—the centralisation of the movements upon the object as a common centre—I say the principle was not originated by Dr. Edmunds, neither by reason of his remarks on Wale's microscope at the R.M.S. in Nov., 1880, nor through his having made some communication to the junior secretary of the R.M.S. in Dec., 1878, those being the dates which Dr. Edmunds has been pleased so far to assign as the grounds of his claim.

The idea has formed the subject of many a conversation among those interested in the improvement of the microscope long before 1878, when Dr. Edmunds joined the R.M.S. As a matter of fact, I discussed the matter repeatedly in 1868, with Messrs. Hartnack and Prazmowski, the well-known opticians of Paris, with particular reference to the facilities that would be gained for oblique illumination; but those opticians did not see their way clear to a commercial success with the idea. The plan I had in view was to suspend the microscope by two trunnions, one on each side of the stage, on pillars, so that the axis of inclination would pass through a diameter of the object on the stage. The idea was suggested to me by examining the Thury-Nachet Traverse Substage (recently figured in the *Journal* of the R.M.S., Vol. III., 1880, p. 1060). I do not, however, claim the principle, for it must be obvious to any candid-minded person that the principle is embodied in every microscopical apparatus in which the object is made to rotate on the optic axis. In several of the microscopes devised within the last ten years, notably, Tolles's, Zentmayer's, Bulloch's, and Beck's, when the microscope-body is inclined to the horizontal, the centre of the rotating base is in a perpendicular line, passing through the object on the stage; the rotation of the microscope on its base then presents the object to a fixed source of light in the then horizontal plane (say a lamp-flame used with bull's-eye condenser) at all obliquities from 0° to 90°. This is unquestionably an application of the principle which Dr. Edmunds claims to have discovered.

As I have said, the main principle of Mr. Wenham's microscope has been in the minds of many microscopists for a considerable number of years; the difficulty has been to hit upon a design that would impress an optician with a favourable prospect of success. Mr. Wenham has been so fortunate in his design that Messrs. Ross have spared neither labour nor expense in their efforts to carry it out successfully. I believe they have secured the assistance of one of the best mechanicians in Europe to supervise certain matters of detail with a view to the greater accuracy of construction; and I have no doubt the microscope will soon be in such a condition as regards workmanship that it will withstand the disparaging criticism of even Dr. Edmunds.

I do not, of course, undertake to assign the precise origin of any idea Dr. Edmunds may have had for the construction of a "concentric" microscope; but it appears to me probable that this gentleman, having heard from some one more experienced than himself that such a microscope would be a desideratum among microscopists, has puzzled himself into obliviousness of the fact that he picked up the idea in conversation, and has imagined himself to have originated it. To use an old saying, "he has dreamt what he desired, and believed his own dreams," which is by no means an uncommon process among claimants to fame.

I think it is regrettable that Dr. Edmunds should still seek to maintain that Mr. Wenham is indebted to him for the main principle embodied in the new stand, in spite of Mr. Wenham's distinct repudiation *on the matters of fact*—matters of fact on which we are bound to accept Mr. Wenham's statements. I should hope that Dr. Edmunds will now see that his persistent attempts to associate himself with Mr. Wenham's microscope are, to say the least of them, in very bad taste.

F.R.M.S.

[20200.]—I have not the slightest recollection of aiming at anything further in the *arc* than keeping the weight nearly over the centre of the base when the microscope was inclined.

The suggestion of Dr. Edmunds was the first intimation of making the focal point the centre of motion, to my knowledge.

The writer of letter 20072, p. 261, must be under some mistake.

Montclair, N.J., June 6. **Geo. Wale.**

[20201.]—Several letters have appeared in your columns, which have been written, apparently with a view, first to deprive Dr. Edmunds of the credit of being the inventor of the concentric microscope; secondly, to impute that, if he were really the inventor, he had merely copied or taken the idea from Wale's microscope, when it was exhibited at the R.M.S., on Nov. 10th, 1880. I hope, therefore, in justice to Dr. Edmunds, you will publish the following statement:—

I was present at the R.M.S. on Nov. 10th, 1880. I was on the platform, talking to Dr. Edmunds, and inspecting the apparatus that was being exhibited, after the business of the meeting was finished. I was one of the knot of gentlemen to whom he expounded the principle of his concentric microscope. Dr. Edmunds invited me to see the drawings he had made of his invention. Having seen those drawings a few days afterwards, I am in a position to testify that Dr. Edmunds is an original inventor of the concentric microscope.

June 17th. **Edward M. Nelson.**

STEAM-LAUNCH SPECIFICATION.

[20202.]—With regard to specification (letter 20115) of boat generally, there is not much to object to; but I should certainly prefer some other type of engine than Willans. There is nothing better than a suitable size pair of vertical engines, and the size required for such a boat will be two cylinders, 6¾in. diameter and 7in. stroke. Revolutions per minute not to exceed 350, i.h.p. = 45; speed of boat 9 knots. The boiler I should prefer would be a horizontal one; but I see no great objection to a well-designed vertical one. In any case, the heating-surfaces should not be less than —grate = 4·25 square feet, surface in furnace and tubes = 180 square feet; propeller No. 1, four-bladed, diameter 3ft.; pitch, 3ft. 10in.; greatest length on line of keel, 5in. This pair of engines are supplied with steam from a horizontal boiler having the above surfaces. Diameter of boiler, 3ft. 8in. by 5ft. long, boiler pressure, 70lb. per square inch. **W. Trathern.**

[20203.]—On page 310 "E. M." of June 9, 1882, "Robinson Crusoe," in letter 20146, in reply to "Steam-Lauch," advises him to have no keel. How does "R. C." propose to fasten on the stern-post and stem, also the first strake on either side? I was always under the impression that the keel was the most important part of a launch. I would advise "Steam-Launch" to adhere to his builder's specification.

Regarding Willans engine, "R. C." has evidently had no knowledge or experience of them, or he would not talk of not being able to get at what he calls the *vital* parts. I will undertake to take a Willans three-cylinder engine to pieces as soon as "R. C." will an ordinary double-acting engine; and what is the use of taking a thing to bits that does not require it, as I see per *Field* of June 17th, page 820, that one of Willans' engines has run six seasons without any repairs.

"R. C." had better take back to his island a "single reversed cylindered engine, with a good heavy balance-wheel." It will just suit his keelless canoe, which, according to last accounts, was high and dry. **Live and Let Live.**

[20204.]—"Edinburgh" (20146) should see that the 5in. compound Willans engine is specified. The difference in cost is not great, but the advantage in economy is considerable. Within the last year or two, the inventor has begun making the engines, at Thames Ditton, from patterns which are a great improvement upon those used by the other firms, which make them under license. There are many other points in the specification which seem to me very defective—too many to take up valuable space with. If "Edinburgh" will advertise his address, I shall be happy to write to him. **Wave.**

"PROPELLING."

[20205.]—It may be interesting to your readers to know that the inclined screw-propeller was patented in 1852 (No. 1002), by a Mr. Wilson, who preferred an angle of 45°.

Also that the "coupling-rod" propeller, referred to by one of your correspondents, with a number of floats on each rod, was patented by Mr. Burnside in 1856 (No. 869.) **Thomas Moy.**

June 17th.

MR. SCOTT RUSSELL AND THE VIENNA DOME.

[20206.]—Your notice of the death of Mr. Scott Russell, with whom I sometimes came in contact, professionally, and who, I think, was an abler man than many people recognised, reminds me of a very curious fact (as I suppose it is) respecting his great iron cone—rather than "dome"—of the Vienna Exhibition; which is 360ft. wide, and, therefore, covers 6½ times as much ground as the domes of the Pantheon, St. Peter's, or Florence Cathedral, and 3 times as much as the Albert Hall (220 × 185).

The gentleman who was his resident assistant then in building it, told me that they were at first uneasy about the expansion and contraction being likely to keep the pillars on which it stands continually leaning outwards and inwards to a serious extent; for according to the tabular expansion of iron, it would vary half an inch in a radius of 180ft. between many days and nights, and an inch between summer and winter; but that Scott Russell came to the conclusion that it would not; and that they did find no motion at all in the pillars. And further, that it had been found by experience that the rollers which were carefully provided for all the earlier tubular bridges to expand and contract upon never act at all, and that other such bridges do as well without any.

I confess all this sounded to me surprising, and still is so, and probably it will be to most people. But it is never of any use to disbelieve experience for theories, if it is certain. The result is so important to all who have to deal with iron beams and rods in holding buildings together, that it is very desirable that we should know how the fact really is, and then (but not before) to investigate some satisfactory theory about it. Railway engineers must know by this time whether it is necessary to allow any play in the fish-joints of rails, or between the ends of the rails if laid down in cold weather; though, to be sure, the length of a rail is quite insignificant compared with the width of the Vienna dome or the Menai bridge. This seems a convenient occasion to start the question, and get it settled for good. **Edm. Beckett.**

ORGAN IN ST. VINCENT FERRER CHURCH, N.Y.

[20207.]—The following are the details of scheme of the above organ, built by Mr. H. L. Roosevelt, the well-known American builder:—

Three Manuals, Compass C C to A^3, 58 Notes.

Great Organ.

	Ft.	Pipes.
1. Open Diapason	16	58
2. Double Gemshorn	16	46
3. Open Diapason	8	58
4. Violon Diapason	8	53
5. Melodia	8	58
6. Principal	4	58
7. Flute	4	58
8. Wald Flute	2	58
9. Mixture	(4 ranks.)	
10. Cornet	(4 and 5 ranks.)	
11. Trumpet	8	58
12. Clarion	4	58

Swell Organ.

	Ft.	Pipes.
1. Bourdon	16	58
2. Open Diapason	8	58
3. Rohr Flute	8	58
4. Keraulophon	8	58
5. Principal	4	58
6. Flute Traverse	4	58
7. Mixture	(4 ranks.)	
8. Cornopean	8	58
9. Oboe	8	58
10. Vox Humana	8	58

Choir Organ.

	Ft.	Pipes.
1. Doppel Flute	8	58
2. Gambia	8	58
3. Dolce	8	58
4. Concert Flute	8	58
5. Viol d'Amour	4	58
6. Rohr Flute	4	58
7. Piccolo	2	58
8. Clarinet	8	58

Pedal Organ.

	Ft.	Pipes.
1. Open Diapason	32	27
2. Open Diapason	16	27
3. Double Gamba	16	27
4. Bourdon	16	27
5. Violoncello	8	27
6. Bombard	16	27
7. Tuba	8	27

Couplers, &c.:

Sw. to Gt. Unison; Sw. to Gt. Oc.; Ch. to Gt.; Sw. to Ch.; Gt. to Ped.; Sw. to Ped.; Ch. to Ped.

Swell Tremulant.

Guernsey, June 10th. **C. H. Domaille.**

THE PORTSKEWET PIER ACCIDENT AND THE TWO-MINUTE BRAKE.

[20208.]—Upon the 25th of April a collision occured at Portskewet Pier Station on the Great Western Railway, between the 6.40 p.m. passenger train from Cardiff and three empty coaches standing near to the buffer-stops at the end of the pier. Colonel Rich held an inquiry, and his report has just been published.

The passenger train consisted of a tank-engine, fitted with a steam-brake, a van, five carriages, and a rear van, fitted with the Sanders and Bolitho automatic vacuum brake, as modified by the Great Western Railway Company.

Colonel Rich reports that "the collision was caused by the vacuum brake failing to act when it was required." . . . in consequence of there being a very small amount of vacuum in the pipe and cylinders; possibly none, as the train approached the pier, after the driver had applied it three times during the short journey from the junction. He thinks the efficiency of this brake has been materially interfered with by the hole in the piston-rod, which allows it to leak off in a short time; he experimented on the carriages of the train, and found that the brake leaked off the front van in about 30 seconds, and off one of the coaches near the tail of the train in about *two minutes*. Colonel Rich also mentions that on the same day, after his inquiry, there was very considerable leakage in the vacuum brake upon an express train; "the pump rose the gauge very slowly to about 22in. to 23in. while the train was running; but the whole of the brake power appeared to be exhausted before the train was half stopped when running into Taunton station, so that at that momentous time there was actually no continuous brake available until the vacuum was recreated by the application of the ejector, after which the train was stopped at the platform. I doubt whether this was considered by the engine-driver as a failure of the brake, and would be reported as such; to my mind it was a very important failure."

I trust that the very important facts to which Col. Rich refers will be seriously considered by the directors of the Great Western and Midland Railways before some disaster occurs.

In my letters to the English Mechanic, and also in the third and following editions of my pamphlet, I have pointed out the very great risk and danger which results from the use of what is generally known on the Midland and Great Western Railways as "The Two-Minute Brake," because it is purposely constructed to leak off of itself in two minutes. Col. Rich calls attention to the fact that "the whole of the brake-power appeared to be exhausted before the train was half stopped, when running into Taunton." This is no unusual occurrence, as I have myself frequently seen trains come into stations with the vacuum brake "leaked off," and the final stopping of the train effected by means of the steam brake upon the engine and tender; of course the vacuum brake was useless until the driver recreated another vacuum which, when applied, would again "leak off" in two minutes.

It will be noticed that your correspondent, "A Driver," letter 46828, p. 334, this week calls attention to the Board of Trade Returns and the failures of brakes.

The Railway Returns (Continuous Brakes) Act, 1878, enacts that "Any person who makes, or is privy to the making of a return under this Act which is to his knowledge false in any particular, shall be liable, on summary conviction before a court of summary jurisdiction, to a fine not exceeding fifty pounds."

This penalty has not been inflicted, and is therefore regarded by a few companies as a "dead letter," the result being that their returns become more and more incorrect each half-year, until now they are practically useless for comparison.

The Portskewet Pier accident, and the report of Col. Rich is a warning which the two companies which now use "Two-Minute Brakes" will do well to seriously consider without delay, and before any other accidents take place. This brake frequently leaks off, and allows trains to run past signals and stations, but as the companies in question do not profess to consider "leaking off" a failure, these cases are never reported to the Board of Trade, and therefore do not appear in the returns; they also consider that a steam brake on an engine is not continuous, and therefore do not report any of the numerous steam-brake failures. **Clement E. Stretton.**

Saxe Coburg-street, Leicester, June 17th.

CUTTING SCREW-THREADS WITH A SLIDE-REST ONLY.

[20209.]—The following is a very simple way of cutting screw-threads with a slide-rest only. Turn a couple of wooden pulleys, and fit one of them on to the bar on which the screw is to be cut, and the other on to the screw of the slide-rest, and connect them by means of an elastic band. By altering the sizes of the pulleys different threads may be cut. It is a good plan to have a set of pulleys answering to the change-wheels of a screw-cutting lathe. As it is required to use the same pulley very often, a plug is fitted tightly in the old hole and a new one bored to fit the diameter of the bar is to be turned.

Hartwell. **E. Thomas.**

MEDICAL REPLIES.

[20210.]—Bright's Disease (47154.)—I cannot imagine that any physician would really have ordered stout and gin for a patient suffering from Bright's disease, and in the teeth of a very wise recommendation from the local medical adviser, who was undoubtedly right and in accord with the best modern practice. Follow the advice of your family doctor.

Iron Medicine (47188.)—The best medical preparation of iron for internal use is that known as "dialysed iron," which may be got at any druggist's The finest and most certain preparation of dialysed iron is that known as Wyeth's, to be obtained from Burroughs and Co., of Snow-hill. The ordinary acid solutions of iron destroy the teeth, and should never be taken, now that a beautiful preparation like the Wyeth's dialysed iron is accessible.

Indurated Liver (47200.) — No one can say, without examining the patient, what is the cause of the induration of the liver, or estimate the probability of recovery. "Induration" is merely another word for *hardening*. If cancerous, the disease is a fatal one.

Jas. Edmunds, M.D.

NEW ELECTRO-MAGNETIC CLOCK.

[20211.]—My criticism of Mr. Huxley's pendulum, figured on page 263, was based on the assumption that it was to be hung on a spring, as usual, in which case it is very evident it would "wobble." It requires very little gumption to see that.

Now, it appears, it was intended to be applied to the clock-motor described on the same page, and if the rods are made a fixture in the armature, it will, no doubt, prevent the wobbling; but the tendency to do so will remain and give rise to very objectionable twisting strains.

There are other forms of compensation-pendulums—the zinc tube for example, quite as simple as Mr. Huxley's, to which these objections do not apply. But, may I ask, what end is supposed to be served by applying a compensated pendulum to a clock whose motive force is as variable as an earth battery current? The small temperature error would be quite lost amongst others.

Mr. Huxley's remarks about the wheels of clocks and the human leg are altogether beside the question, and require no notice. J. E. Floyd.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[45338.]—**Preservative for Iron Ships.**—I am particularly anxious to let Mr. Clifford have the pamphlet I address to you herewith. Although such a favour as forwarding it must be foreign to your custom, will you, in consideration of the great distance at which I am from home, put a line in your "Replies" to say that it is awaiting his address?—W. B. Denny, Magistrate and J.P., Singapore, May 6th.

[We depart for once from our rule, and Mr. Clifford may have the pamphlet by forwarding his address and two stamps.—Ed.]

[46346.]—**M.S.L. Engine 399 (U.Q.)**—This engine commenced running in February, and was put on the Manchester and Liverpool line. When I mentioned her (p. 618, No. 884), she was settling down, but so long in doing it that the men changed the pet name they had given her "Robert the Devil" to "Jumbo," for, like the elephant, they could not keep her out. Several alterations have been made, and I understand she is likely now to behave better. I am told she has taken 20 coaches from Manchester to Liverpool in 50 minutes, including five minutes' stop at Warrington. The driving-wheels are 7ft. 6in. diameter, and the cylinders (outside) 18in. by 26in. The driving-axle only has inside bearings, and the outer framing has a massive appearance, which is increased by the pistons and cross-heads being entirely hidden from view; but the big end of the connecting-rod can be seen below the framing at the half-stroke. The counterweights are on the same arrangement as the bogie-engines on that line; instead of being on the rim of the wheel, they are fixed close to the boss, and are very large. The engine and tender weigh about 70 tons, and were constructed at the company's works at Gorton.—R. N. H.

[46578.] — **Roof Ventilator (U.Q.)** — The neatest way of forming ventilator for roof 30ft. long will be to continue the ridge piece about 2ft. past the point of junction with hips at each end; fix short rafters on each side of said continuation down on to the hips, and fill in the upright face with louvre-boards; finish off on face with cut barge boards, and fix a flashing at bottom.—Ditton.

[46603.] — **Induction Coil Failure.** — I feel sure the secondary is at fault as regards insulation, as it has only two thicknesses of paraffined tissue between layers, and I have not thickened this at the ends, where I see now the struggle to get out would be fiercest. I have pulled my first one to pieces, and shall try again, and if I succeed will report result for benefit of others. I have two small brass balls on the secondary terminals of my present coil, and using three bichromates (series), though no sparks will appear till they are 1-16in. apart; yet, while this small violet spark goes on, a good ¼in. flash every now and then jumps from the side of one ball to that of the other. —B. H.

[46694.]—**Brick-Kiln with Down-Draught.**—I am obliged to "Brick-Burner" for his information on p. 312, and should be glad if he can tell me how the flue from the fires to the centre flue is arranged. Is there only a straight flue from the fire to the centre, and how is the draught controlled? Suppose one part of the kiln is finished burning before another, how is the heat diverted? If "Brick-Burner" could give a sketch of the bottom of the kiln I shall be obliged. The kiln would be for Bridgewater—he may know what the clay is there.—Brick Kiln.

[46771.]—**Zincography.**—Will "P. N." or any other of "ours" kindly give full directions for the photographic process as given in the above? Proportions of mixture, gallic acid or infusion of nutgalls, commercial or glacial acetic acid. If the bitumen is rendered insoluble by the action of light in turpentine, how is the whole plate cleaned up by turpentine? Would it not remove the whole at the first application.—W. B. S.

[46771.]—**Zincography.** — "P. N.," in describing the photographic method with bitumen, writes:—"To dissolve out first the bitumen, which has not been acted on with spirit of turpentine;" and futher on he writes—"the whole plate is then cleaned up with essence of turpentine." How does the turpentine not remove all the bitumen on the first application, if it can on the second? Or is there a difference between spirit of turpentine and essence of turpentine? Or when is the bitumen got rid of? Will "P. N." kindly explain this little difficulty in an otherwise simple method, and oblige?—Try Again.

[46775.]—**Staining Walls and Plain Decorations (U.Q.)**—According to "Spon's Workshop Receipts," any shade of pink may be obtained in distemper with vermilion. Indigo and yellow ochre will give green; so indigo, with small quantity of yellow ochre, would give greenish blue; the pigments should be ground quite fine. Distempers with lime in them are apt to turn black.—Ditton.

[46779.]—**Bleaching Small Articles.**—I presume that this inquirer resides in a town, and is not within reach of a grass-plat whereon to put out cuffs, collars, &c. Such articles, as well as pockethandkerchiefs, do require, every few weeks, to get a good "stewing" in a warm oven, often having to be left there, in a good large "stew-mug," for several days at a time, until they look white. As a preparation for washing, always steep white (I mean not colour-printed ones) articles in cold water for a few hours, and then the soiled parts can be very much cleansed by a good pressing together between the hands,—no violent rubbing,—then use good white soap on them, and let them remain over night, folded flat on a dish, not in water, but yet wet enough to completely melt the soap through the texture of the articles. Do not be too stingy of soap; you can use the lather with other articles of a less fine sort. A little practice will bring you to the use of enough without waste. Next day pour on to said clothes a kettleful of very clean boiling water—boiling, mind you; for if only one degree below the boiling-point it will not be hot enough to whiten them. Cover your washing-mug (or basin) at once, so that the steam is kept in; after 20 to 30 minutes has passed, wash your things, and give them a rinse in plenty of tepid water. If now they are not to your satisfaction, spread them, well pulled out, while wet upon a large dish, which place at, or outside, an open, sunny window, sprinkle them with clean cold water several times a day, and they will bleach lovely. Keep thus going for two or three days; then wash again in a clean "scald," as above described, and when you have them finished it will be your own fault if your laces and handkerchiefs are not a wonder to all beholders. N.B.—Never starch your lace articles, but crisp them in cold water, in which two or three lumps of loaf-sugar are dissolved; also be sure to stretch out the work while wet, then dry flat on a towel upon the bed.—An Experienced Old Hand.

[46797.]—**Academy Boards.** — I have found academy boards very convenient for sketching in oils, but unless you manipulate your colours skilfully they are apt to sink in in the course of time. For good, permanent work I should certainly recommend canvas. For the enlightenment of "Nun. Dor." in connection with query, I would say that academy boards are millboards, prepared to receive oil-colours, and may be had of any of the artists' colourmen.—Edward Flowerday.

[46814.]—**Caledonian Engines.**—To "Carstairs."—Many thanks for details. I have never yet seen a Caledonian engine, having only heard of them, and principally through your interesting papers in the "E.M." I suppose the old six-coupled goods would not be like the modern ones in the arrangement of wheels! If there are any other classes of exceptional construction, either on the Caledonian or neighbouring lines, I am sure the information would be welcome.—R. N. H.

[46847.]—**Equation.**—The second solution of "A Medical Student" is only a repetition of what has been done before—viz., casting out a factor from a biquadratic. He has, however, this time discovered that that can be done without introducing unnecessarily other unknown quantities; but how he should think that the "appearance" of a quadratic, the square of which he is unable to complete, is quite sufficient, I must leave your readers to judge. "R. E. D." has been a little hasty in giving what he calls a decisive proof of the fallacy of my solution. The fallacy he pointed out is known to most of us from our school-days, when, by it, we used to perform the wonderful feat of proving 1 = 0, &c. But in applying this fallacy to my solution he has proved too much. He has proved the truth, and not the fallacy, of my result; for if $(a - b) = \pm (c - d)$, then the terms are, as pointed out by "M.I.C.E.," each = 0. And, moreover, this does not arise, as "M.I.C.E." thinks, through a curious coincidence, but through the arithmetical progression of the terms, as I will now endeavour to show. In my solution (*b*) $2zx - xy = 18$. Then $18 - zx = zx - xy$. $\therefore xy, zx, 18$, are in arithmetical progression, where $zx - xy$, or $zy/3$ = common difference. Then

$$\begin{array}{ccc} zx - xy, & zx, & zx + xy \\ \frac{zy}{3}, & zx, & 36 - zy \\ 9 - \frac{xy}{2}, & 9 + \frac{xy}{2}, & 9 + \frac{3xy}{2} \end{array}$$

are identical in value, but not in terms. Now the following equations, which appeared in my first solution—

$$zx - xy = \frac{zy}{3} \text{ .... } (c)$$

$$zx + xy = 36 - zy \text{ .... } (d)$$

are manifestly *not* identical. If we multiply these together, we still have an independent result, viz.:—

$$z^2x^2 - x^2y^2 = 12zy - \frac{z^2y^2}{3} \text{ .... } (3)$$

and substituting for zx^3, from the progression, the value $\left(9 + \frac{xy}{2}\right)$ is quite legitimate. Then—

$$\left(9 + \frac{xy}{2}\right)^2 - x^2y^2 = 12zy - \frac{z^2y^2}{3}$$

reducing and completing the square, we have, as before—

$$\frac{x^2y^2}{4} - 3xy + 9 = \frac{z^2y^2}{9} - 4zy + 36$$

$$\frac{xy}{2} - 3 = \pm \frac{zy}{3} - 6$$

$$\frac{xy}{2} - \frac{zy}{3} = -3$$

$$\frac{xy}{2} + \frac{z}{3} = 9$$

$$\therefore xy = 6 \quad zy = 13 \quad zx = 12.$$

From the progression we also get readily, without any substitution—

$$\frac{12 - \frac{2zy}{3}}{(xy - 6) + \left(\frac{zy}{3} - 6\right)} = \frac{xy - 6}{6 - \frac{zy}{3}}$$

$$\therefore 2\left(6 - \frac{zy}{2}\right)^2 = (xy - 6)^2 + \left(\frac{zy}{3} - 6\right)(xy - 6)$$

By completing the square and reducing, we get—

$$9 - \frac{zy}{2} = \pm (zy - 6) + \frac{zy}{6} - 3$$

$$\therefore 12 - \frac{2zy}{3} = xy - 6$$

$$\text{or } \frac{zy}{3} = xy$$

$$\therefore zy = 18, \text{ and } xy = 6$$

$$\therefore \frac{zx \cdot xy}{zy} = \frac{12 \times 6}{18}$$

$$x^2 = 4 \quad x = \pm 2 \quad y = \pm 3 \quad z = \pm 6$$

—J. Lane Davies.

[46834.] —**Churchwardens (U.Q.)**—Though addressed to Mr. Wetherfield, as it has not yet been answered, I give the following:—The only alteration I know of in the law of voting at the election of churchwardens is that now the occupiers of small tenements on which the rates are paid by the owner are qualified to vote in respect of their occupation. All householders may vote in vestry, also on a poll; at the latter the voting is regulated by the rateable value, in respect of which the occupier votes. By 58, Geo. III., c. 60, sec. 3, it is provided "that every inhabitant present, who by the last rate made for the relief of the poor shall have been assessed in respect of any annual rent, profit, or value, not amounting to £50, shall give one vote and no more; if assessed for any such annual rent, &c., amounting to £50 or upwards, he is entitled to give one vote for every £25 in respect of which he shall have been assessed; but so that no inhabitant shall give more than six votes." Of course in vestry, when the voting is determined by show of hands, each individual can give but one vote, irrespective of the amount of his assessment.—DITTON.

[46863.]—**Painting on Silk.**—I understand that the proper method of preparing silk for painting is to size it—using preferably isinglass size. The silvering and gilding will be done as usual with gold size and metal in leaf, unless Bessemer's paints are considered good enough. The paints are of course the usual artist's oil-colours.—T. P.

[46881.]—**Boring Working Barrel.**—In the back volumes there are all sorts of devices for boring out cylinders, &c. Perhaps that on p. 628, No. 753, will suit you. Possibly, however, you will find a simple cutter, mounted in a disc the size of the barrel, will work easiest, if slow.—E. G. M.

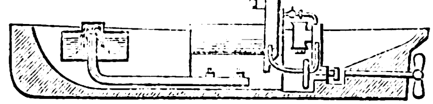
[46885.]—**"Austral" and "Sahara."**—The engines of the "Austral" are compound surface-condensers; one high-pressure cylinder, 62in. diameter, and two low-pressure, 86in. in diameter, with a stroke of 5ft. The crankshaft is "built" and the propeller-shaft is of fluid compressed steel. The four boilers are of mild steel, cylindrical, 16ft. in diameter, and 17ft. long, with six furnaces in each, being fed from both ends. The working pressure is 95lb. The length of the vessel is 474ft., breadth 48ft. 3in., depth 37ft. I have not seen any published dimensions of the "Sahara."—ESSAR.

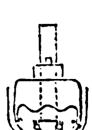
[46886.]—**Model Marine Engines.**—The engines would do for any boat into which they can be placed; but they most certainly will not drive any boat at 10 miles an hour even with the tide. Test the boiler according to directions given last week, p. 331. But suppose your model finished, and the engines will drive it at the rate of 10 miles an hour, what are you going to do with it? Models of the kind, which are in reality "models" of nothing at all, serve only to show the skill of the workman, and are utterly useless when finished.—ESSAR.

[46911.]—**Lathe.**—If choice lies between a 4in. with backgear, and a 5in. without, the former will be most useful, as by it you will be able to turn metal.—X. P.

[46926.]—**Regilding Candlesticks.**—How can anyone answer this question, without knowing the material of which the candlesticks are made? By the fact that leaf is mentioned, they may be wood; but the querist seems to be further in doubt whether he wants gold or bronze.—DUBEX.

[47000.]—**Model Steamboat.**—The dimensions given by "Amateur" for the engine and propeller would do very well for his boat, but it is hardly long enough for a boiler 6in. long; and instead of a round boiler I should recommend one made to fit the shape of boat, and about 5in. long; and if the top of firebox is corrugated, you would get as much heating surface as a plain boiler 6in. long would give. The propeller should have only two blades, with a fine pitch. The lamp should be made as shown in sketch, the object being to keep the supply of spirits away from the boiler, and well above the bottom of tubes and burners, which should be filled with wick as shown in sketch, to act as a siphon, and so keep the burners regularly supplied with spirits. You should have two of these tubes, with two burners on each, about ⅜in. diam. The exhaust steam should be turned up chimney. The whole of the metal-work should be as light as possible consistent with safety, as the boat is rather small for a steamer. If you can refer to back numbers, you will find plenty of information on the construction of boilers for model steamboats.—E. L. P.





[47004.]—**Bread.**—In the issue of 9th June, your correspondent has quite overlooked the drift of "A Disgusted Foreigner's" query. No one can doubt that the bread on the Continent is infinitely superior to that made in this country; we have only to consult our travelling friends on that head. What he wishes to know is, as I take it, what do the Austrians (who have the name of being the best bakers in the world) and other foreigners use in the making of their bread that Britishers do not? Of course, we do not call "Yankees" foreigners: they have more or less the habits of Britishers, and further, what judges could there be where there are few professional bakers, where in most places they bake for themselves, not being able to purchase the commodity from bakers, and scarcely any of them used to good bread—certainly not such palatable bread as the Europeans make. The question is not so much what makes the English bread bad, as what makes the Continental bread so good, and this is a thing a good many of us would like to know.—SEMPER FIDELIS.

[47016.]—**Repairing Ebonite Dish.**—Ebonite dishes when broken are very awkward things to repair. The only safe method of mending is to make a small metal frame to fit over the broken corner, and then to cement this frame tightly to the corner; the dish may then last a long time, but all attempts to rejoin the broken corner will fail, unless there is a strong support underneath to keep the corner rigid.—W. J. LANCASTER.

[47029.]—**Difficulty with Coil.**—To MR. LANCASTER.—In the first place, from your query I fear that the insulation of primary is bad, and that as the primary is, it is insufficient to induce the strength of current that the secondary ought to produce; and, secondly, the joinings of secondary are faults, each one taking away from length of spark. I would rather use only half the quantity without a join than all that you have with a number of joinings. You should also have had better insulation between primary and secondary; the thin layer of paraffin is insufficient. I would advise you to unwind part of the secondary, then test with battery until you get the ½in. spark again; then put plenty of paraffin around coil, and bake it for a night, clean off the outside, and having carefully gone over every joint, resoldering where necessary, rewind the wire, gradually thickening it to the centre of coil, leaving the ends bare, something of this shape ⬭; then test after every two layers, and if spark increases in length go on winding; but the moment the spark seems to be going back, stop winding; put in paraffin and bake again. I think you will then have a good coil.—W. J. LANCASTER.

[47043.]—**Camera.**—You will have to give more information about your lens before anyone can assist you. Say in another query how many lenses there are in it, and the diameter of the lenses. I am afraid you have a centre lens only, belonging to a "Jamin"; if you have, it is of no earthly use without the other part.—W. J. LANCASTER.

[47053.]—**A Question for Spectrum Analysis.**—This is not a question for spectrum analysis at all. It has only to do with the reflection of light by the roughened surface of the glass; this scattered reflection does of course prevent direct sunshine entering the conservatory; but the light that does enter differs only in quantity from what would enter if the glazing were of clear glass. Why don't you have half a dozen of the panes removed, and clear glass put in just where the sun would shine through? Even then I am afraid the plants would not thrive, and that the question would still be an open one as to the cause.—W. J. LANCASTER.

[47054.]—**Incandescent Lamps.**—Don't attempt to light one of the lamps with Leclanché cells; it will only end in failure. You may get a light for a few seconds, and then it will be all over. Rig up a few Bunsens, and the effect will be good.—W. J. LANCASTER.

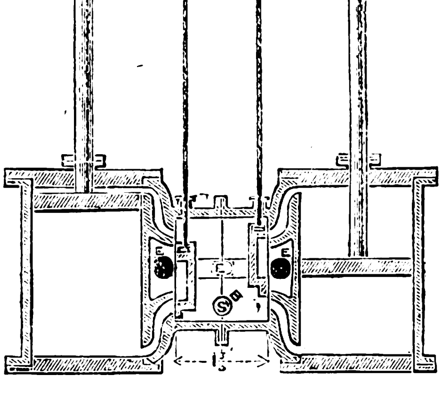
[47055.]—**Cardboard.**—The use of cardboard for shutters is a failure. Better get a piece of blackened block-tin; one sheet of tin will make a number of shutters. You might get a 14 by 10 ferrotype plate, and cut it up into 9½ plate shutters, or 4½ plate. This will cost you about 5d., and is already blackened. By the bye, you can make a nice dark slide out of ferrotype plate. Make a block a little larger than plate, then bend over it the ferrotype plate, and make a flange in front sufficient to allow the shutter to slide down; then remove the block, bend over the top piece, and let this go lower down than the other parts to allow shutter to slide over. Now cut out a thin wooden frame just large enough for plate to drop in, and to fit tightly into dark slide, join up the corners clean, and solder; put two little turn buttons on to carrier to keep plate in place, and the slide will be made, and will work very well.—W. J. LANCASTER.

[47056.]—**Bacteria.**—I am very thankful to Mr. Thoms for his kind reply to my query; but he has, unfortunately, mistaken the purpose of the barm in question, which being "intended for distilling—alcoholic fermentation," and my object with it, to obtain as thorough and low an attenuation as possible, the remedy so kindly suggested is hardly applicable, as I work on the thick-mash system, and nothing is strained, all "grains" passing through the fermenting-tuns and stills. With your kind indulgence I will explain further, hoping that Mr. Thoms will again reply. The barm is made from 50 per cent. each of rye, barley, and malt meal, mashed with water at 185° Fahr., or so, in order to give it the proper consistency and saccharine concentration, when mashed to 150° temp.; it is then covered for two hours, when covers are removed, and it remains open for ten hours more before being roused, which rousing is continued every two hours, till a proper acidity (as indicated by Ludersdorf's oxymeter with ammonia) is observed. This takes about 24 hours, the temperature of the barm mash being then about 124° Fahr., and the acidity from 1¾ to 2¼. It is then cooled as rapidly as possible to 65° Fahr., mother added, and after a good rousing, again covered. After nine hours the mass is generally found to be nearly half-attenuated, and to be of a temp. of 83° Fahr.; the mother is then taken off and rapidly cooled, while the mass remains another hour or two, and is then put into the fermenting-tun with the mash to be fermented. The quantity of barm is 7 per cent. to 8 per cent. weight (of meal) of the mash fermented, and attenuation ought to arrive at 1002 (Bate S. G.), temp. 60° Fahr. (this being a filtered sample from mass), in 48 hours: pitching temp., 66° Fahr. My remarks on barm not always rising to the surface will now be, perhaps, better understood. Such skimmings never show any other than pure torulæ germs. Sometimes a lactic rod will appear; but very rarely, although fermenting barm abounds with them. This system of making yeast is general all over the Continent. I do not think now that Mr. Thoms will recommend the use of sedimentary yeast, and am sorry that the misunderstanding as to the rising of the barm arose. Will Mr. Thoms please tell me the way to prepare the ash of carbonised raisins or grapes, and give me also his opinion on the use of ammonia for invigorating the growth of our torulæ?—CYGNET.

[47065.]—**Gaiffe's Medical Battery.**—The coil in Gaiffe's is a little induction coil without a condenser. You can make one easily with primary and secondary circuits. I make a little coil that you can almost put into your waistcoat pocket, that would give you more current than you would care to receive.—W. J. LANCASTER.

[47069.]—**Fruit-growing.**—The "Fruit Manual," by Dr. Hogg, published at 171, Fleet-street, and Scott's "Orchardist," are two most useful works on fruit-trees. The latter was published by H. M. Pollett, 10, Bridgewater-gardens, E.C.; but don't rely too much on manuals in planting. See what kinds suit your own neighbourhood best, or you may be led into error. Dr. Hogg is a well-known authority on fruit-trees, and Mr. Scott is, or was, a practical orchardist at Merriott, Somerset.—BETA.

[47093.]—**Double Steam-Chest.**—Hoping that I understand your case correctly, I should like to suggest the plan shown in the sketch, where the valves used in the old arrangement work in one steam-chest. This valve-chest could be made by bolting each of the original valve-chest flanges to one of the flanges of the middle part of the casing of such a width as to keep the faces 1⅜in. apart. You require then only one steam-pipe, which may be bolted to a branch on the middle part of the casing. The exhausts must be joined by a short double-elbow pipe, with a branch for the exhaust-pipe (B in the sketch). If the discs of your eccentrics are split, it is easy to change their positions from outside to inside; if not, as is often the case in models, I can see no other way but to make new eccentrics with such discs.—R. KANTHACK.



[47093.]—**Double Steam-Chest.**—I should say that "J.M.L." could easily arrange his valves, &c., as he requires. If he will say what the length and breadth of his exhaust port is, and the length of shaft available to put his eccentrics on, I shall be glad to give him a sketch for the same.—G. I. C. E.

[47094.] — **Combustion of Coal.** — If freely supplied with air, the products of combustion will be carbonic anhydride CO_2 and water H_2O. In 100cwt. of coal, we have per question 88·42cwt. of carbon, 5·6cwt. of hydrogen, and 5·97 cwt. of oxygen. Since in water H_2O the proportion by weight of H to O is 1 : 8, the atomic weight of oxygen being 16, the quantity by weight of O necessary to convert 5·61cwt. of hydrogen into water is 5·61 × 8 = 44·88. Similarly since in carbonic anhydride CO^2 the proportion by weight of C to O is 3 : 8, the atomic weight of C being 12, the quantity by weight of O necessary to convert 88·42cwt. of carbon into CO_2 is 8-3rds of 88·44 = 235·792. Therefore, the total weight of oxygen required to burn the H and C is 44·88 + 235·79 = 280·67cwt. But of this amount 5·97cwt. are supplied by the coal; therefore, weight of oxygen required from the air is 280·67 − 5·97 = 274·7cwt. Now, oxygen by weight in the air is 23·16 per cent.; therefore, weight of air necessary to supply 274·7cwt. of oxygen is 1 / 2316 of 2,747,000 = 1,186cwt. approximately. Therefore, weight of air necessary to burn 20cwt. of coal, and 1-5th of this is 293cwt.—Mide.

[47094.]—**Combustion of Coal.**—In 20cwt. of coal we have—

$$\text{C} \ldots \frac{20 \times 88{\cdot}42}{100} = 17{\cdot}684\text{cwt.}$$

$$\text{H} \ldots \frac{20 \times 5{\cdot}61}{100} = 1{\cdot}122\text{cwt.}$$

$$\text{O} \ldots \frac{20 \times 5{\cdot}97}{100} = 1{\cdot}194\text{cwt.}$$

$$\overline{\quad 20\text{cwt.} \quad}$$

The combining weights of C, H, and O being 12, 1, and 16, we require

$$\frac{32 \times 17{\cdot}684}{12} = 47{\cdot}157\text{cwt. of O to form } CO_2$$

$$\text{and } \frac{16 \times 1{\cdot}122}{2} = 8{\cdot}976\text{cwt. of O to form } H_2O$$

Thus, total weight of O required for complete combustion = 56·133. 1·194cwt. being in the coal, 54·939 have to be taken from the air, which contains 23·14 per cent. of O. The weight of air required is then $\frac{54{\cdot}939 \times 100}{23{\cdot}14} = 237{\cdot}4$cwt. of air, or 2,942 cubic feet of air. (In practice, much more air is supplied to furnaces.)—R. Kanthack.

[47094.]—**Combustion of Coal.**—The combining weight of carbon is 12, and that of oxygen 16; therefore 12 parts of C will require 2 × 16 = 32 parts of O. The atmosphere contains about 23 of O in every 100 parts by weight. We must now find by proportion what weight of air contains 32 parts of O. Thus:—32 × 100 / 23 = 139·131. To find the weight of air required for the combustion of a body containing

Carbon........................	88·42	parts
Hydrogen	5·61	,,
Oxygen	5·97	,,
Total	100·0	,,

We must first find the weight of O. required for 88·42 parts of C. This we do by proportion. If 12 requires 32, how much will 88·42 require? The hydrogen would burn to form water (H_2O). The combining weight of H is 1; therefore 2 parts of H will require 16 of O, in the same way as for the C. We must now find how much O is required for the 5·61 parts of H. We now know how much O is required for the combustion of the C and H, and must now subtract the 5·61 parts of O in the body from it, so as to obtain the amount of O. required for the combustion of the whole body. We must now find, as in the first part, how much air contains the quantity of oxygen calculated. To find the weight of air required to burn 20cwt.: we know how much is required to burn 100 parts; how much will be required to burn 20 parts, supposing the whole amounts to be in cwts? Proportion again.—Burette.

[47098.]—**Engine Queries.**—I will answer query 2 first. Let D A, D B, Fig. 1, be the position of the crank at the beginning and end of stroke. A B represents length of stroke of piston; A D = half-stroke of piston, and any portion of A B represents distance travelled by piston. Produce A B indefinitely, and take A C = length of connecting-rod between centres. About A B, as diameter, describe a circle A E B F. Let *h* = position of stroke at which it is desired to find angle of crank. Then lay off *n*C′ = A C, and with centre C′ and distance C′*h* describe arc of circle G*n*H join G D. Let arrow indicate direction of rotation, then G D A = angle of crank at given position of piston. With regard to query 1, the solution is entirely relative. If "Phenix" requires a solution of a particular case, I shall be happy to offer him one if he will furnish particulars; but if he requires a general one, I would refer him to Dr. Zeuner's method as found in Rankine's "Useful Rules and Tables." Query 3: Let A B C D, Fig. 2, represent tank with inclined base. Through centre of C D draw F E G; *h*′E = mean pressure, *h*D = greatest pressure, and *h*″C = least pressure; total pressure on base = area of C D × *h*′E.—Ligurian.

FIG. 1.

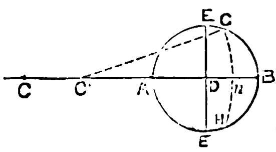
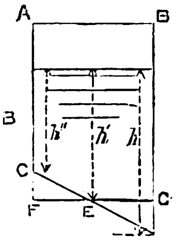


FIG. 2.



[47098.]—**Engine Queries.**—1. The angular advance can be found graphically, and by the formula sin. (angular distance) = lead + lap / throw of eccentric. In Fig. 1. C D represents the travel of the valve, and C E D F the eccentric circle. Bisect C D at O, and draw E F perpendicular to it. On O D from O mark off lead + lap on the same scale as C D. If O B represents this distance, draw A B perpendicular to C D, join A O, and A O E is the angular advance, its sine being equal to O B / A O = lead + lap / ½ travel. 2. In Fig. 2 let A B C D represent the cylinder, E F the piston in a given position, K P or R the connecting-rod, O P the crank, and O the centre of crank-shaft. Also call the stroke S the remaining part of the stroke at a given position S′. Then, if G H are the positions of K at beginning and end of stroke, K H = S′, H L R, and because O L = O P = 3 / 2. H O = R − S / 2; therefore, K O = K H + H O = S′ + R − S / 2. O P = S / 2 and K P = R. We can now easily find sin. θ (= sin. P O K) by the formula: $\text{Sin. } A/2 = \sqrt{\frac{(s-b)\,(s-c)}{bc}}$ where

$$A = POK,\ S = \frac{R + S/2 + S' + R - S/2}{2}$$

= R + S′ / 2, *b* = S / 2, *c* = S′ + R − S / 2. (3) In Fig. 3 let H be the head of water at B C in feet, H′ that at A D. Then the average head H + H′ / 2 × ·434 × the surface of incline base in square inches gives you the total pressure.—R. Kanthack.

FIG. 1.

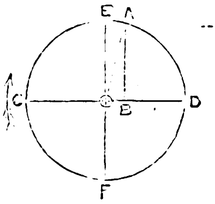


FIG. 3

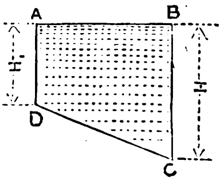
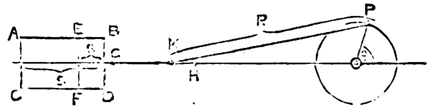


FIG. 2.

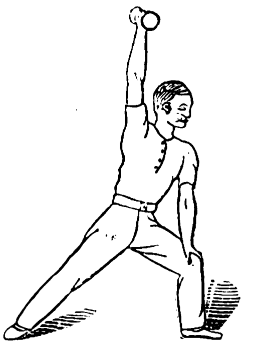


[47101.]—**Polypus.**—Not long ago, I read in a medical paper of a very simple and efficacious way of getting rid of nasal polypus. Dr. Cesarini injects with a fine squirt (as used for subcutaneous injection of morphia) 4 or 5 drops of chemically pure acetic acid in the polypus, which, four to five days after, withers away. A serious operation is very seldom required. This operation is painless. Should, after the lapse of many years, the polypus reappear, perform the same operation.—C. W.

[47103.]—**Explosions in Collieries.**—You would be unable to do any good by introducing nitrogen into the pit. The nitrogen would, if in sufficient quantities to dilute the explosive gases, merely add another terror to the miners, producing death from oxygen starvation. Better have the explosion and an instant death than be gradually starved to death through want of oxygen. The death of a miner from an explosion is in all probability a very rapid one, except, of course, when imprisoned by falling rock, and how much worse was the death of the 123 who perished in the black hole of Calcutta. It seems to me that the risk will remain as long as coal-mining exists. It may be that by more perfect ventilation and the use of fans a better circulation of air may be obtained; then the risk would be lessened, but this will take time. There are precautions, of course, taken now, and the inspectors, I believe, are very useful men. The training of mining engineers is now very different to what it was 20 years ago, and it will still improve.—W. J. Lancaster.

[47106.]—**Dry-Plate Photography.**—A simple lens may mean anything, just as a single lens is used to denote either really a single lens or an achromatic lens. However, use an achromatic lens, you can have them now cheap enough. Don't try to work with bad tools, get good ones, and do good work. Many a man has been ruined as a workman by having only bad tools to work with, and in photography, a bad lens will only be a source of annoyance and disgust. It may be that the amateur possessed the germs of success, to be annihilated by a bad lens. Emulsify means to make into an emulsion. Soaking a gelatine film in a saturated solution of alum will harden it.—W. J. Lancaster.

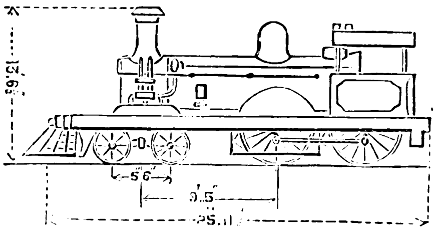
[47109.]—**Gymnastics.**—The following exercise would, I think, be beneficial:—Take up your position with the feet together and at right angles, the left foot pointing to the front; step to the front with the left foot, keeping the right foot firm, and the feet still at right angles. The step should be about a yard. Keep the rear leg quite straight and the front one bent; with the left-hand grasp the thigh, just above the knee, and with the right-hand seize one of the bells (which should be just in front of you), and raise it above the shoulder, bending the arm during the ascent, and raising it to the full extension, leaning, meanwhile, with the left arm on the left knee; put down the bell and raise it again six times as before, then step back and step forward with right foot, and repeat the exercise with the left arm. After this, go through the same exercise, only raising both the bells, first with left foot forward and then the right. I think it would be best to use both arms, only I should use a heavier bell with the left arm—say 16lb. and 10lb. with the right, although after practice these weights might be considerably increased. This would tend to equalise the two shoulders. The position is very important, and should be carefully studied. I shall be pleased to give further particulars, if not clear. I send figure of the position with the bell raised. If possible, "D. D. M. L." should consult Maclaren's "Physical Education."—Hemisus.



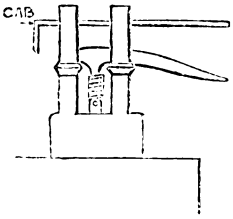
[47111.]—**To Mr. Lancaster.**—I do not know of any source from which you will gain more information about small dynamos and storage cells than in the pages of "ours." Certainly there is "electric light," electricians, "telegraphic mem's," &c., which contain accounts of large machines. Now to tell you the truth—and I would not mislead a single reader of "ours"—small dynamos are a "failure," and it will be some time before anything really good will be made. The storage cells are almost equally bad. I cannot get 60 per cent. out of them of the current used up in charging them. There is a lot of bosh written about them by men who ought to know better.—W. J. Lancaster.

[47121.]—**Indian Locos.** — In answer to "Russell," I send the following particulars of some locos. for Bombay, Baroda, and Central India Railway, which came out in March and February, 1882. They were built partly by the Vulcan Engine Company, Newton-le-Willows, and partly by Messrs. Stephenson and Co., Newcastle. The loco in question is an eight-wheeled one, having four coupled wheels and a bogie. The principal dimensions are:—Gauge of road, 5ft. 6in.; cylinders, 17in. by 24in.; driving-wheel diam., 6ft. 1in.; bogie, 3ft. 7in.; wheel-base of bogie, 5ft. 6in.; centre bogie to centre drivers, 9ft. 5in.; wheel-base of coupled, 8ft.; from leading buffer-beam to trailing buffer-beam, 25ft. 11½in.; wheel-base, total, 20ft. 2in.; h. s. of tubes, 1,019 sq. ft.; h. s. of firebox, 90 sq. ft.; grate area, 16½ sq. ft. Boiler:

length, 10ft.; diam. outside, 4ft. 7½in.; thickness of plates, ½in.; thickness of tube-plates, ¾in.; pitch of rivets, 1⅞in.; diameter of rivets, 13-16in. Firebox casing is flush with boiler. Length of firebox 4ft. 10½in.; breadth at bottom, 4ft. 7½in.; thickness of plates, ½in. Smokebox: length outside, 2ft. 8⅜in.; breadth, 5ft. 2⅜in.; diameter of doorway, 4ft. 1in.; thickness of plates ⅜in.; diameter of rivets, ⅞in.; pitch of rivets, 2½in.



Chimneys of BB Staffordshire iron with polished copper cap. Length, 4ft. 1in.; diameter inside at top, 1ft. 3⅜in.; diameter inside at botton, 1ft. 5⅞in.; plates, 3-16in. and 1-14in. Ash-pan door made to work from foot-plate independently. Thickness of plates, 5-6in.; depth of ash-pan, 1ft.; width of ditto, 4ft. ½in. Number of tubes, 189; length, 10ft. 5¾in.; diam. outside, 2in.; at smoke-box a length of 4in. is 2⅛in. diam.; thickness 13 W.G. at smokebox, 10 W.G. at firebox; safety valves, Ramsbottom, blow off at



140lb.; blast-pipe cast iron; diam. nozzle, 4¾in.; height, 3ft. 6in.; distance from centre to centre of cyl., 2ft. 8in.; distance from valve spindle centres. 5¼in. The valve motion is of Allen's straight-link type, axles of Yorkshire iron. Driving and trailing, diam. at centre, 7in. and 6in.; diameter at wheel, 8½in.; diam. at bearing, 7in.; buffers, Turlon's patent; buffer beam teak. Injectors are by Messrs. Sharp, Stewart, and Co., Atlas, Class F, No. 9, two to each engine. Smith's vacuum ejector and brake are fitted to work from left side.—E. W.

[47130.]—**Decorating Organ-Pipes.**—"J. E. B." does not say whether his pipes are wood or metal. I may inform him that I have made the bottom octave of a principal of zinc, scraped them bright, and, after burnishing, gave them a coat of pale varnish, and they look well and keep their polish excellently.—STATIONMASTER.

[47132.]—**Hæmorrhoids.**—If "Grateful" will follow the following prescription of Dr. Gullon, jun., I think he will very soon get relieved. Make some camomile tea, pour out a saucerful, add thereto 10 drops of "aqua plumbi," dip in a pad, and place this on the piles; as soon as it gets dry wet it again. In a few days the piles shrivel together. Inwardly you take homœopathic nux vomica as long as you feel the piles, and continue with the pads. Take the sixth dilution, three doses a-day—*i.e.*, morning, mid-day, and evening, half an hour before eating. The dose is one drop to a tablespoon.—C. W.

[47143.]—**Aluminium.**—This is rather a cool request. The querist has discovered a method of obtaining aluminium easily (which means a moderate fortune) except one step, and he placidly asks the readers of the ENGLISH MECHANIC to give him the information required to complete his process, without the slightest hint of payment. The analytical separation of Al and Zn is easy enough; but that is not what is needed: and the separation of metallic aluminium from its alloy with zinc is a much more troublesome problem.—WM. JOHN GREY, Elswick Science School.

[47146.]—**Tin Plates.**—The following is the mode generally employed to render the plates chemically clean. They are first immersed for four or five minutes in dilute sulphuric acid, then they are raised to a red heat in a reverberatory furnace, and when cool hammered flat. To remove scales of oxide they are then passed through rollers, after which they are kept for about two hours in a mixture of bran-and-water which has become sour from exposure, thence they are transferred to a vessel containing a mixture of dilute sulphuric and hydrochloric acids. Lastly, they are scoured with bran, and may then be kept for any length of time in pure limewater. In some works after being scoured they are further cleaned with hydrochloric acid holding zinc in solution. After being so prepared the plates are plunged, one at a time, into a vessel of melted tallow, and after being kept in this for an hour they are immersed in the bath of melted tin, over which is a stratum of grease 3in. or 4in. thick. Here they are kept for about an hour and are then allowed to drain. After this they are again plunged into a second bath of pure tin, and excess of tin removed by heating in a bath of tallow; the tin melts and collects at edge of the plate; when cool this margin is finally reduced by dipping the edge of the plate into tin kept at a high temperature; the superfluous metal is quickly fused and then detached by a sharp blow.—MIDE.

[47151.—**Washing-Machine.**—The way that I would do this would be to bore an auger-hole, the size of the square of the iron, right through the roller, drive the axle through, also drive a ring of, say, 4in. diameter by ⅛in. thick, and about 1in. deep, with one edge hammered sharp into each end of the wood; and finally drive four iron wedges between this hoop and the axle at each end, and you will have a firm fixture.—J. J. A., Liverpool.

[47152.]—**Field - Glass.**—If "Spot-lens" is quite sure that the spots are in the cement, let him take one o.g. apart first by warming it over a hot plate, and then boiling the separated lenses in turpentine or spirits of wine. When quite clean and dry, put the concave lens on the plate; when warm drop a little Canada balsam into the centre of lens, and carefully slide the convex lens into its place, taking care that the same surfaces touch as before separation. Allow the o.g. to bake until the superfluous balsam (when cold) is slightly brittle. Clean the edges with turps and replace in cell. It would be wise to mark the edges of o.g. with a lead pencil before separating, to keep true.—GOBO.

[47153.]—**Weston Dynamo-Machine.**—Not much Weston. Is it Siemens'? He patented winding the wire in slots on a cylinder. You cannot get 70 yards on each coil. Better do without the slots. Make 8, 12, or 16 coils of 14 wire; circuit machine; splendid arc: several incandescent lamps. Sorry I cannot give the current in Webers.—GEORGE TOLMAN.

[47155.]—**Boehm System.**—In reply to "Bassoon," the Boehm system aims at placing all holes in wind instruments as near their correct distance from mouthpiece as possible, and having them proportional to the size of bore, and in geometrical ratio as to distance from each other. But, as this subject is a special one, and not of much general interest, if the querist advertises his address, I will give him every information, or tell him where to get it.—VULCANITE.

[47157.]—**Heat.**—The rate of cooling is expressed by Dulong's and Petit's formula: $ca^r(a^\theta - 1)$ or $c(a^{r+\theta} - a^r)$, where r represents the temperature of the surrounding air, $r + \theta$ the temperature of the thermometer—*i.e.*, of the radiating body. If r and θ are expressed in Centigrade units, $a = 1{\cdot}0077$; if in Fahrenheit units, $a = 1{\cdot}0043$. This formula applies to all cases where the temperature of the hot body is less than 320° C., the difference of temperature of hot body and inclosure being less than 240° C. c is a constant with which $a^r(a^\theta - 1)$ has to be multiplied to find the absolute loss of heat per hour per sq. ft. of different surfaces, its value depending upon the nature of the surfaces. Values of c:—For polished silver, 2·7; polished copper, 3·31; polished brass, 4·55; rough cast iron, 67·21; lampblack, 85·79.—R. KANTHACK.

[47158.]—**Homogeneous Immersion Objectives.**—In all work where difficult resolutions under high powers are needed, the homogeneous objectives are immensely better than water-front lenses. Get catalogues from Zeiss, of Jena, or Powell and Lealand, of London.—JAMES EDMUNDS.

[47158.]—**Oil-Immersion Objectives.**—For all ordinary examination of diatoms, a good one-eighth or one-tenth water immersion o.g. will be found amply sufficient; and it is far less troublesome than one requiring oil or glycerine. But if you are bitten (like myself I confess) with Amphipleura pellucida, or desire to distinguish, if possible, between Frustulia saxonica and Navicula crassinervis, and to decide whether they are anything else than small examples of N. rhomboides, there is nothing for it but a high-class "homogeneous" objective.—ANTARES.

[47159.]—**Heating Greenhouse.**—I should recommend that, if the vent-pipe is not so large, it should be increased to 3 or 3½in. If this does not stop the down-draught, an Archimedean cowl should be put on of the same diameter as the pipe, or a little larger.—HEMISUS.

[47159.]—**Heating Greenhouse.**—I think the down-draught would be effectually cured by one of Boyle's caps, which act on the principle of the ejector. They are so made that if any wind is blowing it passes through the vanes or louvres in such a way as to pump up air from the chimney to which it is affixed.—NUN. DOR.

[47159.]—**Heating Greenhouse.**—It seems to me that the cause of this downward draught is, first, the coldness of the upper portion of the pipe gives a down-draught for some time after the gas is lit; and, secondly, the sudden gusts blow down the pipe in the usual manner. I should recommend "W. R. S." to cover his pipe with painted felt from above the point where the pipe gets very hot, to its top. This, when the pipe is once warm, will keep it so, and draw up the burnt gas-fumes; and I should then place an ordinary cowl on the top to foil the sudden gusts. I tried this method with a flue some years ago, and it was successful.—B. H.

[47160.]—**Recovery of Silver.**—"Porous Cell" had better ascertain, properly, how much silver there is in his lead before he asks about its recovery; the fact that the lead will do for use in a (Smee) battery does not prove much. Carbon can be used in a nitric-acid cell, instead of platinum; but it would be a foolish thing to conclude that, therefore, the carbon contains platinum.—WM. JOHN GREY, Elswick Science School.

[47161.]—**Sulphate of Alumina.**—The best method of obtaining the sulphate from bauxite is first to obtain from it the soluble trisodic aluminate. The ore mixed with soda-ash is heated to bright redness until no effervescence occurs on addition of an acid. On lixiviation the trisodic aluminate, $3Na_2O, Al_2O_3$ is dissolved and separated by filtration. Through this solution carbonic anhydride, CO_2, is passed, when sodic carbonate is produced, and alumina Al_2O_3 deposited, which is then dissolved in sulphuric acid, giving the sulphate.—MIDE.

[47161.]—**Sulphate of Alumina.**—The method of preparing this from the mineral bauxite, is as follows:—The bauxite is first broken up small in crushing machine; the powdered mineral is then mixed with carbonate of soda, which is obtained as a by-product, as shown further on, or else with a mixture of sulphate of soda and charcoal, and heated strongly in a furnace. The mass is afterwards lixiviated with water in tanks, when it yields a solution of aluminate of soda; carbonic acid gas is then passed into the solution, causing the alumina to be precipitated in the form of a hydrated gelatinous mass; carbonate of soda, being formed by the double decomposition, remaining in solution. The precipitated alumina is next washed and formed into the sulphate by adding it to dilute sulphuric acid, contained in lead-lined tanks, kept at about 90° Centigrade, until the acid will dissolve no more. This solution is then placed in copper boilers and boiled down to sufficient strength, and afterwards poured into moulds. The original solution from which the alumina was precipitated is also boiled down and the carbonate of soda allowed to crystallise out.—ARTHUR E. MORRIS.

[47161.]—**Sulphate of Alumina.**—There are several patented processes for making sulphate of alumina, the best of which is, I think, that described in Newlands's Specification, No. 5287, 1880. The following is a brief description:—Bauxite is first ground to a fine powder, and then dissolved in sulphuric acid, the operation being performed in a mixer, such as is used in the manufacture of superphosphate. The acid acts in a very energetic way on the mineral, and the mixture which is at first liquid, sets into a mass, which varies in hardness according to the strength of the acid employed. The crude cake thus produced is dissolved in water by means of steam, and the solution either allowed to settle, or filtered by means of a filter press, whilst hot. In the former case, the solution will have to be evaporated down to such an extent as to produce a magma, or mass of crystals; but in the latter case, the solution can be filtered sufficiently strong to produce a magma on cooling. The magma is pumped, or forced into a filter-press (lined with lead), and in a short time, cakes of sulphate of alumina are produced (yield No. 1) of very good quality. The mother liquor is evaporated, and another magma is produced, which on being pressed produces a second quality (yield No. 2), and in like manner a third quality can be obtained, or even a fourth, and the final residue, which is very small, and contains much iron, is evaporated to such an extent, as to set into a hard mass on cooling. This impure salt can be sold for sewerage purposes, or for the manufacture of brown paper. The quality of sulphate of alumina obtained in each operation of pressing, varies with the specific gravity of the magma. Following this will be found a statement of an experiment made with the process, but which gave by no means the best results obtained, and is only given on account of the process having been carried through to the end, all the yields being carefully weighed and analysed. The bauxite from which the sulphate of alumina was produced, contained rather more than 2½ per cent. of peroxide of iron. If the first and second yields are redissolved in a small quantity of water, and converted into a magma again, and the operation of pressing repeated, the amount of iron is reduced to about half the quantity originally present. By a slight drying in a stove, heated by steam pipes or a flue, the percentage of alumina in the cake can be increased and the product much improved in appearance. The bauxite, brand Irish Hill, best quality, contains 59·37 per cent. of alumina, and only 0·53 per cent. of peroxide of iron, according to the analysis of Mr. J. Pattinson, of samples dried at 212° Fahr. I can supply bauxite in any quantity and of four qualities.—G. G. BLACKWELL, Liverpool.

[47165.]—**Casehardening.**—I beg to inform "Cycle" that prussiate of potash will not penetrate, probably, the sixty-fourth part of an inch, and he will do well to make his bearings of "double shear steel" of best quality, which is what I would use for the hardened cones of a lathe also, and then, with care and a little soap in the water, he need not fear that they will crack.—J. J. A., Liverpool.

[47167.]—**Floor.**—I think that the floor proposed by "W. L. P. P." would spring far too much, with even ordinary weights, to be satisfactory, and would soon get unsafe. It might be done with H-rolled girders about 7ft. apart and 4½ deep, and 3in. deal floor laid straight across (not at an angle). The floor would be further strengthened if, instead of dowels, a ½in. iron rod were passed through the centre of the boards midway between the girders and tightened up at each end.—HEMISUS.

[47167.]—**Floors.**—From this query I gather "W. L. P. P." requires a floor for a shop, to cover a space 14ft. by 14ft., and not be more than 3in. thick. This is impossible with any arrangement of iron joists. The only method would be to make a similar floor to that referred to in Tredgold's Carpentry, as described by Rondelet in "L'Art de Batir," as being at Amsterdam in a room 60ft. square. In this, the wall-plates are very strong round all sides of the room, firmly secured at the angles by iron straps, and rebated to receive the floor, which is formed of three thicknesses of 1½ boards; the first thickness is laid diagonally, the ends resting in the rebates of wall-plates; the second is also laid diagonally in the reverse direction to the first; both are well-nailed together. The third thickness is laid parallel to the walls, and well-nailed to the floor below—all the boards are grooved and tongued together, and the whole forms a solid floor 4½in. in thickness without joists. In "W. L. P. P.'s" case the boards would probably be sufficient if 3½in. total thickness. But is it not possible to alter level of shop floor, so as to allow of joists in the ordinary way?—DITTON.

[47168.]—**Tinning Copper Sheets.**—The surface of the copper is rendered clean by rubbing it while heated with sal-ammoniac; when quite bright the copper is sprinkled with a little rosin to prevent oxidation, and melted tin is then poured on and spread over the surface with tow by the workman, who keeps the article constantly at a high temperature; the superfluous tin is wiped off with the tow.—MIDE.

[47169.]—**Throttle-Valve.**—I strongly disadvise you to use a stop-cock instead of a throttle-valve, the former giving rise to very much friction, however well made, and requiring twice the travel that a throttle-valve of equal diameter would to produce equal differences in the steam-supply.—R. KANTHACK.

[47169.]—**Throttle-Valve.**—You will not find this work well. In the first place, the aperture is too small unless the engine is very diminutive; then the friction will be very great upon a tap with brass working upon brass. This could be partly reduced, as I have tried formerly, by making the plug of iron; but, after all, it is much inferior to a properly-constructed throttle-valve.—J. J. A., Liverpool.

[47171.]—**Action in Voltaic Cell.**—Action in Bunsen cell: $Zn + H_2SO_4 + 2HNO_3 = ZnSO_4 + 2H_2O + 2NO_2$, or perhaps $3Zn + 3H_2SO_4 + 2HNO_3 = 3ZnSO_4 + 4H_2O + 2NO$; this NO, however, seizes one atom of O from the atmosphere to form NO_2. The second part of your query I cannot answer with certainty; I however, found for my own purposes the following equations:—$K_2Cr_2O_7 + H_2SO_4 = K_2SO_4 + 2CrO_3 + H_2O$, $2CrO_3 + 3Zn + 6H_2SO_4 = 3ZnSO_4 + Cr_23SO_4 + 6H_2O$.—R. KANTHACK.

[47171.]—**Action in Voltaic Cell.**—In either case the action of the zinc on the dilute sulphuric acid is—

$$Zn + H_2SO_4 = ZnSO_4 + 2H.$$

In Bunsen's battery this hydrogen decomposes nitric acid, reforming nitric acid, and liberating hydrogen on the surface of the carbon-plate, when it is oxidised by the nitric acid as follows:—

$$2HNO_3 + 2H = 2NO_2 + 2H_2O$$
$$\text{or, } 2HNO_3 + 4H = N_2O_3 + 4H_2O$$

In the bichromate cell, the hydrogen reduces the bichromate in presence of sulphuric acid, forming potassium sulphate, and chromium sulphate as follows:—

$$K_2Cr_2O_7 + 4H_2SO_4 + 6H = K_2SO_4 + Cr_2 3SO_4 + 7H_2O.$$

—X. N. X.

[47171.]—**Action in Voltaic Cell.**—I presume Mr. Salt understands the theory of the transference of elements or radicals under the influence of a current, and merely requires the chemical action involved. In the Bunsen or Grove the hydrogen passes through the porous pot, and it is a moot question as to whether it there attacks the acid, or whether it is passed on to the negative plate. Reasoning by analogy from the Daniell cell, it should go to the plate; but the Leclanché battery rather points to the reaction occurring at the porous pot—a view which is held by Professor Guthrie ("Electricity," p. 142). It is not exactly known as to whether the acid is reduced to NO thus:—$3H_2 + 2HNO_3 = 2NO + 4H_2O$, or to NO_2 thus: $H_2 + 2HNO_3 = 2NO_2 + 2H_2O$. Personally, I incline to the latter view, because the acid in the battery turns green from absorbing the NO_2. It is quite possible that both reactions go on, and that N_2O_3 may be formed also. In the bichromate battery the chemical change consists in the reduction of the potassic dichromate to chrome alum, and the following equation fairly expresses the action:—$K_2Cr_2O_7 + 4H_2SO_4 + 3H_2 = Cr_2K_2\ (SO_4)_4 + 7H_2O$, the change being rendered evident by the solution turning from orange yellow to that undescribable colour which is so characteristic of chromium acting as a base.—WM. JOHN GREY, Elswick Science School.

[47173.]—**M. R. Engines:**—

Eng.	Class.	Cylndrs.	Wheels.	Date. Orig.	Date. Reblt.
2	Passenger	17 × 24	6ft. 8in.	1873	1878
3	,,	17 × 24	6ft. 8in.	1871	—
7	,,	17 × 24	6ft. 8in.	1874	—
23	,,	17 × 24	6ft. 8in.	1871	—
29	(Single)	16½ × 24	6ft. 8in.	1864	1879*
41	Passenger	17 × 24	6ft. 8in.	1873	1876
110A	,,	16½ × 22	6ft. 0in.	1867	—
192	,,	16½ × 22	6ft. 2in.	1867	—
330	Goods	17 × 24	5ft. 2in.	1853	1880
382A	,,	16 × 24	5ft. 2in.	?	1872?

Nos. 2, 7, and 41 are of the same class. They belong to a set of 23 engines built at Derby, with inside frames to the driving and trailing-wheels, and outside to the leading-wheels. Nos. 3 and 23, 110A, 192, and 29 have outside frames to all wheels. No. 193 (172—199) was built by Beyer, Peacock, and Co. The asterisk opposite the date of No. 29 means that in 1879 a boiler taken from some other engine (I believe one of the 800 class) replaced the old one. I do not know anything of engines 151—155, 160—164. Can any reader oblige with a few particulars and dates? Also of 77—89 class.—METEOR.

[47175.]—**Varnish.**—Dissolve shellac in methylated spirits. This makes a good negative varnish.—HIGHLANDER.

[47175.]—**Varnish.**—The following is by Valentine Blanchard, in the "Yearbook of Photography," for 1881. Take half a pint (or less, according to taste), of deep red shellac varnish, to be obtained of most oil and colourmen, and one pint and a half of methylated spirits; shake well together, and let it rest for a day or two before use. Mr. Blanchard says two pints cost less than 2s. 6d.—DITTON.

[47176.]—**Broken Tracing-Pen.**—Drill a hole through the bone, stick the tang of a small rat-tail file into it and heat over a gas, then screw it out.—J. J. A., Liverpool.

[47178.]—**Dynamo.**—The disc is of iron. Is in reality a ring edgeways; is magnetised as a ring. Have sent particulars of small dynamo.—GEORGE TOLMAN.

[47179.]—**Magnets.**—Strength of a current = E.M.F. / R + r, r being the external and R the internal resistance.—R. KANTHACK.

[47179.]—**Magnets.**—The strength of an electro-magnet is proportional to the quantity of electricity circulating round it—that is, until the core approaches saturation. The lifting power depends on the "strength" above named, the form of the magnet and its poles, and the quantity of wire, or number of turns.—NUN. DOR.

[47184.]—**Special Express Train on Midland Railway.**—The special express train which conveyed T.R.H. the Prince and Princess of Wales from St. Pancras to Leicester and back, on Whit-Monday, May 29th, upon the occasion of the opening of the Abbey Park at Leicester, consisted of engine and tender, No. 1483 (driver, H. Leadbeatter, of Kentish-town), leading van, directors' "bogie" saloon carriage, T.R.H. bogie saloon-carriage, first-class carriage, rear van. The load was, therefore, equal to seven ordinary vehicles, and it will be seen from the following details of the running that, although the trains started considerably late, they arrived at their destination before time. This result was attained by running up the inclines at a high speed, which was possible in consequence of the load being light compared with the ordinary express trains—

		Due time a.m.	Actual time a.m.
St. Pancras	dep.	10.50	11.5
Bedford	arr.	11.54	12.0
	dep.	11.57	12.3
Leicester	arr.	1.0	12.59
Leicester	dep.	4.55	5.6
Bedford	arr.	5.58	6.4
	dep.	6. 1	6.7
St. Pancras	arr.	7. 5	7.2

Upon the 22nd inst. T.R.H. the Prince and Princess of Wales will travel by special express from St. Pancrass to Saltaire, via Kettering, Manton, Nottingham, Eckington, and Water-lane Junction (Leeds), upon which occasion the new Pullman dining-car will be used. The train will be drawn from St. Pancras to Nottingham by the same engine (No. 1483, driver Leadbeatter); the engine which is to convey it thence to Saltaire has not up to the present time been finally decided upon.—CLEMENT E. STRETTON, June 17.

[47187.]—**Bacteria.**—"R. V.'s" questions read easy and look very simple; but they are a long way from being easily answered with an approximation to truth. The lowest temperature that will coagulate the different albuminoids in malt, cereals, &c., depends upon whether the albuminoids are in a soluble state in fluid, and, along with the non-soluble fibrine, free from the tissues where they originate. The answer in this aspect is: The vegetable albumen proper, which is simply a part of the semi-fluid protoplasm of the tissue-cell, is already coagulated, and in part carmelised by the kiln-drying process, between 160°F.—170°F.; the diastase comes next, between 180°F.—190°F.; the fibrine cells at 190°F.—212°F.; and the casein, without hops, and as in milk, at 230°F., under pressure. We only assume, from the absence of the lactic organisms in British beers, that the casein of malt is coagulated by the tannin of the hops and prolonged boiling, aided, no doubt, by the chlorides and sulphates in the hard water. Inasmuch as the albuminoids of malt, as found in unboiled worts, are only in part free from the endosperm tissue-cells, the coagulating temperatures given will not hold good except for such albuminoids as are free. That is the other aspect of the question. And to coagulate the albuminoids in the seemingly small particles of endosperm seen floating in well-strained worts, said particles consisting of hundreds of cells which have been in part only influenced by the mashing process, require not only a boiling temperature, but prolonged boiling to cook and disintegrate. Whether the coagulated albumen, by prolonged boiling, is or is not again rendered soluble I could not say, but think it highly improbable, or, if so, that it would encourage the growth of bacteria, I see no reason to believe. These schizomycetes are not permanent types of life. They are simply free components of higher cells, not necessarily vegetable. In a thoroughly sterilised malt infusion they will never arise, and any added with the yeast or falling from the atmosphere (where they are of a spherical and non-motile form, except when the atmosphere is surcharged with moisture, when they become ovoid and may form spores), have a powerless existence, if there is a sufficiency of digestive elements in the wort, such as the chlorides and sulphates of lime and soda. Every moment of our life we all are fighting with them; they seethe and swarm in our lower stomachs in countless myriads, and that we are masters and enjoy existence is due to the sodium in the bile, in which they cannot exist; they are dissolved, and we feed and grow upon them, instead of them on us.—W. A. THOMS, F.R.M.S.

[47189.]—**Bridge Opening.**—Taking your sketch and numbers, No. 1 pinion has to revolve 5·181 times to turn wheel No. 2 through one revolution. Pinion 3 gearing into wheel No. 4 has to revolve three times to turn No. 4 once, consequently 5·181 × 3, or 15·543, equals number of revolutions of capstan head to turn No. 4 once. No. 4 being 3ft. 9-16in. in diam., gives a circumference of 10·405ft. This divided into 40ft. (length of rack), gives 3·844. Multiply this number by the number of revolutions of capstan to one of No. 4, and the product, 59·747, is the number of revolutions required to turn the bridge from end to end of rack. STANLEY HAWKINGS, S.E.R.

[47190.]—**Fernery.**—As the querist does not state what shape he wishes his fernery to be, I will offer him a few hints for making one of a rectangular form. We will suppose that the case is to be one yard long and about 30in. broad, and the height may also be about 30in. Five pieces of glass will be needed; three of this number must be 36in. long and 30in. broad; one of them will be for the top, and the others for the sides of the case; the remaining two will constitute the ends, and each ought to be 30in. square. "Sheet" glass should be used, and let it be as clear and as flat as can possibly be procured. After having ascertained that it is the exact measure, clean it well. Now make some very strong glue, and also obtain some wide tape; then lay the piece of glass intended for the top of the case upon the table, or any other convenient place. Covering the tape with hot glue, lay half its width on the edge of the glass. Having done this all round, raise the glass up, supporting it on a box or any other suitable article. The height raised should be about 30in. Now the remaining half of the tape should be glued; and bringing one of the glass sides to the edge of the top, press down the tape so that they are attached to each other. Now repeat this operation with the other side and the two ends. Half a day should elapse before touching the case again; this will give the glue time to harden. The next step, after the interval, is to turn the case upside down, then tightly press into the internal angles some narrow tape. A short time will be required to allow this to dry, after which tinfoil, a little wider than the tape, should be glued all round. It will be all the safer and better if the process is continued inside. If this is done, about four coats of oak varnish should be given it for protection from moisture. The tin-foil outside should have two or three coats of black Japan varnish. The next question is the bottom of the case. This is very easily made. A frame of wood of the required size, and about 1in. in thickness, will be needed. This should be made with a groove for the case to rest in. To this frame a bottom must be secured, the whole forming a kind of box. Into this should be placed a pan either made of earthenware or zinc, to hold the soil and plants. In the centre should be placed a pipe, to allow any waste water to escape into a pan placed beneath to receive it. You have now a simple, respectable, and inexpensive fernery. The cost will be about 10s.; and if the case receives proper and careful attention it will last a very long time. There are many more elaborate cases, and of different sizes and shapes; but the one described is, perhaps, the easiest to construct, and it certainly has one good quality—cheapness. With a little ingenuity and skill, various ideas and additions might be appropriately made. One thing I should like to impress—"all that is done should be thoroughly done, and no work which is at all incomplete should be passed over."—W. Henly Richmond.

[47195.]—**O.G. Making and Correcting.**—I have no doubt "J. C. L." might considerably improve some of the common object-glaeses if he knows what to do and how to do it. This is entirely a practical matter, altogether out of my line, and he must wait till "Prismatique" takes up the subject. It is this final work which makes a fine object-glass so costly, for the figuring by polishing is long and tedious, just as in parabolising a mirror. I believe the general form of the curves is somewhat as follows:—Crown: 1st surface, elliptic; 2nd, hyperbolic. Flint: One or both surfaces somewhat hyperbolic. This may to some extent indicate the character of the working required, to one who is master of the action of a machine, but it must be remembered that the exact curve cannot be defined by any regular form. There is also another serious matter, viz., the quality of the glass. A pair of 3in. discs of Chance's "best" would probably cost about 10s. each; these could not be put into an o.g. sold for about a couple of sovereigns.—Orderic Vital.

[17196.]—**Electricity v. Gas.**—The querist might as well ask if we could not differentiate a tom-cat by means of polarised light; and decompose the two together in a spectroscope.—Wm. John Grey, Elswick Science School.

[47203.]—**N.E. Engines.**—I send a few dimensions of the Darlington class of passenger engines on the N.E. Railway. Cylinders, 17in. by 26in.; diameter of driving and trailing-wheels (coupled) 7ft.; boiler, length, 11ft.; diameter, 4ft.; 158 tubes, 2in. diameter; total heating-surface, 1,100 sq. ft.; firebox length, 4ft. 5in.; width, 3ft 6in.; height, 5ft. 8in.; diameter of leading-wheels, 4ft.; working-pressure, 140lb. per sq. in.

	Tons.	Cwt.
Weight on leading-wheels......	11	0
,, driving-wheels	10	4
,, trailing-wheels	10	4
Total	31	8

The tender runs on six wheels, 4ft. diameter, and carries 2,400 gallons of water, and six tons of coal. Weight of tender, 21 tons; total length of engine and tender, 44ft. 5in. The dimensions are those of No. 1068, the engine at the Darlington jubilee. It was designed by Mr. Bouch in 1874. I do not know Nos. 1160 and 1161, but if they are "Quakers," I presume they belong to the standard class, of which 1068 is one. The engines built since 1879 have this difference from the old ones—that a pattern of ovals in the driving-wheel splashers has been substituted for the older pattern; 1162 belongs to the newer class. Is "Cleaner" sure of the number 1160? No. 1160 at Darlington (1875), was a bogie passenger engine built by Stephenson and Co., 1860. I have not a drawing of the "Quakers" to hand.—Meteor.

[47204.]—**L. and N.W.R.**—If "Cleaner" means that small regulator handle on the left of the "starting regulator," and similar in shape, but smaller, it is for putting the "steam brake" on the driving wheels. When opened it admits steam through a pipe near the safety-valve into a small cylinder under the "foot-plate," which actuates the brake.—G.

[47201.] — **Instantaneous Photography** — In order to answer this, it is necessary to know the sort of plate used by "Tyro." So-called instantaneous pictures can be obtained with any of the "rapid" dry plates, with a suitable development. Use a developer strong in all its constituents, and perfectly fresh.—Ditton.

[47206.]—**Dry Plate-Developer.**—Citric acid is no use for this purpose. Make a stock solution as follows, and use a dropping bottle:—Pyrogallic acid, ½oz.; methylated spirit, 4oz.; glycerine, ½oz. I have some of the above solution more than a year old, and it is still fresh and active.—Highlander.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

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46923.	Hollow Back Vellum Binding, 228.
46924.	Anemometer for Use in Mines, 228.

The Growth of Coral.—After a cruise of a few months in the South Pacific, a French man-of-war was recently found to have specimens of living coral growing upon her hull. This interesting discovery has thrown some light on the question of the rapidity of growth of corals. The evidence tends to show that the vessel on passing a reef of the Gambier Islands, against which it rubbed, had picked up a young fungia, which adhered to the sheathing of the ship, and grew to the size and weight it had when observed, a diameter of 9in. and a weight of 2¼lb., in nine weeks.

The trains on all sections of the Great Western Railway, with the exception of the "Flying Dutchman" and the limited mails, now carry passengers at third-class or Parliamentary fares. This concession does not include the Bridport company's line. Minor alterations in some of the fares between stations west of Bristol will gradually be put in force.

M. Pierre Manches says he has found that when sulphurous acid is passed into water through which an electric current is conducted, the sulphur is deposited as a yellowish-white powder on the negative pole.

The use of the Siemens regenerative gas furnace enables a ton of crucible steel to be melted with an expenditure of only 1⅓ tons of coal, as against 2 tons of coke in the ordinary furnace.

The vane of the Osler's anemometer at the Greenwich Observatory made in the year 1881 fourteen revolutions in the positive direction N., E., S., W., N.

QUERIES.

[47208.]—**Chamber Organ.**—During my leisure hours I am amusing myself by constructing a small organ from the excellent information found in "our" columns: have made bellows 4ft. 6in. by 2ft., and Stopped Diapason pipes CC to G, 56 notes, and voiced them on a kind of hollow box fixed over bellows in a temporary frame; have loaded bellows to a pressure of 2in. So far everything works very fair, excepting when small pipes are on I notice they rise in pitch every time the feeder of the bellows is closed. What is the cause of this?—will they do so when fixed on proper soundboard? Box is 16in.×8in.×4in., so it must contain plenty of wind for six or eight pipes that I can stand on it at a time. Bellows are made exactly as described by Mr. Dresser in his articles; soundboard is 3ft. 6in.×19in. I have not quite finished this, as I have only the pipes named, and do not know how wide to make bearers and slides. Should like the following stops, and shall be obliged if someone will advise me:—Stopped Diapason, Bass, 12 notes; Stopped Diapason, Treble, 44 notes; Open Diapason, Tenor C to G Alto; Dulciana Principal, CC to G Alto, and Flute to Tenor C; the end of instrument to be formed by six of the largest Diapason (Stopped) being planted at each end, and front decorated by 20 of the largest of the Principal. What width must I make the sliders and bearers for each? If there is not room for all, I must sacrifice flute.—Station-Master.

[47 209.]—**Lever Watch.**—Some time ago the mainspring of my watch (an English lever) broke in the middle. I sent the drum with broken spring in it to a firm that advertises in "ours," and they fitted a new spring for, I believe, 1s.; so spring is doubtless all right. While the drum was away I took the watch to pieces and cleaned it, got it all put together (as I thought) first-rate. On getting the drum back and put in, I found the watch kept time with our regulator on being hung up, but when it was worn it gained four or five minutes a day, and the same when it is laid down on its back. I used best watch oil when putting it together, and find cap over balance is screwed down so that there is but little end shake. Was I correct in oiling jewel holes and the small pin that works the lever backwards and forwards? Or, can someone suggest a remedy? I find it gains more when nearly run down. Have set spring up one turn, but this makes no difference.—Station-Master.

[47210.]—**Pedometer.**—I have a pedometer which I am desirous of using occasionally when out rambling in the country. I have taken it to a local watchmaker; but, unfortunately, mine is the first which he has seen the inside of. I notice there is a fast and slow regulator, and my idea is that its use is to regulate the lever so that it will indicate on the dial, say, one, two, or three minutes to the mile, instead of indicating 1¼ or 1½ minute to the mile if unregulated, and thus save having to calculate the fractions. If I altered my pace faster or slower, what would be the action of the pedometer? If some of your readers can give me any information, it will be received with pleasure by—Don Carlos.

[47211.]—**Magneto-motive Force.**—Would Mr. Huxley, or some other reader who understands the theory of electricity, inform me of the best method of measuring the magneto-motive force (or the intensity of a magnetic field)? Also, the units generally used for such measurement, and how to obtain the E.M.F. of a battery or dynamo-machine? Any information on the subject will greatly oblige—H. S.

[47212.]—**The Fingernails.**—To Dr. Edmunds.—Will Dr. Edmunds kindly advise on the following?—One of the fingernails and one of the thumbnails grows very thick. There seems to be a growth underneath them of soft improperly-formed nail. The skin all round the nail, but chiefly the part nearest the first joint, does not adhere to the nail as on the other fingers, and the skin of the affected fingers is dry and scaly. There is little or no pain, but they are unsightly.—No Name.

[47213.]—**Camel's Hair Brushes.**—How are "camel's hair" paint-brushes made and pointed? I am told the hair is generally that of a squirrel's tail.—A. Trotter.

[47214.]—**A Clock to Strike Quarter-Hours.**—Would "Alfojoe" kindly let me know how to make an eight-day clock strike the quarter-hours? It is one of those gilt American ones. Also, how to regild same?—A Poor Irish Boy.

[47215.]—**Embossing Glass.**—Would someone kindly elucidate my difficulty in embossing? After putting the acid upon the glass, I find it sometimes gives a beautiful transparent effect; another time, a rough ground appearance. For instance, I once left the acid on seven minutes, the result being clear; another time three minutes, which gave a ground glass,—some places white, others semi-transparent. The seven minutes caused a white ash to peel off. I use the acid pure.—Phonetic.

[47216.]—**The Berliner Violin.**—Can anyone suggest a plan to improve the violin after Berliner's method without taking the instrument to pieces? I should be glad to make the alteration, and no doubt should get it to pieces easily enough, but the rebuilding would beat me.—Frank Smith.

[47217.]—**Gaiffe's Medical Induction Coil.**—Can I use this in connection with telephone and microphone? If so, how can I connect it?—Frank Smith.

[47218.]—**Circulating Decimals.**—Can anyone direct me to a book or paper (in English or French) dealing fully with the theory of circulating decimals? I have seen a reference to Clarke's "Rationale of Circulating Numbers," but I cannot find it mentioned either in the English catalogue of books, or in the Royal Society Catalogue of scientific papers.—A. J. Smith.

[47219.]—**Textbook of Physiography.**—What are the most complete textbooks of physiography, going over the ground required for both the Elementary and the advanced stages of the Science and Art Examinations?—A. J. Smith.

[47220.]—**To Mr. Lancaster.**—I am making a shocking coil, wooden reel, 6in. inside reel-ends, ¼in. core, three layers of No. 16, five of No. 24, six of No. 30, and four of No. 34, all cotton-covered, well insulated with shellac and paper, and have got on the No. 16. Would you advise me to proceed with what now appears to me so disproportionate a primary ?—J. H. A.

[47221.]—**Dyeing.**—I attempted to dye a large piece of cotton in a tin bath with rosaniline, having mordanted with fustic. The colour is bright enough, but throughout the whole piece black patches came, of which I cannot get rid. Is it owing to using a tin bath ? Will some kind reader oblige by advising me how to remedy the evil, or is it possible to get rid of the rosaniline colour by any process, and start again on the white ground ?—Amateur.

[47222.]—**Free Oil.**—I have to estimate the amount of free oil in a mixture of oil, soap, and rosin ? Will Mr. Allen, or some other kind chemical reader, favour me with the latest and most expeditious method ?—Old Railway Grease.

[47223.]—**Birdcage Making.**—Will any reader kindly mention the necessary tools for bending and cutting wire for birdcage making, or give some general instructions ?—C. H.

[47224.]—**Affection of the Heel.**—To Dr. Edmunds.—I suffer from a painful affection of the tendons at the back of one heel when walking, with slight contraction; no enlargement—the result of chronic rheumatism. Can Dr. Edmunds help me ?—Adonis.

[47225.]—**The Cup-and-Ball Microphone.**—I think great praise is due to the gentleman who devised this form of microphone, and placed it unfettered at the disposal of the public. But the "public" is not usually very demonstrative of its gratitude in cases of this kind. I have found it a wonderful and most useful general transmitter. My pair have been lying idle a few months, and latterly, on trying them, they are less sensitive than they were. Can anyone kindly give a hint ?—Beta.

[47226.]—**Picture-Frame making.**—Is the plane and shooting-block still the best way for making picture-frames commercially ? In mitreing with a jack-plane I find difficulty in working true—often too much taken off the heel. Is my plane too light, or what is probable cause of failure, which is usually in the hard woods more than others ?—Beta.

[47227.]—**Size and Power of Boilers.**—Would "J. H." (letter 20117, p. 287), who answered the question on the size and power of boilers, or some other kind reader, please say how the figures ·693 (used in calculating the h.p. of engine in the question) are arrived at and oblige ?—J. H. W.

[47228.]—**Telephone.**—What quantity of No. 36 wire on bobbins will give the best results, and what should be the dimensions of the bobbins to receive this quantity, the soft iron core on my magnets being 5/16in. in dia. ?—R. Kanthack.

[47229.]—**M.R. Engines.**—Can any of your readers give the wheel-bases of the new Midland express (No. 1501, Neilson), loads on each axle in working order, height of boiler centre from rail, and distance of driving-axle centre from firebox front, and trailing axle from back of do. ?—G. M. M.

[47230.]—**Unhealthy Trades.**—Which is considered the most unhealthy trade, or which shortens life most ? Is it glass-blowing ? Is it considered impossible to remove the evils of glass-blowing by the introduction of machinery ?—J. W. B.

[47231.]—**Insulating Material.**—I should be glad to be informed whether there is any material or composition that can be used as a substitute for indiarubber or guttapercha in insulating underground telegraphic wires, and if so, what is the nature of it ?—B.

[47232.]—**Merlin Patent Bicycle.**—Can anyone explain how the silent pawl acts in the above machine, and the means by which the clicking caused by the pawl running over the toothed wheel is prevented ?—C. F. S.

[47233.]—**To Mr. Lancaster.**—Can you kindly help me ? I want to obtain a steel band ¼in. high, [illegible]in. in dia. It must be a perfect circle, and will be required to undergo a constant variety of deflections from the circle not to exceed [illegible]in., but to return to the perfect shape again. Do you think some of the bandsaw makers would be able to make this, as, if successful, I should probably require a large quantity ?—E. P.

[47234.]—**Weight of Girder.**—What would be the weight and dimensions of a box-girder, length 12ft., to break under a load of one ton, to be made of plate and angle iron ? Any reliable information will oblige—E. P.

[47235.]—**Immersion Objectives.**—Please describe in the same way as "Carpenter," p. 17, describes the construction of objectives, how a Parkes 1-16 immersion is built up, and what would be the effect of adding an additional combination at the back, its construction, focus, &c. It appears from "Carpenter," p. 18, that the American objectives have three achromatic combinations and a single front of crown.—Zeta.

[47236.]—**Object Mounting.**—Would any of your good-natured microscopic correspondents kindly answer the two following questions ?—How can I best mount anatomical specimens—e.g., section of lungs of rat, &c. ? Secondly, in mounting botanical objects, how to avoid the natural juice or moisture contained therein from exuding, and thus spoiling the slide completely ? I have tried mounting both the above classes of objects in Canada balsam (previously having soaked them in turpentine), but have been very unsuccessful. I shall be very grateful for any hints on this subject.—A Constant Reader.

[47237.]—**Medical.**—To Dr. Edmunds.—I am 38 years old, and single. This last two years I have suffered with an occasional rash, which attacks my body in various places, but especially in the hands and bottoms of my feet. It is painful and very irritable, especially so at night-time. It comes in small and large flakes or patches, raises up the skin, and gets very red. I drink beer and stout, but no wine or spirits; am a hearty meat-eater, preferring fat to lean. I should be greatly obliged if Dr. Edmunds would state a diet, or suggest some medicine that I could take when the rash indicates an appearance; for sometimes my hands are so bad it is painful to hold my hammer or file. I may say I weigh 11½ stone, and am 5ft. 7in. high; take plenty of exercise, and am a smoker, and by trade a—Working Whitesmith.

[47238.]—**To "Aldebaran"—Astronomical Telescope.**—I must express my thanks for your comprehensive reply to my query on telescope lenses. I may say I have succeeded in making a telescope with a 2¼in. o.g. of 36in. focus, and that so far as I can judge it seems to define very clearly, though, for the want of a knowledge of proper test-objects, I have not been able to test it in any other way than by trying at what distance I can read small print with it, and I find I can very easily read the query column at 25ft. distance, and do not notice any coloured fringes at the edges. Perhaps you will be kind enough to give me an easy star test suitable for this aperture. Any other hints you can give me will be much appreciated. Also what would be the best kind of eyepiece, and a rough-and-ready method of calculating its magnifying power when it is used with this o.g. ? I forgot to mention that I could not get a plano-convex lens short enough in the focus (one ¼in.); the one I have seems to answer very well, but I suppose the other would have been better.—J. L.

[47239.]—**Deafness.**—Will Dr. Edmunds kindly give me the following information ?—I have suffered from a discharge of the left ear since I was about four years old, from the measles. The doctors at King's College Hospital advised me never to try to stop it and it would probably get well as I got older; but I took to placing cotton-wool in it and am now totally deaf with it. A short time ago I had a severe cold and was deaf with the other one. It has gone away, but I have had it twice since then, attended with a humming noise in the head. I wished to know if I could get into King's College Hospital, or where there is a clever aurist. The doctors down here (Worcester) say they can do no more. I did not want to have my journey up for nothing. Hoping you will oblige—An Old Subscriber.

[47240.]—**Oil Silk.**—Would some correspondent give directions how to make what is called oil-silk ?—An Amateur M.

[47241.]—**Thief Detector.**—Last autumn some thieves got into my garden and stole my fruit. In order that I may be made acquainted with the presence of these malefactors should they pay me another visit, I am fitting up an electric bell from my garden-gate (through which they gained access to my garden) to a bell in my house, and I have completed my work except the providing of a contact-maker to set the bell in action when the gate is opened. I should be glad if anyone would give me a sketch or particulars of what I require. I have seen various kinds of thief-detectors for doors, windows, &c., but none answer my purpose. The contact-maker I want will have to be of a trigger or lever-like construction to be fitted on the opening side of the gate (not the hinge side) to break contact by the action of the gate closing, and to make contact and continue ringing the bell as long as the gate remains open.—H. H.

[47242.]—**How to Get Rid of Mites.**—Will some reader be good enough to assist me to get rid of those "little pests" ? I have a loft over my shop where I store meal and flour. The ceiling of shop underneath is sheeted with boards and rebated into each other (not tongued and grooved). The mites work down through the upper floor and sheeting of shop ceiling and destroy a great deal of goods in shop. I wish to paper shop ceiling; but what should I do before papering to prevent the "little pests" from coming through ?—Church-Hill.

[47243.]—**Dry-plate Photography.**—To W. Robinson, Junr.—I am obliged by your ready answer to my queries. Can you have patience to answer the following ?—Can the difference between the visual and actinic foci be found by calculation ? When found, would it be well to have the ground-glass screen as far behind the position of the plate as the one focus is from another ? Will you, or any other reader, tell me how to make a double dark slide, with working drawings, if possible ? I am not a skilled cabinet-maker, so the simpler the better.—F. J. N., Liverpool.

[47244.]—**To Mr. Lancaster.**—Will you please to give me instructions to make a galvanic battery ? I saw one some time ago worked by a three-pint bichromate battery, which was very powerful. The magnet was a bundle of fine iron wire 6in. long and 1in. thick, and was inclosed in a box about 7in. by 6in. There were four powers on the machine, also a brass rod, which drew out. A sketch of the above to work from, also the number of coils of copper wire and the gauge, would oblige.—W. Wright.

[47245.]—**Electric Bells.**—In connection with my telephones I have put up a pair of call-bells; distance is about 250 yards, line wire copper, return wire iron, two Leclanché cells at each end. Telephones answer well, and so do bells sometimes, but sometimes again they will not. For instance, one day lately I put on switch at station A to call station B; no bell rang at B. I left it on, and in about thirty minutes, all of a sudden, without being touched by anyone, the bell at B commenced to ring. Again, at present moment, I have done same thing, and bell at B will not ring, although yesterday it would; but I have discovered that if I, with a bit of loose wire or my silver pencil-case, bring the two cells at B into work also, the bell at B will ring very strong, and then, after half a minute, the battery at A will ring bell at B, and so reversing it, bell at A can be made to ring, which it now will not do. Can anyone kindly explain this ?—Meme.

[47246.]—**Private Telegraph Wires.**—Some considerable time since I sent a query which was inserted as No. 46634. "Sunlight" kindly replied to it, but did not answer same at p. 160. Under same number I addressed further query to him at p. 179, to which no answer has been given. I, therefore, venture to repeat—i.e., How to strain outdoor wires to insulators ? and how, when strained, to keep tight ? Also, how near wires may be carried to a wall without fear of leaking ?—Meme.

[47247.]—**Product in Brick-burning.**—On opening a kiln of newly-burned bricks preparatory to drawing same, the surfaces exposed to the free draught are found to be covered with a grey deposit, which, on examination under the microscope, appears to be of a sub-crystalline character arranged in stellate-shaped masses of about one hundredth of an inch diameter. The slightest contact of the bricks is sufficient to prevent the formation of the substance and the true colour of the clay is preserved. Some parts of the kiln appear more affected than others. The substance is not acted upon by hydrochloric acid, and must not be confounded with the usual efflorescence due to the presence of salts of soda, potash, &c. All the evidence points to the mischief being done by the vapour; but what can the substance be ? The kiln is a down-draught one, the clay a pure silicate of alumina with crushed spar, the sand used pure silica. Can there be actions of heat and moisture going on during any stage of the burning sufficient to account for this deposit.—as I have read if colourless rock-crystal is heated red hot and quenched in water, it becomes opaque and friable, a description applying to the substance referred to ? If any of "ours" can assist me with an explanation, I shall esteem it a favour.—Didymograpsus.

[47248.]—**Wind-Pressure.**—I should be very glad of a solution to the following problem:—The wind blows at the rate of C miles per hour upon a rigid rectangular plane, fixed by its four corners, whose length is *a* and width *b*. The direction of the wind is inclined at the angle A to the direction of the length of the plane, and at the angle B to the width. What is the direction ? and what is the amount of each of the pressures produced on the four corners ?—A. W.

[47249.]—**Putting Steel Tongues in Concertinas.**—I repair concertinas, and when any tongues are broken, replace them by steel reeds for the sake of durability, and knowing steel to keep in better tune than brass or any other metal. I get the tongues ready hardened, but otherwise in the rough, from the manufacturers of English as well as German concertinas; nevertheless, some tongues I put in break immediately when played on, while others, put in the same instrument by me and at the same time, stand splendidly. I am careful in the filing, leave them as heavy as is consistent with the quality of tone, and can, therefore, in no way account why it happens. Can anyone confer a great favour on me by informing me of the cause and what I must do to effect a remedy ? and put under great obligation—New Zealander.

[47250.]—**Galvanising Boat-irons.**—I have been trying to galvanise some irons for my boat, but cannot get them smooth and bright. I first had them pickled in dilute sulphuric acid, then scoured with sand and coke, immersed in lime-water, and from this into chloride of zinc, then dried on a hot plate over a smith's fire. A piece of pipe stopped at one end served as a crucible into which I put a quantity of scrap zinc parings from plumbers, &c., covered with sal-ammoniac. Having the zinc nicely melted, I placed the articles in the crucible, dipped them a few times, and could not make them come out clean and smooth. Can any person help me ?—Yachtsman.

[47251.]—**Carriage Varnishing.**—What is the cause of copal carriage varnish, when put on, drying full of small holes ? and where the best varnishes are obtained ? Also, the best for a white job, and the simplest method of polishing it ?—An Old Subscriber.

[47252.]—**The Solar Protuberances.**—Would "F.R.A.S." kindly say whether there is any apparatus, at an accessible price, suitable for viewing the solar protuberances ? and whether there is any peculiar difficulty in making such observations ?—T. Loftus Wylde.

[47253.]—**Weakness.**—A man of 30 wishes to know of Dr. Edmunds if he can indicate any course of procedure which would perfect his physical condition. The fault is inability to bear the heats of summer, the digestive organs break down; whilst in the winter, though the cold does not make him ill, it inevitably brings an abundant supply of chilblains. Diagnosis is:—Height, 5ft. 4½in., moderate girth, lean but not skinny, pulse about 64 per minute and fairly strong, lungs and heart good, reasonably muscular for one following light employ, fond of walking, can do twenty miles very well, life teetotaller, never smoked, no proclivities for animal food, very regular in all habits, disposition studious, perspires somewhat tardily, nervous temperament. A query appeared once before on Chilblains, which I think was not answered, for I looked out for the answer with interest.—Rob. Crus.

[47254.]—**Electric Commutator for Intermittent Action.**—I should feel obliged if any correspondent would favour me with the following information:—I propose constructing a small Gramme dynamo to be connected with a windmill, and by it to charge a secondary battery. I understand construction of the whole affair, with the exception of the commutator, since as the power will be intermittent, the ordinary commutator brush will not do alone, as it would allow the battery to discharge itself through the dynamo. Is there any automatic arrangement to break circuit when the machine is not running, and remake it when well started ? A sketch of same would be very acceptable, and also of arrangement to indicate by electric bell when battery is fully charged. Would this idea be practicable on a small scale so as to charge, say, 3 quart Sutton's cells to drive a sewing-machine from two to three hours daily ? I may say I should try this as an experiment rather than as an economical method. A few Daniell cells would, of course, be best to use for this purpose.—Philolektron.

[47255.]—**Lacquer.**—In Napier's "Electro-Metallurgy" a method of depositing copper on flowers, &c., is given, but it does not mention any method of lacquering the deposit. Could this be done by immersion, as some parts of it would be very delicate and not stand lacquering with a brush? Also, a recipe for a cheap clear lacquer suitable will oblige—Philolektron.

[47256.]—**Surface Condensing Engine for Launch.**—Will some engineer kindly give me a little information on working the above? I have driven several kinds of high-pressure engines for the last eight years, but have not had any experience with condensing.—Simple Simon.

[47257.]—**Bookbinding in Vellum.**—I have lately been binding some books and pamphlets in parchment and vellum with limp covers and edges cut flush.

I went by instructions received from a workman forty years ago, and the books, when first out of the press, look very nice, but when quite dry they curl up like the petals of a turkscap lily, or the brim of a fashionable hat. I have tried re-pressing, but cannot permanently re-press this curly tendency. I shall be glad of advice. Perhaps parchment is unsuitable for limp bindings. I have succeeded with thick boards.—Argent Sable.

[47258.]—**The Coming Transit of Venus.**—Now that we are hearing so much about the coming transit of Venus, there are many who, like myself, have but little notion of the special purpose for which these observations are taken, beyond determining the Sun's distance, and are quite unable to see what is their real practical value. Would "F.R.A.S." give me some information on this subject, and in so doing I am sure that he will confer a favour on many other of your constant readers.—A Constant Reader.

[47259.]—**To Mr. Lancaster.**—I have made two electro-magnets and armature for small motor, but I can scarcely get any power in the magnets. Would you please to state where I am in fault? The magnets are flat pieces of soft iron 3½in long, ¼in. thick, 1in. wide. Two of these are screwed together 1in. apart with a piece of boxwood between to wind the wire on. The wire is wound on lengthways, the same as cotton on a shuttle. I have tried it with a ¼lb. of 22 silk-covered, also with 16 gauge, and six Bunsen ½ pint batteries, but can get scarcely any power in the magnets. I have made the armature the same way as the magnets, but I have not wound that yet, as it is no use till I find out my fault. If you would kindly help me I should be much obliged. The instructions you gave me to make the induction coil a week or two ago I followed out. I have just finished it, and it has proved a success, and am quite pleased with it. I thank you and Mr. Andrews kindly for your help. —J. A. W.

[47260.]—**Compound Engine.**—Will some kind friend please help me out of a few slight difficulties? What pressure can I run at with cylinders of cast-iron, low-pressure 2in., high-pressure 1¼in. bore? Cylinder covers ⅛in. thick. What size fly-wheel will be required? What is best form of surface condenser, bore of air-pump, and is ⅜in. thick enough for smallest part of steel crank-shaft?—W. J. P.

[47261.]—**Arsenic in Wall-paper.**—I have got some wall-paper with a green pattern, which I suspect contains arsenic. Could any reader kindly tell me the best way of detecting it? and oblige—Erin-go-Bragh.

[47262.]—**Wheel Grease.**—Can some of "ours" give me a good recipe for making the above?—Burnley.

[47263.]—**Boiler Cleaning.**—Will some of our chemical friends please tell me if 56lb. of cutch per month put into one boiler at the time of cleaning out be considered excessive? and what will be its action on the plates of the boiler? We put in the cutch to prevent boiler scaling. We have been told that our boilers are being injured by its use.—Jumbo.

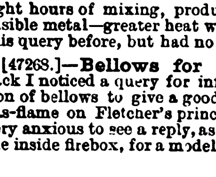
[47264.]—**Lightning Conductors.**—Would some of your correspondents say what is the best form and material to use as lightning conductors for a very tall chimney or other tall structure? And how should the conductor be fixed to the building? What arrangement should be made at the upper end for the attraction of the lightning? and what at the lower end for conveying the electric current into the earth? Any information on this important subject, founded on recent experience, will be thankfully received by—Shropshire.

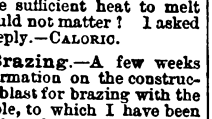
[47265.]—**Forecast of Storms.**—Having taken a little interest in the above, and having tried two experiments with reference to the above subject, and I may say with little success, I should be extremely obliged to W. M. Gardner (letter 20163) if he would give us a short description of his barmometer.—Home-Made Barometers.

[47266.]—**Locomotive Engines, &c.**—I would like to have some particulars on the following points:—1. Indicated h.p. of different classes of engines. 2. Weight of various trains. 3. Frictional resistances of trains. 4. Air-resistance to trains.—Wm. John Grey, Elswick Science School.

[47267.]—**To Chemists.**—Will someone please say what chemical mixture of materials will, within six or eight hours of mixing, produce sufficient heat to melt fusible metal—greater heat would not matter? I asked this query before, but had no reply.—Caloric.

[47268.]—**Bellows for Brazing.**—A few weeks back I noticed a query for information on the construction of bellows to give a good blast for brazing with the gas-flame on Fletcher's principle, to which I have been very anxious to see a reply, as I have been trying to braze the inside firebox, for a model locomotive made of copper 1-32 thick; it is 3½in. long, 1¾in. broad, and 3in. deep. As I could not get enough force out of a pair of kitchen bellows, I have commenced making one 18in. by 13in., with rounded corners with a separate feeder and reservoir on top, which can be loaded with weights to obtain the needful pressure. The valves I have made of india-rubber 3in. diam. and 3-16in. thick fixed to the boards in the centre, and covering a number of holes ⅜in. diameter. What I want to know is, what sort of leather to use, and if any composition is used to put between the latter and the boards (which are elm ¾in. thick) to make it air-tight? Or, whether it is simply nailed to the wood? I should be very glad if anyone would give a few hints on brazing, as occasionally I have got the spelter or silver solder to melt, but it would not run into the joint, although scraped clean previous to applying the borax and spelter.—E. L. P.





[47269.]—**Electric Motor for Tricycle**—Will any readers of the Mechanic, who are acquainted with the working of electric motors, inform me whether it would be possible to fix one to a tricycle in such a way, as from the rotary motion of the wheels whilst on the level or going down hill, sufficient power could be accumulated to make it easy going up hill? I have read that on the Brighton Railway some of the trains are lit up by electric light produced by power derived from the motion of the train wheels, and it seems to me quite as feasible that electricity can be produced from the motion of tricycle wheels, if there is any way of storing it. Or, would it be possible, by using a small steam-engine to produce both electricity to light up a shop, and also to accumulate power for a tricycle motor. I see in *Chambers's Journal* for this month that the French are bringing out electric-driven tricycles, but no particulars are given, and I shall be glad if some reader will be good enough to give me a practical answer to the above, or any practical suggestion or particulars as to a motor. I should be satisfied if I could get one that would make going up hill easier work. —A. J. C., Winslow.

[47270.]—**To Mr. Lancaster.**—I have a portrait lens, the two front glasses of which are cemented together; the cement has gone cloudy. Can I take them apart and clean them without fear of breaking? If so, how?—W. Brown.

[47271.]—**Waterwheel Grease.**—I shall be thankful for a good cheap grease for a waterwheel 30in. diameter, and partly working in water.—L. H. S.

[47272.]—**Drill for Boring Fireproof Floors by Machinery.**—Can any of your readers inform me what is the best kind of drill to use for the above purpose, as rose and taper drills knock too much brickwork, &c., into the room below? The mill is quite a new one, and the mortar, &c., has not had sufficient time to set.—A Subscriber.

[47273.]—**Lines of Force.**—Will some reader of the Mechanic be so kind as to give some explanation of what is meant by a "coil cutting lines of force," and a "coil adding and subtracting lines of force"? Of course, I have seen the experiment of iron filings on a piece of card producing lines of force, but I have sought in vain for an illustration of the way in which lines of force are cut by a coil of wire revolving between the poles of a magnet. And, also, how the iron ring influences the lines of force in a dynamo-machine? I have learned many things from the Mechanic, and wish to learn this.—S. C.

ANSWERS TO CORRESPONDENTS.

◆

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, June 21, and unacknowledged elsewhere:—

Capt. Ternan.—Lt.-Col. Fendall.—W. A. Ryan.—Capt. Guyon.—J. Chown.—J. Noble.—E. C. Ames.—Rev. T. E. Espin.—W. Walker.—E. J. Warmington.—Gymnastic.—An Amateur.—C. H. Romanes.—A. Matthews. —W. A. French.—J. R. Brown.—J. P. H.—W. D.—J. H. Huxley.—John Bond.—H. S. Frost.—Rev. S. Mills.—M. Jonson.—J. H.—Collodion.—F. Walker.—Beetle Crushers.—W. Baldwin.—E.—A Fellow Workman.—W. McAndrews.—C. R. Beaumont.—A Fellow of the Royal Astronomical Society.—Svenska.—Light.

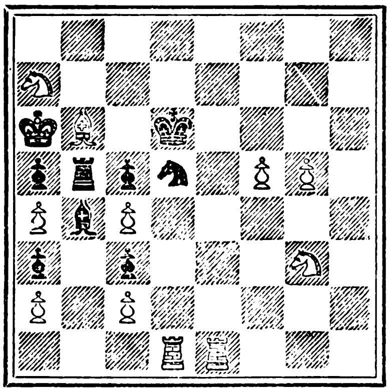
Sans Sanitas. (Dyspepsia; try lighter meals, and especially lighter suppers.)—Carino. (Thanks; shall appear next week. It seems as you suppose with regard to the other matter, but we doubt it. If it be so, and the Editor is troubled as we were, he will, and probably with regret as we did, have to dispense with the help rendered.)—Nil Desperandum. (Work hard and learn all you can. If possible, get into a civil engineers' office in some subordinate capacity, and show by your work that you are capable of better things. 2. Several textbooks are published giving general rules for such calculations. Templeton's "Workshop Companion" is as good as any. If there is any special case, we are always ready to answer or insert a query, but we cannot be always repeating elementary rules.)—T. McDonald. (Yes, forty years at least. Of course in older, and far more imperfect patterns.)—Enod. (Have you tried the Dichroic ink? The subject has been several times previously discussed.)—C. F. Lloyd. (The ink is made of equal parts of tallow, wax, soap, and shellac, with sufficient fine Paris black. It is cast into sticks and ground up with water. For price, apply at the dealers.)—H. T. B. (To what is your letter a reply? Where is the question?)—S. H. (We believe it can be had of Messrs. Hachette, King William-street, Strand, W.C.)—Walter R. Herring. (The manufacture of coils has been fully described again and again in our last 25 volumes. Possibly the instructions given on pp. 15 and 16 of present volume will suit you. If not you are sure to find something that will in back volumes.)—Telewag. (Join one of the art classes, and procure some of the handbooks of the art.)—Electrician. (Two would no doubt be sufficient, if properly made. 2. The solution is not decomposed if the zinc is withdrawn. 3. A very simple affair. You will find some hints on p. 180, present volume.)—Argent Sable. (If blasting is out of the question, perhaps the readiest way is to bore holes and fill with petroleum or naphtha. After that has soaked in, the stumps are fired. Saltpetre will do, but takes longer to soak in. Blasting is the cheapest method.)—Young Clerk. (They can be bought at bicyclists' outfitters, and at many other shops. You must choose for yourself.)—Amateur Electrician. (Whichever way you want them. Zinc to zinc gives what is called quantity, and makes one large cell. Zinc to tinpot gives E.M.F., or intensity as it used to be called.)—Semper Fidelis. (You have nothing to do but to purchase one of the lamps and a suitable battery, and connect up with copper wires. You will find it very expensive. A dynamo is a machine for generating current; but it is too late in the day to ask for an explanation here. You will find all about them in our back volumes. 2. Dr. Edmunds answered the question on p. 324, last week. 3. It is cream of tartar in the proportion by weight of 3 to 4 of tin.)—P. (It is prepared from the stomach of the pig by a series of processes which cannot be carried out without suitable plant. The other is made from the pancreas, and the same remarks apply. If you are prepared to go in for the manufacture, you should consult the files of the *Pharmaceutical Journal.*)—Intending Emigrant. (It depends entirely on the emigrant himself, that is, on the money he can afford and the time that he can devote to the journey. The appointments of some of the sailing vessels are quite equal to those of the steamers, but the duration of the voyage is longer.)—François. (Kindly read up recent back numbers. See answer to "Semper Fidelis" above.)—Alnwick. ("Roads and Streets," published by Lockwood and Co., Stationers' Hall-court, E.C., is the best we are acquainted with.)—Paulatim. (Certainly you require a battery. Read up the subject in back numbers.)—Florence. (Yes, hot-water heating is the best and most trustworthy.)—A Poor Irish Boy. (Search the indices under head of Silvering. The usual plan is to place tinfoil on a flat table, pour quicksilver on it, and spread it over, then push the clean glass on, and weight down.)—M.R.C.F. (We do not know of such a book.)—Beginner. (You will find a number of recipes in back volumes for beverages of the kind. The query is not of sufficient general interest to insert.)—Tapeworm. (All druggists make up suitable preparations; but it would be unwise for a person of 60 to take any without the advice of a medical man. A remedy that would be effectual and harmless in the case of a strong hearty youth might not be adapted to a feeble old man.)—A User. (Pebble is colder to the tongue than glass; but a definite test is to place the lens between two pieces of glass and hold up to the light. If pebble, rings of colour will be visible, owing to polarisation.)—A Young Civil Engineer. (See p. 595, Vol. XVIII. Find out the cause, and then perhaps some one can give a remedy. You can do no harm by washing frequently with cold water to which a solution of borax has been added; but the cause is probably constitutional.)—C. E. Peek. (Thanks, we had noted it. You will find a brief description of Clamond's burner on p. 304. The *Times* has made the mistake of confusing magnesia with magnesium wire. Lewis's improved burner, of which we give a description this week, contains a basket of platinum wire: hence, probably the error. We have the book referred to. We believe Bourbouze's idea was based on something that preceded it.)—An Amateur M. (Seidlitz powders are made usually of Rochelle salt 2 drachms and bicarbonate of soda 40gr., mixed, and put into a blue paper. In a white paper are 35 grains of tartaric acid. The quantities are sufficient for half-pint of water.)—Red Cobal. (We presume you mean ebonised—*i.e.*, stained and polished; but if paint, the latter is mixed with varnish. 2. Try the coaguline again, or else shellac, heating the parts to be joined. You might stain it red.)—Beginner, Commercial-road. (See pp. 237, 251, 381, last volume, for many practical hints on electro-plating. The Bunsens will do; the bichromate is not economical or good, and the Leclanchés are no use at all for the purpose. The Daniell is the best arrangement for electro-depositing. However, you will find all information in the pages mentioned.)—A. H. B. Olney (The copper cups will not do. See recent letters. American potash properly prepared will do; but you can easily make the soda solution by boiling solution of common washing soda with some lime. See p. 308. Four shillings a pound for caustic soda is absurd.)—A Workman. (We believe that treacle is the best medium for moulding up carbon plates; but they are very inferior, and you certainly will not make "filaments for arc lamps" by that means. What was meant about the odds and ends being used for batteries was that they can be broken up and used with manganese for the Leclanché batteries. Much secrecy is observed in the manufacture of "rods," not filaments, for arc lamps; but of one thing you may be certain—that very powerful presses are needed, and the rods are baked in a furnace where no air can reach them.)—W. R. C. (A coil is not required, only a battery. A piece of thin platinum wire is inserted in the circuit, which becomes red hot, and so fires the powder.)—An Amateur. (See recent back numbers, and the index of the last volume.)—A Watchmaker. (Rub up the surface with a bit of sandstone or emery-cloth, and try again.)—Kent. (Either by attaching the contact piece to the hinged part of knocker, or by making the hammer drive in a spring pin when it falls on the door. 2. The best remedies are antimonial emetics and change of air, the latter to be preferred.)—F. H. Harrap. (Why not write to the patentee? A patent agent would supply it for a small fee.)—One in a Fix. (What do you mean by "all the rates and taxes"? They cannot have charged house duty, for instance? You are bound to pay land tax and poor rates, if that is what you mean.)—W. H. RICHMOND. (We should be glad to hear from you at greater length as to the proposed series.)—THOMAS CLEARY. (Probably from £8 to £10 10s., including agents' fees for provisional protection. 2. You would have to employ a patent agent to make a search for you at the Government Patent Office, which is in Southampton-buildings. You had better write to one of the patent agents whose advertisements appear in these pages, for a copy of their instructions to inventors, which will give you all necessary information.)—G. W. H (We know of none that we care to recommend.)—RUST. (We do not know. Possibly a note to the secretary would obtain for you the information. 2. The advantage claimed is in the economy of tin used, but we have no practical knowledge of the process. We see no advantage in using the double process, except for goods where an extra thick coating is wanted.)—T. PEMBERTON. (See index to any back vol.)—E. S. (Cleanliness and the use of water or air beds is the only means of prevention, but with long sickness and much loss of flesh they are almost inevitable.)—AN ENGLISHMAN. (Half to the wife, the rest equally among the mother and sisters.)

CHESS.

ALL Communications for this department must be addressed to the Chess Editor, at the office of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCLVII.—By F. C. COLLINS.

Black.

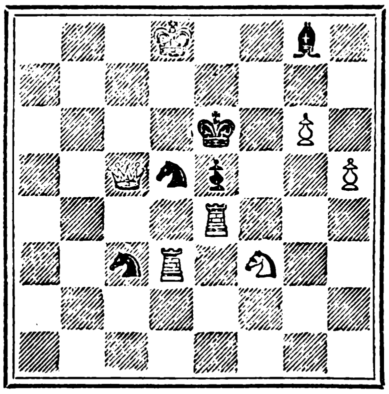


White.

White to play and sui-mate in two moves.

PROBLEM DCCLVIII.—By A. BRIGGS.

Black.



White.

White to play and mate in two moves.

SOLUTION TO 753.

White.	*Black.*
1. R to Q Kt 2 (dis ch)	1. Q to Q 7
2. Q to Q Kt 8	2. B to K R 2
3. R to Q B 2 (ch)	3. B takes R mate

SOLUTION TO 754.

White	*Black.*
1. Kt to Q 2	1. Anything
2. B, Kt or Q mates accordingly.	

NOTICES TO CORRESPONDENTS.

THE author of Problem 751 informs us that it can be made sound by adding a Black Pawn at K 13 4. The Pawn at K B 2 can be removed.

SCHMUCKE.—A sui-mate problem is one in which white compels black to mate him (white) in so many moves. The strategy involved in such is quite distinct from that in ordinary problems, and well deserves attention when exemplified by such masters as Kidson, Slater, Gilberg, and others. Problem 753 is a capital example of the kind. We intend to give others from time to time. Try the one above. Your solutions to 754, 755, and 756 are correct. As to the problem, it is a very fair one for a first attempt; but it is rather too easy for publication, on account of the check threatened by black. Moreover, there is a dual in the main variation.

Every Workman connected with the Building Trades requiring a situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden London, W.C.

"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

Every Workman should insist on seeing "THE BUILDING NEWS" every week at his Club or Coffee House. He will find more "Lists of Tenders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Intercommunication" if he wants to know anything about his trade; to write to the Editor if he has any suggestions to make and to advertise in the paper when he wants work.

The charge for Advertisements for Situations is One Shilling or Twenty Words, and Sixpence for every Eight Words after.

TERMS OF SUBSCRIPTION.

PAYABLE IN ADVANCE.

5s. 6d. for Six Months and 11s. for Twelve Months, Post-free to any part of the United Kingdom. For the United States, 13s., or 3 dols. 25c. gold, to France or Belgium, 13s., or 16f. 50c.; to India (via Brindisi), 15s. 2d.; to New Zealand, the Cape, the West Indies, Canada, Nova Scotia, Natal, or any of the Australian Colonies, 13s.

The remittance should be made by Post-office order. Back numbers cannot be sent out of the United Kingdom by the ordinary newspaper post, but must be remitted for at the rate of 3d. each to cover extra postage.

Messrs. JAMES W. QUEEN and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post-free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes they must be paid for at the rate of 4d. each copy, to cover extra postage.

Vols. XXIV., XXVI., XXVII., XXVIII., XXIX., XXX., XXXI., XXXII., and XXXIII., bound in cloth, 7s. each.
[Vol. XXXIV. Now ready.]

All the other bound volumes are out of print. Subscribers would do well to order volumes as soon as possible after the conclusion of each half-yearly volume in March and September, as only a limited number are bound up, and these soon run out of print. Most of our back numbers can be had singly, price 2d each, through any bookseller or newsagent, or 2½d. each, post-free from the office (except index numbers, which are 3d. each, or post-free, 3½d.)

Indexes for each half-yearly volume up to Vol. X. (except Vols. II., III., IV., V., and X.) inclusive, 2d. each. Post free 2½d. each. Indexes to subsequent vols., 3d. each or post-free, 3½d. Cases for binding, 1s. 6d. each.

⁂ Subscribers are requested to order Cases and Vols. through their booksellers, and not to send direct. The regulations of the post-office prevent their transmission through the Post.

CHARGES FOR ADVERTISING.

	s.	d.
Thirty Words	2	6
Every additional eight words..	0	6

Front Page Advertisements Five Shillings for the first 40 words afterwards 9d. per line. Paragraph Advertisements One Shilling per line. No front page or paragraph advertisement inserted for less than Five Shillings. Reduced terms for series of more than 6 insertions may be ascertained on application to the Publisher.

ADVERTISEMENTS in EXCHANGE COLUMN—for

	s.	d.
Twenty-four words	0	3
For every succeeding Eight words..	0	3

ADVERTISEMENTS in the SIXPENNY SALE COLUMN.

	s.	d.
Sixteen Words	0	6
For every succeeding Eight Words	0	6

⁂ It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions; and in cases where the amount sent exceeds One Shilling the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement and charged for.

Advertisements *must* reach the office by 3 p.m on Wednesday to insure insertion in the following Friday's number.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a PINK Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

Holloway's Ointment should be well rubbed upon the pit of the stomach and region of the heart in that particular form of indigestion which gives rise to palpitation, shortness of breath, and a suffocating sensation. Every distressing symptom soon yields, digestion becomes easy, the spirits light, and good health returns.—ADVT.)

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

A pair of well-finished **Needle Instruments** in good order, platinum contacts, new coils, thoroughly reliable. Offers.—LOGAN, St. Cross P. O., Winchester.

Oil and Limelight **Dissolving View Apparatus** for Screw-cutting Lathe, Twist Drills.—D. W. N., Ernest Cottage, Peyton-place, Royal Hill, Greenwich.

A one-horse **Water Motor** in exchange for a good Perambulator (rubber tires), or offers.—WM. O BRIEN, 113, Haddington-road, Dublin.

Sociable **Tricycle**, for two or three persons, cost £24 nearly new condition. Exchange good Photographic or Dissolving View Apparatus, or offers.—WRIGHT, Photographer, Northampton.

Wanted, a good **Plane** and Shooting Block for picture-frame making.—BELL, Belbroughton, Stourbridge.

Half-horse and one-horse **Engine Castings**, cylinders bored, &c.; or two-horse ditto. Offers.—JAMES SUTCLIFFE, Engineer, Princess-street, Granby-row, Manchester.

Medical Coil, Galvanic Battery, Engines, and Lathe Castings, Field Glass, Screw Press "English Mechanic," "Engineer," &c. Offers.—JAMES SUTCLIFFE, Princess street, Granby-row Manchester.

Organ Pipes, new, flute stop, 5 oct., cost £3 10s.; for Telescope or Violin equal value.—G. J. R , 2, Claremont-terrace, Blackpool.

Mahogany folding **Camera**, upright and horizontal motions to front and back, hinged focussing screen, double slide, &c., takes 7½ by 4½, 6½ by 4¾, 5 by 4, and 4¼ by 3¼, plate's weight, 5½lb.; perfect; instantaneous spring shutter. What offers?—BEAUMONT.

Mahogany full-plate folding **Camera**, with improvements, dark tent to use either as changing box or for developing, 4½ by 18 by 24in. when closed, very light and portable. Wanted, Magic Lantern.—BEAUMONT, Withington, Manchester.

"**English Mechanic**," Vols. XI. to XV., bound, clean. Exchange for Pocket Revolver or Telescope.—287, Crystal Palace-road, East Dulwich, London, S.E.

Wanted to exchange, about 9 years of "**Engineer**" and 12½ years of MECHANIC; for Bicycle, or what offers?—Address, Mr. S. BOUL, Mr. T. Malden's, Park-lane, Donington, near Spalding.

"**English Mechanic**," 1875, to May, 1882, unbound, clean, few numbers short.—W. RICHARDSON, 59, Varna-road, Birmingham.

Achromatic **Telescope**, 3in., good quality, garden and tripod stands, finder, star diagonal, two celestial, one terrestrial eyepieces, rack motions.—Above address.

Bicycle, 50in., central fire double Gun, 16ft. pleasure Boat, quarter plate Camera, lens and chemicals, Gun Case, Lathe Exchange Launch Engine, boiler, &c., or offers.—CARLEY, Mt. Trenchard, Foynes, Limerick.

Orguinette, with tunes, cost 52s. three months' since. Will exchange for Metal Organ Pipes.—HURSNELL, Plumtree Station, Notts.

Will exchange Scott Burn's "**Carpentry and** JOINERY," strongly bound, cost two guineas, for Lathe Heads, Telescope, Microscope, or offers.—ALEX. MILLER, New Prestwick, Ayrshire.

Vols. I. and II. "**English Mechanic**" (bound), 35 parts, October, 1881, to date; 82 parts "Gardening," August, 1880, to date. Exchange Fern Case, or offers.—THORNTON, 280, Cumberland street, S.S., Glasgow.

Two horse-power **Vertical Engine**, with two cylinders, complete, equal to new. Will exchange for good Bicycle about 50in.—SIXSMITH, Jackson-street, Oldham.

Superior 7½in. back-geared **Lathe**, with tools, face-plates, chucks, &c. What offers in exchange to £10 value in Tricycle, Bicycle, &c.?—F. UNDERWOOD, Beverley.

American Organ, cost £8, for other **Musical** Instruments, or something useful.—W. J , 15, Ullin-street, St. Leonard's-road, E.

New **Vertical Engine**, cylinder 3in. bore, 6in. stroke, massive ornamental turned flywheel, 54lb.—Offers to ROBERT VENNER, Lynton Villa, Erith.

Stanley Heads, pair Rubbers, steel Hub, 56in. and 18in rims, backbone, and numerous other sundries. Exchange anything.—ROBERT VENNER, Lynton Villa, Erith.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

For Sale.

Lantern Photographs, 12,000, with readings, from 6d. plain, 1s. coloured.—A. PUMPHREY, Emily-street, Birmingham.

Gelatine Films for photographs, reduce cost and labour of photography to minimum.—A. PUMPHREY, Birmingham.

The **Filmograph** carries 100 films or 12 plates! Lightest Photo. Apparatus. Illustrated tests.—PUMPHREY, Birmingham.

Filmographic Manual, free 6d., with photograph from Film Negative. Full instructions. Films, Filmograph.—A. PUMPHREY, Birmingham.

100-Fold **Filmograph Slide**, can be used with ordinary camera. Plates changed anywhere.—A. PUMPHREY, Birmingham.

Collographic **Photographs** for Machinery and Trade Patterns. Sample and list for 2d.—PUMPHREY and DAY, Birmingham.

"**The Night-light Clock.**" Illustrated and described on page 370, No. 848. Price, carriage free, 5s. 6d.—P ROBERTSON, 13, Greek-street, Soho, W.

Lathe, 3½in., 3ft. bed, screw-cutting, slide-rest compound, set change wheels, chucks, &c., second-hand, good as new, £11.—MAKIN, Cupola, Sheffield.

Stocks and Dies, now in extensive use. List one stamp.—F. M. ROGERS, 21, Finsbury pavement.

Electric Lighting.—Inventors wishing to perfect, patent, or sell inventions connected with electric lighting should communicate with F. M. ROGERS, 21, Finsbury-pavement, E.C.

Minerals, 100 good specimens, including sapphire, ruby, topaz, emerald, opal, all named, different, 10s. Apply for list. Also many finer, rarer specimens.—COLLECTOR, Richard's Library, 42, Tachbrook-street, Pimlico, London.

Metallic "E" **Violin Strings**. Infinitely superior to gut. Four post free 1s.—SMITH, 2, Bedford-street, Plymouth

Micro. Photos.—List of 350 one penny stamp.—E. and A. DANCER, 436, Stockport-road, Manchester.

New loud **Violins**. No back or soundpost, 15s., 20s., by "FIDDLER," 19, Edward-street, Burdett-road, E.

Lathes, Lathes, cheap good screw-cutting, from £10. Easy payments. Hire system. First-class tools.—MAKIN, Cupola, Sheffield.

Electrical Depot and Manufactory.—MILLAR'S, 126, Chapel-street, Salford. Handiest shop in the trade for amateurs.

Electric Lamps, 5s.; Bells, 5s.; Batteries, 2s. None better or cheaper. Instruments repaired.—MILLAR, as above.

Gas Compressing Pump, hand lever, 500lb. sq. inch, perfect order £7 10s.—C , 29, Oberstein road, Clapham Junction, S.W.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, JUNE 30, 1882.

SPIRAL APPARATUS.

By J. H. Evans.

In continuation of the spiral apparatus, I am now about to show and describe it as seen at the rear or back of the lathe-head, which is really the proper place for it, by reference to page 101, Oct. 7, 1881, of this journal. The apparatus is there figured as fitted to the front of the lathe-head, and I may say that the present arrangement is virtually a return to the actual original plan of fixing it—viz., at the back, with several improvements, and one reason for its being abandoned at that time was the fact that it could not be applied to any other than lathes with traversing mandrels. The apparatus, as fitted to the front, of course can be fitted to any lathe, therefore it is obvious that those amateurs possessed of a back-centre lathe must be content with it so arranged; but to a lathe with a traversing mandrel I should certainly advise having the apparatus at the back of the head for many reasons, which I will point out. As the various details of the arbors, &c., were fully described in the preceding article, I need not occupy space by going over them again, as they will be exactly the same. One of the chief advantages derived from the present arrangement is that it can be used in conjunction with the oval chuck, and from this some very beautiful work can be accomplished, and, again, except when the screw guides are required to be used, the fittings can all be left on their several places. The fact of having to remove the eccentric carrying the guide for screw-cutting was also another objection to this arrangement at the back, but it is impossible to have a multiplicity of apparatus without having to make changes in the setting up of the same, and as this occupies such a short time, I think it cannot be regarded as an objection, especially when the results obtained by it are so appreciative.

The engraving, illustrative of this apparatus as now shown, gives two views of it, the back face showing the chuck with the wheels in gear, and a side view disclosing the mode of connecting the slide-rest to it; and here I will point out that the joint being made to work upon two separate centres, which is my own introduction, does away with the necessity for such absolute accuracy in the adjustment of the socket which carries the connecting rod, to the height of the centre of the slide-rest, and another advantage in this universal joint is that tapers or cones may be turned by setting the slide-rest to an angle, and it works perfectly in every way that could be desired. I do not claim anything new in the invention of this joint only as applied to this particular apparatus; I merely point this out because I do not wish my readers to credit me with a desire to fall back upon anything that has been done before, and endeavour to claim it as my own. This joint, however, although nothing new in itself, is, as applied for the present purpose, my own original idea, and has met with

FIG. 1.

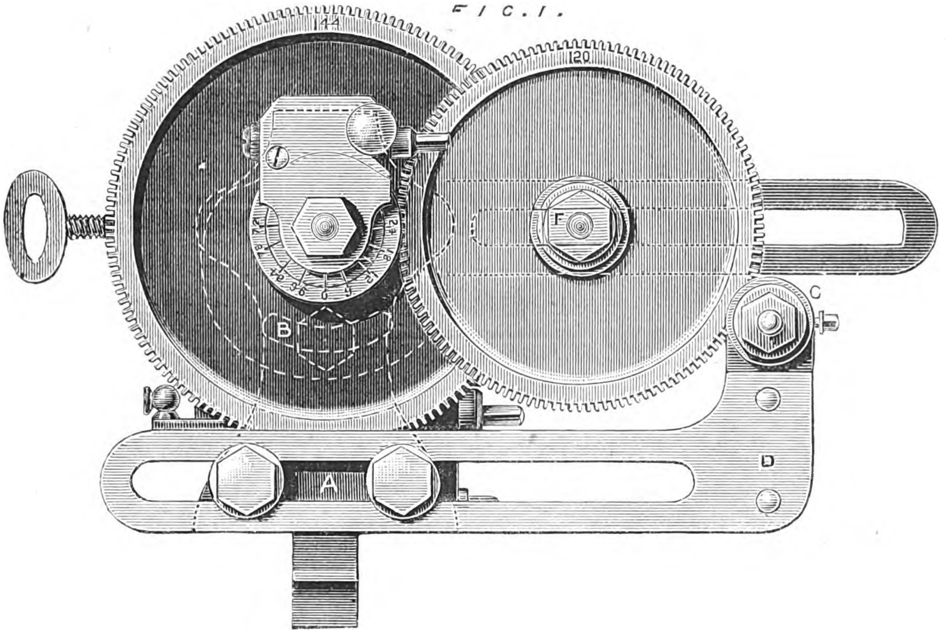


FIG. 2.

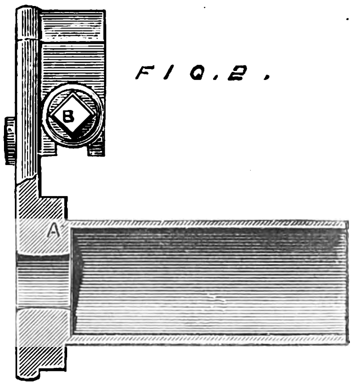


FIG. 3

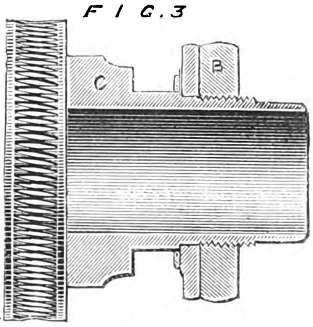


FIG. 5.

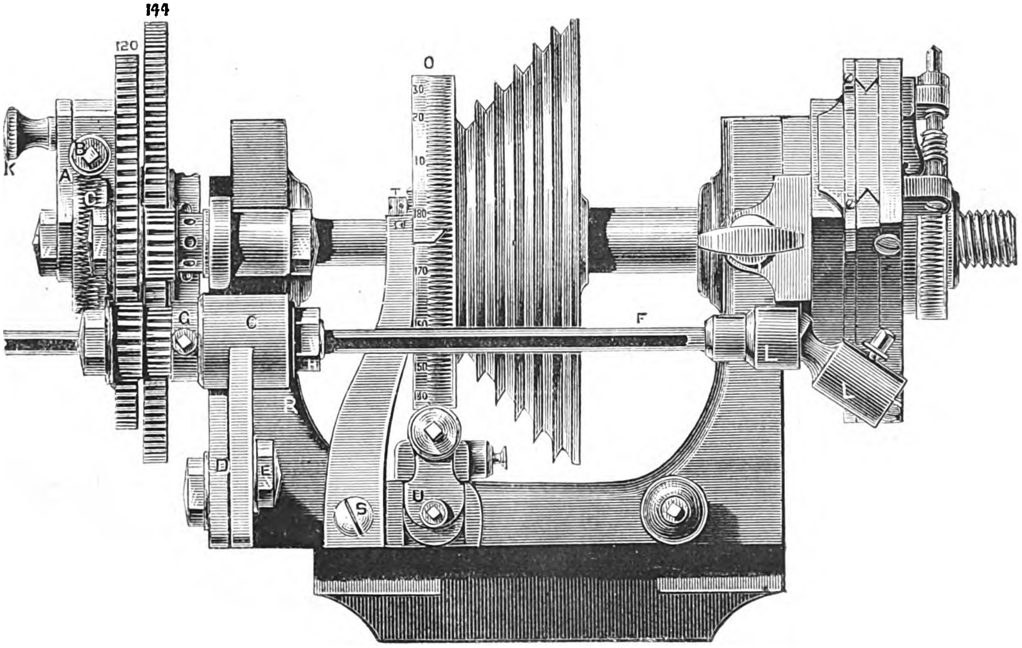
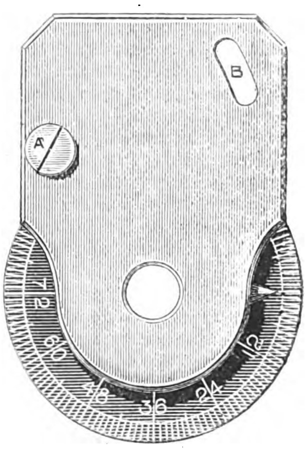


FIG. 4.



every appreciation from very many amateurs for whom I have made it, and who use it a great deal. As the question has been asked several times through the columns of this paper if I am going to finish the articles upon the spiral apparatus, I will endeavour to show our readers the best way to make it, or to transfer it, if they already have it fitted to the front. Letter A, Fig. 1, shows the outline of the mandrel-frame; this is shown by a dotted line, as the wheels nearly cover it. The first part to do will be to cut out a circular recess for the radial arm to work in. This must be cut out with the aid of a boring bar and cutter, which is shown in Fig 9, page 4, Sept. 9th, 1881, and, in order that the recess may be cut perfectly true to the collar, bushes must be fitted one in each collar to guide the bar; boxwood will answer very well for this purpose. The radial arm, if being transferred from the front, must have the projecting ring taken off the side that it is on, and another fixed on the opposite side. The best way to do this will be to fix the arm on to its place and cut out a recess exactly the same as that in the cast iron; in fact, it may be done at the same setting of the bar—that is to say, having cut the cast iron, place on the metal arm, and cut out the recess in it, about 1-16in. deep, and into it fit a ring of metal, which will, of course, then fit into that cut in the lathe-head. It may either be soldered or screwed on: the former is the least trouble, and as it is simply a guide, will be sufficiently strong. The radial slot B is arranged so that the same hole that receives the bolt for the eccentric of screwing apparatus may be used. This being the case, it is simply to make a new bolt, with hexagon head, to tighten the radial arm, in whatever position the gearing of the wheels requires it to be fixed. The wheels shown in the engraving are those which are used to produce the coarsest pitch that the series of 15 wheels will produce—viz., 144 on the chuck-gearing with a pinion of 16 on the middle arbor F, which is the double one; the 120, also, on this same arbor and the latter gearing with a pinion of 15 on the lower socket, which, in this case, takes the place of that on the slide-rest, and answers the same purpose, the actual pitch or rise of this spiral cut, by aid of these wheels, is as near as possible one turn in 7in. Such a pitch would only be used in ornamental turning. To proceed with the making. The next part to do will be the lower arm D, which is straight, and has a long slot in the centre to admit of its being adjusted with the slide-rest. It is fixed to the lathe-head by two steel bolts with hexagon heads, as seen, which have loose washers underneath. The plain part of the bolts will form sufficient guide for the slot to work on without its fitting down on to the bed; also, it will prevent the necessity of moving the head forward—by the way, an old objection when the bracket was fixed to the bearers. There is no necessity to move the head at all under any circumstances connected with this apparatus. The spiral chuck, of which I give two separate views, will form the best part to proceed with,—I mean, provided the whole is being changed from front to back. If being made, the arbors should be made first, in order that the line of gearing may be more readily got when making the chuck. To make the latter, the body (Fig. 2, A) should be chucked by the back-plate on to a surface-chuck, and held tightly by two clamps and bolts; while the hole is turned out, which it must be, to fit on the mandrel, and a hole made at the bottom for the steady-pin, which prevents the steel guides for screw-cutting turning round to fit into. This fitting must be very carefully done, and when screwed up quite tight, the mandrel must work freely, without any shake. Fig. 3 shows the tangent-wheel, which has 96 teeth; on the body of this the wheels are placed when in use, and are held firmly to it by the circular steel nut B, Fig. 3, against the face of the shoulder C, Fig. 3. A hole through the centre, Fig. 2, is for the purpose of allowing the steel screw to pass freely, usually used for fixing the steel cap for ordinary turning. This same screw will do, if long enough, and it generally is; but in lathes that have been made for a considerable time, this was not thought of, and the screws are sometimes too short; it is, however, an easy matter to make another. B, Fig. 2, shows the end of tangent-frame and screw; and Fig. 4 gives an end view, showing how the centre upon which the tangent-frame works is obtained. The screw A, Fig. 4, having a plain part, which fits into the hole, and is screwed as tightly as possible to a shoulder when the frame bears well against the inner face of the plate; the radial slot B is that in which the fixing-screw works for tightening it when in or out of gear. This chuck I introduced to obviate the difficulty of dividing the work, as the original plan of raising the radial arm and wheel out of gear, and shifting the mandrel or slide-rest screw round, was indefinite. This, of course, I saw in a moment was most deficient in accuracy, and so set about making the present one, which obviates all risk of inaccurate work; the face of the body of the chuck C, Fig. 3, must be turned away until the wheels on the chuck, line correctly with those on the arbors, and that should be the centre of the pinions, which are half an inch wide, the wheels being $\frac{3}{8}$, and the difference is made up by the thickness of the blanks which fill up the large holes in the wheels. The adjusting of the various parts to work well is rather a troublesome job, as there is very little room to spare.

We now come to the metal bearing C, Figs. 1 and 5. This is fitted to the straight arm D, Figs. 1 and 5, by a steel piece, $\frac{1}{2}$in. wide and 2in. long; the depth of the metal is a little less than the projecting piece, screwed with a steel nut on the end E, Fig. 5. This is made to adjust up and down, to admit of the connecting-rod F, Fig. 5, being raised to the height of the slide-rest screw; the metal C has in the centre a steel socket, fitted to it, with a collar, G, on it, to form a shoulder bearing; it is made taper, to fit the hole in the metal, and has a steel nut, H, on the other end; also a loose steel washer, which is screwed tightly against the face of the steel socket, and so forms a bearing, the socket revolving freely between the two shoulders G and the face of the washer in front of the nut H. It will be seen that the long connecting-rod F passes through this socket, and is fixed in the desired position by the square-headed screw, and I find that it is an improvement to have a long V-slot made in the rod into which the point of the screw should fit; this effectually prevents any chance of the rod moving without carrying the wheels with it.

I have had the whole of the lathe-head engraved, in order to show the apparatus as arranged, also to illustrate the oval chuck at work; the latter being on its place will show clearly how it works in conjunction with the spiral apparatus, and as this head has the segment apparatus fitted to it, it forms a second subject in one article, which will save the space at another time. Before describing this latter, I will finish spiral, however, in Fig. 5, the side view of the chuck, Figs. 2, 3 and 4, A being the back, B the tangent-frame, C the tangent-wheel, the large wheels being tightened on to the chuck by the steel nut and washer, seen more plainly in B, Fig. 3, K, Fig. 5, being the screw with a milled head to fix the tangent-wheel in or out of gear. There is a great advantage in being able to do this, as it saves a deal of time if the wheel is required to be divided into, say, four or six; but where a much larger number of divisions are required, the tangent-screw must be used, one turn of it being equal to one division on the face of the wheel. The joint L, before mentioned, is composed of three separate pieces: in the first, that fixed to the rod, a semicircular piece, is fitted to move freely, and works upon two small steel centres. In the centre of this the ball attached to the loose piece is also hung upon two steel centres at the opposite sides. This latter piece is bored out to fit on to the end of the slide-rest screw, and it has a hole bored through both, and then broached taper, and the screw is turned down, just leaving sufficient screw to take effect on the outer part of the steel and the plain part fitting the taper hole. A plain pin would answer the purpose, but a screw is always preferable to having to tap out a pin with a hammer. When not being used, the rod may be pushed right home to the socket out of the way, the radial arm raised, the arbor taken out of gear, and the chuck may be allowed to form the collar to keep the mandrel in its place instead of replacing the steel cap, so that, as I have before said, the apparatus need not be taken down. If not likely, however, to be used for any considerable time, perhaps it is as well to do so; but it will not be found in the way if left on. I think there is little left to be said upon this except that should anyone desire to do so, it can always be seen, and further explanation obtained at my works.

Having so far finished, I will now proceed to give the various details of the segment apparatus as seen in the engraving. On the back of the pulley a projection is generally left for the purpose of adding this at any future time. The segment-wheel O, is turned out to fit on this projection, and is fixed to the pulley by four steel screws, the plain parts of which should fit well. The wheel is cut in the same way as all other tangent wheels, which method I have explained before. It has 180 teeth, and is divided on the edge to the left side at every tooth, and figured at every tenth division; on the side the segment holes are drilled, generally 72 in number, and about 3-16th in diameter. Before fitting in the pins every hole should be made slightly taper, and the best way to do this is to make a taper half-round bit with a stop to it, to insure every hole being exactly the same size; the pins should have a small round hole in the end to facilitate their removal; and having used this apparatus, be sure and take them out before putting on the foot-band, or some damage may be done. The pillar is made in iron from a forging, and fixed so that the side of it will be close to that of the wheel. When fitting this up, the cast iron must be filed away to get a flat bearing for the pillar to go against, and should be fixed firmly to the cast iron with a steel screw S, and it is better not to finish shaping it until it is so fixed, and the two stop screws T are in their places. In the top of the pillar a hole is tapped through, and two screws as seen, one on the top, the other underneath; their object being to enable the distance of the segment being cut, to be compensated the distance of the space of the holes. This part done, we may proceed to fit up the tangent-frame, which is made either of steel or gun-metal, the length being the width of the frame. At the back of the head a space is filed out and a metal frame let in and fixed with a steel screw as in the case of the pillar, and this metal frame has in it two steel centre-screws, upon which the tangent frame works when placed in or out of gear, which operation is performed by an eccentric actuated by the square-headed screw. In the centre of this part of the frame a recess is cut out a

¼in. wide, and a steel eccentric fitted to it, sufficient eccentricity being given to allow it to throw the screw tightly into gear with the wheel; but when used it should be so adjusted that it will work freely with a winch-handle, in order to give a better bearing for the cam to work on. I always have a steel piece fitted to the cast iron: it forms a better bearing and wears better. On the top of the frame at the back a steel ball is screwed, through which a centre screw is fitted for the point of the main screw to work in, by which also it is kept against the metal shoulder. On the front of the screw a square is filed, and metal collars with different divisions are fitted; but I think one will be found sufficient, and that should be divided into 10: it will serve every purpose, and saves a multiplicity of different parts, which are seldom, if ever, used. I sometimes make the main screw to pass through double bearing, so that it can be worked from either side of the head. This is convenient; but not, I may say, necessary. In the centre of the head will be noticed two steel projections, which are for the purpose of keeping the tangent-frame steady. They are simply screwed into the cast iron and filed away, the side of each one until the frame fits well when working upon its centres. This will be found a most useful addition to an amateur's lathe, as it forms a means of holding the mandrel firmly while heavy cutting is being performed. One amateur told me that he found it exceedingly useful if a chuck got jammed on the nose, as he could fix the mandrel by it, while he forced off the obstinate offender; but I would beg of any one possessing it not to use it for such a violent purpose; but retain it in a state of perfection as long as possible for a better purpose. When using the dome-chuck, it will be found of great service, especially when doing heavy drilling.

ASTRONOMICAL NOTES FOR JULY, 1882.

The Sun.

Day of Month.	Souths.				At Greenwich Mean Noon.								
					Right Ascension.			Declination. North.			Sidereal Time.		
	h.	m.	s.	p.m	h.	m.	s.	°	′	″	h.	m.	s.
1	0	3	31·91	,,	6	41	17	23	6	50	6	37	44·94
6	0	4	25·86	,,	7	1	51	22	41	26	6	57	27·73
11	0	5	11·39	,,	7	22	22	22	6	11	7	17	10·51
16	0	5	46·24	,,	7	42	40	21	21	26	7	36	53·29
21	0	6	8·16	,,	8	2	44	20	27	37	7	56	36·08
26	0	6	15·62	,,	8	22	34	19	25	14	8	16	18·86
31	0	6	7·93	,,	8	42	10	18	14	50	8	36	1·64

The method of finding the Sidereal Time at Mean Noon for any other station will be found on p. 390 of Vol. XXXIV.

At 9 p.m. on July 3rd the Sun will be in apogee, or, in other words, the earth will be in that part of her orbit at which she is at her farthest from him. If we accept the Solar Parallax as 8·85″, we shall, at that instant, be separated by an interval of 93,910,166 miles from our great centre of light and heat. There will be no real night in any part of the United Kingdom until after the 20th. The usual indications of solar disturbance continue to manifest themselves.

The Moon

Is Full at 6h. 8·3m. a.m. on July 1st, and enters her Last Quarter at 9h. 51·8m. in the evening on the 7th. She will be New at 7h. 1·3m. a.m. on the 15th; enter her First Quarter at 10h. 17·5m. on the morning of the 23rd; and finally be Full, for the second time during the month, at 2h. 1·5m. in the afternoon of the 30th.

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
1	B.A.C. 6347	6½	†3 59 a.m.	S. by E.	14	47				
6	B.A.C. 8152	6½	2 30 ,,	Bright.	94	74	3 35 a.m.	Dark	322	313
29	B.A.C. 6536	6½	†1 55 ,,	N.N.W.	196	225				
30	8 Aquarii	6	8 49 p.m.	Bright.	98	68	9 55 p.m.	Dark*	299	276

† A near approach. * But apparently bright.

The Moon.

Day of Month.	Moon's Age at Noon.	Souths.		
	Days.	h.	m.	
1	15·7	12	45·9	p.m.
6	20·7	4	23·3	a.m.
11	25·7	8	45 2	,,
16	1·2	0	59·6	p.m.
21	6·2	4	31·5	,,
26	11·2	8	33·9	,,
31	16·2	*12	24·9	,,

* After midnight of the 30th.

The Moon will be in conjunction with Saturn at 5 p.m. on July 10th; with Jupiter at 2 p.m. on the 12th; with Mercury at 5 p.m. on the 13th; with Venus at 7 p.m. on the 18th; and with Mars at noon the next day.

Mercury

Is a Morning Star during the entire month, attaining his greatest elongation West (20° 5′) at 5 a.m. on the 20th. He may now be well seen in the east before sunrise. His angular diameter diminishes pretty rapidly from 11·6″ on July 1st to 5·8″ on the 31st.

Day of Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	6	19·2	18	40·8	11	41·5	a.m.
6	6	10·7	18	43·7	11	13·4	,,
11	6	9·8	19	17·7	10	52·8	,,
16	6	18·2	20	12·0	10	41·6	,,
21	6	36·4	21	9·7	10	40·1	,,
26	7	4·0	21	48·7	10	47·9	,,
31	7	39·6	21	45·1	11	3·8	,,

As shown by the above ephemeris, Mercury never travels out of Gemini during the entire month. On the 14th he will be some 2½° south of μ Geminorum, and on the 26th in the same low-power field of view with δ. These are the most conspicuous stars he will approach.

Venus

Is an Evening Star throughout July, and may be seen after sunset in the West. Her angular diameter increases from 12·6″ at the beginning of the month to 14·6″ by the end of it. She is still gibbous, and forms by no means an interesting object in the telescope.

Day of Month.	Right Ascension.		Declination North.		Souths.		
	h.	m.	°	′	h.	m.	
1	9	1·7	18	47·3	2	23·6	p.m.
6	9	25·5	16	58·3	2	27·6	,,
11	9	48·7	14	58·7	2	31·1	,,
16	10	11·3	12	49·8	2	34·0	,,
21	10	33·4	10	33·2	2	36·4	,,
26	10	55·0	8	10·5	2	38·3	,,
31	11	16·3	5	43·0	2	39·8	,,

So that Venus will travel from the most easterly portion of Cancer across a considerable part of Leo. On the evening of the 3rd she will be close to the 6th magnitude Star 83 Cancri. She will be rather more than 1° north of Regulus on the 14th, and about 1½° N. of ρ Leonis on the 19th. On the 27th she will be in the same telescopic field of view as χ Leonis. She will be in conjunction with Uranus (17′ N. of him) at 9 a.m. on the 30th. This is a month quite remarkable for the absence of the Major Planets from the night sky. MARS, JUPITER, SATURN, URANUS, and NEPTUNE being none of them visible. The Minor Planet

Juno

will, though, come into opposition to the Sun on the 18th, and may be seen by anyone who cares to regard a seeming 8th magnitude Star of orange hue.

Day of Month.	Right Ascension.		Declination South.		Souths.		
	h.	m.	°	′	h.	m.	
10	19	49·1	4	15·5	12	33·8	p.m.
20	19	40·4	4	53·5	11	45·8	,,
30	19	31·7	5	45·4	10	57·9	,,

Hence Juno must be sought in a perfectly barren part of Aquila.

Shooting Stars

Are more numerous than they were during the previous month. Watch should be kept for them especially on the 17th, 20th and 29th.

Greenwich Mean Time of Southing of Seven of the Principal Fixed Stars on the Night of July 1st, 1882.

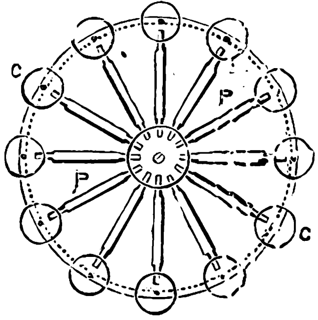
Star	Souths. h.	m.	s.	
δ Ophiuchi	9	28	54·87	p.m.
Antares..	9	42	53·97	,,
a^1 Herculis	10	29	51·07	,,
α Ophiuchi	10	49	59·18	,,
γ Draconis	11	14	19·50	,,
Vega	11	53	17·86	,,
δ Aquilæ	12	39	46·83	,,

The Method of ascertaining the Greenwich Mean Time of Southing on any other night in July of either of the stars in the above List, as also that of determining the instant of its Meridian Passage at any other station, will be found on p. 392 of Vol. XXXIV.

BARNEY'S IMPROVEMENTS IN TELEPHONES.

AMONGST recent patented improvements in telephonic instruments we find as specially deserving of notice, those devised by Mr. W. C. Barney, of 53, Bernard-street, London, whose specification (No. 4905, 1881) describes several forms, the most useful of which have perhaps to be discovered; but excellent results have, we understand, been obtained with one form already tried. The invention comprises both transmitting and receiving instruments. In microphones heretofore constructed the quantity of electricity passing through them is extremely small, and represents an almost infinitesimal part of the electric power emanating from the source of electricity employed. The current which passes through a microphone used for telephonic purposes should be as great as possible, having due regard to the sensitiveness of the microphone to the action of sound-waves upon it, because the variations of the intensity of the current produced by the action of the sound-waves are in proportion to the variations of the resistance of the microphone. Various forms of microphone have been devised, some in which the variations of the contact-points of the several parts of the microphone are caused by means of a spring or springs, others by means of a tympan. The microphone invented by Professor Hughes is simple and effective. In a microphone constructed on the principle of Professor Hughes, the greater the number of points of contact the greater will be its conductibility, which is a great desideratum. The microphones devised by Mr. Barney offer the least possible resistance to the passage of an electric current, and, at the same time, possess the greatest sensitiveness to the action of sound-waves; consequently, the current induced in the secondary wire of the induction-coil, to the primary wire of which the microphone and battery are connected, has great variations of tension, and its action on the coil of the receiving instrument is proportionately great. In one form of the microphone, which we select for illustration, Fig. 1, a number of pencils, P, of hard coke-carbon, or other equivalent material, are used, the ends of the pencils being held loosely in blocks C of carbon. A block of carbon B, to which is connected one terminal of the primary wire of an induction coil, about one inch in diameter, and about half an inch thick, forms the centre of the series of blocks of carbon placed around at a distance of about two inches from it; this periphery of blocks is connected together by any good conductor, to which is connected one pole of a battery, the other pole thereof being connected to the other terminal of the primary wire of an induction coil. The centre block has a series of holes around its circumference, equal in number to the blocks surrounding it, and in each of these blocks is a hole, in which lies loosely one end of a carbon pencil P, the other end of which lies loosely in a hole in the centre block. Each pencil is covered with a metallic sleeve, which must not be in contact with any of the blocks; this metallic sleeve increases greatly the conductivity of the pencil, and also increases its specific gravity, both of these effects being advantageous. Another form is made with carbon pencils and carbon bars in the following manner:—Two carbon bars about half an inch thick, having a length proportionate to the number of pencils used, are placed parallel to each other about two inches apart. They have a series of holes in the sides facing each other, in which holes lie loosely, the ends of carbon pencils, thus connecting electrically the two bars of carbon, one of which is to be connected to one terminal of the primary wire of an induction-coil, and the other bar to one pole of the battery, the other pole thereof being connected to the other terminal of the primary wire. A third carbon bar may be added with carbon pencils connecting it electrically with one of the other bars; in this arrangement the two outer bars should be connected together by a good metallic conductor, to which one terminal of the primary wire should be connected, and the centre bar should be connected to one pole of the battery. In another form the patentee dispenses with carbon, and uses pencils of wood, bone, ebonite, or any equivalent suitable material, placing on each end of the pencil a small capsule of hard tin, or of any hard metal, preferably platinum; the capsules on each pencil are connected together by a metallic conductor, such as fine copper wire or tinfoil; the capsule ends rest loosely in similar capsules placed in holes in blocks or bars of wood, ebonite, bone, cork, or any suitable non-conducting material. The exterior surfaces of the capsules on the pencils are roughened, and the interior surfaces of the capsules in the holes of the blocks are also roughened. The connections of this microphone with the induction-coil and battery are made in the same way as above described for carbon microphones. In order to confine the movements of a microphone to the direct action exclusively of sound-waves, and to avoid any secondary movements of it which must occur when sound-waves act upon a microphone through the medium of a tympan or of any vibratory plate, which movements interfere materially with its faithful response to the sound-waves, the blocks or bars are firmly secured to a flat surface of a non-resonant, non-vibatory, sound-absorbing material, such as cork. This material may or may not form one side of a box made of the same material. If inclosed thus in a box, or not inclosed, the material on which the carbons are fixed must not be fastened to any other material, but should rest loosely in a narrow frame of wood or other suitable material, or it may be suspended in any convenient manner; when pumice-stone is used the bars or blocks may be clamped between two pieces of pumice-stone. The sound-waves may fall directly upon the carbons or other pencils, or upon the obverse side of the material to which they are fixed. The object of leaving the material to be kept in its place by its own *vis inertiæ* only is to allow the whole mass to be moved by the impact of sound-waves upon it. The molecular movement in these light, porous substances being much greater than in dense compact substances, will communicate to the fixed blocks or bars a much greater movement than denser materials would. Microphones thus attached to porous substances will be affected by the molecular movement in these substances, as well as by the movement of the mass, and there cannot be any compression of the carbon; but the effect of sound-waves upon it is to vary the surface contacts by a shaking or jolting, or molecular motion; it may be possible that there occur rapid makes and breaks of the circuit; but these, however, are so rapid that an undulatory current flows, corresponding faithfully to the sound-waves, which is not the case when sound-waves act on the microphone through the medium of a tympan or vibratory plate, because the vibrations of a tympan or plate produce secondary motions.

FIG. 1.



In order to protect a microphone from the secondary action of any vibrations which might occur when the fixed parts of a microphone are attached to the surface of any material whatever, the patentee attaches the series of blocks surrounding the centre block, Fig. 1, to a narrow flat ring of copper, or other suitable metal, and the centre block is attached to a narrow strip of wood, ebonite, or any non-conducting equivalent material, lying across the centre of the ring, to which its two ends are secured.

The efficiency of microphones constructed with pencils and blocks or bars depends in a great measure upon the angle of inclination which the pencils make with the perpendicular. When the pencils stand perpendicularly their *vis inertiæ* is almost entirely at their lower ends, and when they lie horizontally their *vis inertiæ* is equally divided between the two ends. In this latter position the force of the sound-waves necessary to overcome their *vis inertiæ* is the maximum force, and in the former position the force required to overcome the *vis inertiæ* of their upper ends is the minimum force; but the contacts there being very slight, the current passing through these ends will be very feeble, and consequently the variations of the current passing through the microphone would be very slight, inasmuch as the current passing through the lower ends of the pencils would be almost uniform. The greater the variations of the quantity of current passing through a microphone used in a telephonic circuit, the greater will be the effect on the coil of the receiving instrument; hence it is necessary that a microphone should combine great sensitiveness to sound-waves with the bearings of the contacts of its several parts so arranged as to present the greatest surfaces of contacts where the variations of the current are produced.

A microphone composed of from eight to ten pencils connected together for quantity, inclining at an angle of about 20° from the perpendicular, gives excellent results. The microphone can be placed in a box of wood, ebonite, brass, iron, or any suitable material, about one inch from one of its sides, in which there is the usual hole with a mouthpiece, care being taken to have a hole in each side of the box between the microphone and the side of the box to which the mouthpiece is attached.

In the case of telephones, the patentee asserts that a plate, or diaphragm, or tympan must be held in close contact with the pole or poles of a magnet, and the plate, diaphragm, or tympan need not necessarily be made of iron or steel, or of any material capable of inductive action, but may be of cork, wood, ebonite, glass, or brass. Words spoken in any good transmitting instrument are reproduced in a clear, loud, and distinct tone in his receiving-telephone placed in the same circuit with the transmitter.

The action of the magnetic force in his telephone seems (he says) to be of a totally different character from that in the Bell telephone, in which the magnetic force acts directly by attraction upon the plate armature, whereas the magnetic force cannot possibly have any direct magnetic effect on the plate or diaphragm when this plate or diaphragm is not made of any material capable of inductive action, nor with any such material attached to it. The diaphragm, tympan, or plate may be made of cork, wood, cardboard, ebonite, ivory, glass, brass, iron, steel, mica, or their equivalents, and must be held by a constant pressure applied upon its edges, corners, or points, as the plate is made round, oval, square, star-shaped, or triangular, against the spiral end of the magnet. One function of the diaphragm or plate seems to be to confine within a narrow range the molecular elongations of the magnet produced by the passage of an electric current through a helix encircling the magnet, and it doubtless serves to intensify the sounds emitted by the magnet at this time.

The patentee was led to use a spiral wire for an extension of the core in the helix on an electro-magnet, from the results of numerous experiments made with a thin strip of iron, having one end firmly secured to a board and the other end slightly bent over by a weight attached to it, with a helix placed on a strip of iron. When a current of electricity was sent through the helix, the strip of iron instantly made efforts to resume its normal position, and sounds were emitted during the passage of the electric current.

In constructing his telephones, Mr. Barney uses several combinations of a spiral wire with electro-magnets, the spring being sometimes continued around the core and fastened to the shoe.

In Fig. 2 a bar of iron or steel, which may or may not be a permanent magnet, has one end fastened to a shoe S of soft iron equal in weight to about five times the soft iron elongation E of the other end, on which is placed a helix H. To the end of this elongation is fastened a short spiral spring G of iron extending about one half an inch above the end of the core of the helix. The end of this spiral spring may be capped with a disc of iron or steel, D, the same size as the end of the core, or larger; or the terminating convolutions of the spiral spring may be wound in a plane gradually diminishing to a centre.

FIG. 2.

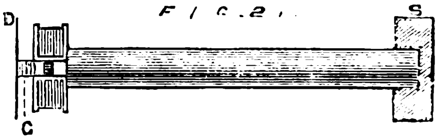
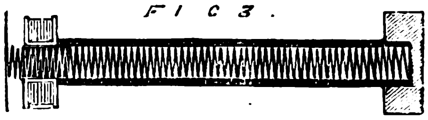


FIG. 3.



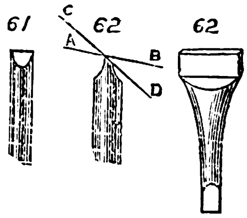
In another form, inside of a tube of iron or of steel, Fig. 3, upon one end of which is fitted a shoe of soft iron, is placed a spiral wire of iron or steel fastened to the soft iron shoe, the spirals being in close contact with the inside of the tube throughout its entire length, and extending above the end of the tube. On the spiral wire above the top of the tube is placed a helix, and a soft iron plug is placed inside the spirals encircled by the helix—the end of the spiral wire being arranged as in the first form. The connections are those usual with other telephones, and the cases may be of any suitable material.

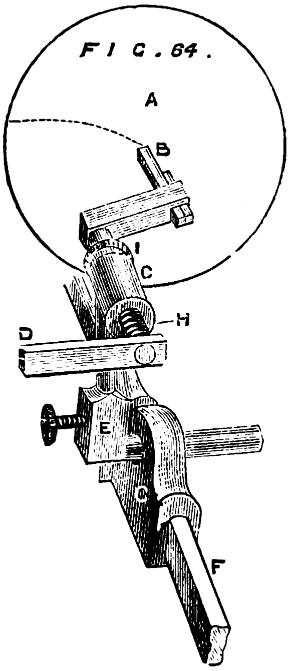
WATCH-CLEANING AND REPAIRING.

By "A FELLOW-WORKMAN."

(*Continued from page* 301.)

YOU must be careful and enlarge the right hole. As I said before, there are two barrels, but the *top* hole is always the largest, that would be the one nearest the chuck, and, of course, would be the last hole. Now you must see that the new bush does not protrude beyond the surface of the plate; to level it, use a tool, Figs. 61, 62, 63 instead of a drill; you must bring the rest up in front of the hole, and let the blade of the tool rest upon it to keep it firm; but for counter-sinking, you will find Fig. 64 a good substitute for a slide-rest. If you fix it firm and take pains in making it, it will do the work very well. A is plate in turns, B piece of a graver, C is a piece of tubing soldered on to a piece of brass wire; D is the handle for turning tool B, E is part of rest of turns, F body of turns, G part of rest, H wire-spring, I thumb-screw for putting tool deeper or fleeter, and works on a screw, so that you can cut any depth to a nicety. I think the drawing will sufficiently explain how it is made; but if any one who wishes to make one finds any difficulty, I will explain more fully.





Now to return to Fig. 53: B should be screwed on to the arbor, and the top hole should be larger than the bottom.

There are several different kinds of click-works: there is the circle-spring and dog, straight-spring and dog, the one as shown Fig. 51, and several common ones, but they are all more or less easy to repair, and as there is no particular rule attached to them, so long as they do their work and are firm, they will do.

Centre-wheel (F, Fig. 51): If the wheel breaks or is spoiled, you must send circumference and number of teeth, but it is difficult to get this unless you have a good gauge, so it would be best to send the old wheel. Fix the new wheel on a piece of plate with shellac, then fix plate in chuck, same as shown Fig. 54, and work by rule (Fig. 57), in the same way as explained for barrel. To put in a new pinion, get the length from shoulders, turn to fit wheel first, and then holes, place it on an arbor to turn it; but you will seldom, if ever, have this job to do; set square, and arbor can be bought in rough and only want fitting. The holes should be in the centre of the counter-sink, and you will generally find it so. I had one case where it was not so, but it was a common watch, and was made wrong in the first instance, and I think you may safely take the counter-sink in every case as a guide for your hole. If you have depth tools, of course, you can use them; but I have known jobbers to get wrong even then; however, we will suppose you have not got a depth tool and you want a new centre hole to pillar-plate: make old hole larger and "bush it," next place it in the chuck (C, Fig. 54), with the outside of the chamfer running true, then with your drill (H, Fig. 54) drill your hole.

I cannot say so much for the smaller wheels, as I have often found that they do not (in common watches) run in the centre of the counter-sink, but they should do; but to put new holes to 3rd, 4th, 5th, and top and bottom holes, you want a depth tool. I made a depth tool which answered very well, and I will give a description of it next week; but unless it is made with great care, it will be useless; a depth tool would cost about 12s. 6d.

(*To be continued.*)

THE ACHROMATIC OBJECT-GLASS.—III.*

By W. BRADBURY ("ORDERIC VITAL").

(*Continued from page* 344.)

DOLLOND, having found a remedy for the dispersion, could overcome the spherical error by practice. I have met with no account of the proportions of curves used by him, and it is probable that the calculations by which he found them, have never been published. But that he possessed a good knowledge of theoretical optics, will be evident from the following extract from a communication of his to the "Philosophical Transactions" for 1753:—

"If anyone would have the visual angle of a telescope to contain 20°, the extreme pencils of the field must be bent or refracted in an angle of 10°, which, if it be performed by one eye-glass will cause an aberration from the figure in proportion to the cube of that angle; but if two glasses are so proportioned and situated as that the refraction may be equally divided between them, they will each of them produce a refraction equal to half the required angle, and therefore the aberration being in proportion to the cube of half the angle taken twice over, will be but a fourth part of that which is in proportion to the cube of the whole angle, because the cube of one is but the eighth of the cube of two. So the aberration from the figure, where two eye-glasses are rightly proportioned, is but a fourth of what must unavoidably be, where the whole is performed by a single eye-lens. By the same way of reasoning, where the refraction is divided between three glasses, the aberration will be found to be but a ninth part of what would be produced by a single glass, because three times the cube of one is but one-ninth of the cube of three. Whence it appears, that by increasing the number of eye-glasses, the indistinctness which is observed near the borders of the field of a telescope may be very much diminished, though not entirely taken away."

The general construction of his double object-glasses was a double convex of unequal curvature—the shortest radius in front—combined with a double concave of similar character, with the longer radius posterior. This form is retained in the practice of the present day, with such alterations as the changes in the qualities of the glass have necessitated.

A difficulty appears to have been found in securing a proper balance of spherical error, owing to the excessive aberration of the convex lens; and as there were no theoretical rules for duly proportioning the curves, the task of final correction would doubtless be a very long and laborious one. This led Dollond to apply the same principle to object glasses, that he had recommended in the construction of eyepieces. Instead of a single convex, he divided the refaction between two convexes, and thus made his object-glass a triple by placing the concave between them. His son, P. Dollond, made a very many excellent instruments of this kind of various apertures and focal lengths. One of the earliest of these, of 46in. focus, was purchased by a French nobleman, who took it to pieces, and carefully measured the radii of the different lenses. As the foci are not mentioned, no inferences respecting the character of the glass can be drawn from the mere numerical radii: they were:—

1. Double convex.	2. Double concave.	3. Double convex.
1st radius 32·4	1st radius 22·2	1st radius 30·6
2nd „ 40·8	2nd „ 30·6	2nd „ 35·5

I have met with particulars of two other triplets by Dollond:—

No. 1.—FOCUS 46.

1. Convex.	2. Concave.	3. Convex.
1st radius 28	1st radius 20·9	1st radius 28·4
2nd „ 40	2nd „ 28	2nd „ 28·4

No. 2.—FOCUS 46·3.

1. Convex.	2. Concave.	3. Convex.
1st radius 28	1st radius 21·1	1st radius 28
2nd „ 35·5	2nd „ 25·75	2nd „ 28

Of his double o g.'s I have no particulars. About 5in. seems to have been the utmost limit of aperture obtainable at this period. Discs of good flint glass were very scarce, as its manufacture was not well understood, and any striæ or veins of unequal density rendered it useless for astronomical purposes. With regard to the glass used at this period, I am kindly allowed to quote from a letter of "our" excellent friend, "Prismatique."

"In Dollond's time, the crown-glass was generally made of the knot or part of the blown sheet where the pipe entered; they are now rare, as glass is rolled, not blown. The first mass of flint glass, out of which Dollond got some perfect object-glasses, was obtained from a firm now known as Powell's Whitefriars Flint Glass Works; it is very much the same as Chance's light flint in its refraction and dispersion."

As a conclusion to my short and imperfect account of the practice of the illustrious founders of the firm to which we owe the invention of the achromatic telescope, I will extract an interesting letter from Rees' "Cyclopædia." It is by G. Dollond:—

"The perfection of our object-glasses is in a great measure promoted by the great pains we take in selecting those glasses that suit each other the best, and also in adjusting them very carefully: yet that is not everything that is necessary to produce good object-glasses; they must be correctly worked, and the glasses be of perfect and proper quality.

"With respect to the surfaces used in our various object-glasses, it would be almost endless to enumerate them, as they depend upon and vary with almost every piece of glass that is used in their formation; and there are some nice points in the method of working them, which I should not wish at present to disclose. Our usual mode of proceeding is, in the first place, to calculate proportions that are requisite for the kinds of glass that are to be used, and then to select from our great number of tools those that come the nearest to the surfaces determined upon; and it frequently happens that we have not any that will answer, particularly for the spherical aberration. We do not enter into those very nice calculations that would be satisfactory to a theorist; we only aim at something near to what is required, for to practical men it is always more easy to produce what they wish by practical methods. Mr. Short, the celebrated maker of reflecting telescopes, used to proceed by first making his large metal as nearly correct or parabolical as he could, and then from a number of small metals to select by trial that which corrected the large one in the best manner.

"In all matters relating to the practice of optics, there is much uncertainty, and it frequently happens that with the very best endeavours, we cannot produce by the same means the same effect where extreme correctness is required, so that you may very readily conceive that very exact calculations, however requisite, will not always answer. In a rough way of taking the focal length and surfaces of an achromatic object-glass, composed of crown and flint glass of the usual densities, we should say crown, 1 to 3, and flint, 2 to 3; the outer surface of the crown shorter than that which is next to the flint, and the shortest radius of the flint next to the crown; and the nearer it can be brought without touching in the middle, the more perfect will be the performance, though this will, in a great degree depend on the aberrating power of the glasses used, for, sometimes we find it necessary to make the crown nearly of equal radii. The French opticians make the radii of the convex lens very unequal, and place the shortest radius next to the flint; and, instead of crown, they use Bohemian plate, which is nearly of the same refracting power, but of a different colour, their flint glass being of a much less specific gravity than the English.

"The great barrier to the further improvement, particularly in the extension of the aperture, is the want of good glass, which circumstance has ever been lamented; and from the excessively increased duties which act against the improvements of every manufacture, a prohibition is now likely to take place altogether."

After Dollond, the second great master of the art was Tulley. There does not appear to have been any very great difference in the practice of these distinguished opticians, if we may judge by a comparison of Tulley's curves, with the general account given in Dollond's letter. But his practice is the more interesting because he seems to have found the necessity of having some theoretical rule to guide him in selecting suitable curves for combination. The formula he employed, though necessarily an empirical one, gives results in close agreement with those yielded by much more elaborate methods; and was, therefore, quite near enough for a practical man. In his time the number of kinds of flint-glass was not large, and their refractive and dispersive powers were not widely different. The light flint glass previously spoken of was probably the most largely employed; as being of low specific gravity, it was the more likely to have the requisite purity for optical work.

(To be continued.)

ELEMENTARY LESSONS IN DRY-PLATE PHOTOGRAPHY.—XIII.*

(Continued from page 348.)

Making Gelatine Emulsion.

THE subject of gelatine emulsions and plates is one on which volumes might, and in fact have been, written, and here of course we can but give the briefest instructions. If the photographer succeed with these, he may with advantage take up the study of the advanced works which have been written on the subject. We do not propose to give the formula which has given the highest sensitiveness in our hands, but shall give one which has given us plates of fair rapidity, and of the very highest quality. The principal piece of apparatus necessary for making any number of plates is a drying cupboard or box. This is a box arranged so that the plates may be placed in it in such a position that a current of air passes rapidly over the surface of all of them. There are various designs of boxes, some of which are so arranged that the current of air is heated. This is not desirable if a fairly dry place can be had for the drying-box. The motion of the air is usually insured by burning a gas-jet at the lower end of a small chimney or flue. The defect in almost all drying-boxes that we know is that the air-passages are too small.

The other apparatus necessary is as follows:—

A large slab of plate-glass, marble, or smoothed slate, levelled accurately, so that the plates can be laid on it to set. The larger the slab the better, as more plates can be placed on it at once. A piece of coarse canvas or "scrim," such as ladies do worsted work on—say two feet square.

Several glass beakers or jam pots for mixing and boiling solutions in. The latter are preferable, as glass is very likely to be broken in the dark-room.

An ordinary hair sieve.

A vessel of such a size and shape that the sieve may stand in it, and that when it—the vessel—is full of water, the upper edge of the sieve will stand (say) half an inch above the surface of the water.

A large glass filtering funnel.

Several hock bottles. These, from their deep red colour, are useful for performing the various manipulations in.

An ordinary saucepan.

A Bunsen ring burner, on which this may stand to boil.

Let the following solutions be prepared, and each mixed in one of the jam pots.

A

Nitrate of silver	100 grains
Distilled water	2 ounces

B

Bromide of potassium	85 grains
Nelson's No. 2 gelatine	20 ,,
Distilled water	1½ ounces
A one per cent. mixture of hydrochloric acid and water	50 minims

C

Iodide of potassium	8 grains
Distilled water	½ ounce

D

Hard gelatine, such as that sold by the Autotype Company for dry-plates	120 grains
Water	several ounces

Let B and D stand till the gelatine is thoroughly soaked as indicated by its being quite soft. Let all the water be poured off D, and let as much water as possible be squeezed out of the gelatine.

The pots containing A and B must now be placed in hot water till the solutions are at about 120° Fahr., when B is poured into one of the hock bottles.

From this time all operations must be performed in the most feeble ruby light possible. A little of B is now added to the solution already in the bottle and the whole shaken. Small additions of B are made so that it is poured in five or six stages into A, the whole being shaken at each addition, and a very thorough agitation being given at the end. C is added, and the solutions, now forming an emulsion, are again shaken. The whole is poured into one of the jam-pots. This is placed in the saucepan, the lid is placed on the latter, and the water brought as rapidly as possible to the boil. A loose cover of some sort should be placed over the jam-pot during this part of the process to prevent condensed water from dropping off the lid of the saucepan into the emulsion. The emulsion is allowed to remain for half an hour in the boiling water. If, at the beginning of the process, a drop of the emulsion be placed on a piece of glass and a gas flame looked at through it, the flame will appear very red. The emulsion is said to be red by transmitted light. At the end of the boiling it will be a more or less near approach to blue in colour. At the end of the half-hour the gelatine D is placed among the emulsion, and the whole stirred to mix it. The can is then put in a cool and dark place to allow the emulsion to set. It will do so in from one to two hours on a moderately cool day, but it may be left for days if it be desired. This is the best period at which to break the process, which is somewhat lengthy to be performed at one time.

When the emulsion is set quite stiff the jam-pot is dipped for a few moments in hot water. If it be inverted the emulsion will fall out of the vessel in the same manner that a jelly for the table drops from its shape or mould. The sieve must meantime have been placed in its appropriate vessel full of water. The lump of emulsion is placed in the canvas, the whole is placed under water in the sieve, and the canvas twisted up, so as to cause the emulsion to pass through it in fine shreds into the water. It must now be washed for half an hour, either by allowing water to run into the sieve, or by frequently changing the water in the vessel.

The object of this washing is to get rid of the soluble nitrate and bromide, whilst the insoluble bromide and iodide of silver—the sensitive salts—remain in the emulsion.

At the end of half an hour the sieve may be removed from the washing vessel, and placed in any convenient position with one side somewhat tipped up, so that all superfluous water may drain off. The draining should go on for at least half an hour. At the end of that time the emulsion is finished, and only requires to be filtered. We have found nothing better for this than several folds of cotton such as pocket handkerchiefs are made of.

Three-quarter of an ounce of alcohol is now added, and the emulsion is ready to be used for coating the plates. The quantity will be about six or seven ounces. It may be kept in one of the hock bottles, wrapt in brown paper. A small earthenware teapot is the best thing to pour the emulsion on to the plates from. It should be very small; such a one as holds a few ounces, and is used by children at a "doll's tea-party," will do. The smallness of this allows a constant check to be put on the quantity of emulsion given to the plates by counting how many are coated by each fill of the teapot.

The glass plates must be thoroughly cleaned before before coated. This may be done by dipping the plates in a 5 per cent. mixture of nitric acid and water, then rubbing them under the tap with a wet cloth, and afterwards drying with a dry cloth. If they have been coated with emulsion before, they should be left at least twenty-four hours in the dilute nitric acid, and then rinsed with hot water.

Let us suppose the plates ready to coat. The dark-room lamp is placed within a few inches of the right-hand end of the levelling-shelf, and at back of it. To the left of the lamp is the pile of plates; to the right a glass measure or jam-pot or other convenient vessel, in which to stand a glass rod to be ready to hand. The glass rod should be about two inches longer than the breadth of the plates to be coated. Immediately in front of the lamp is placed the teapot full of melted emulsion. A plate is taken from the pile. It is placed as far forward on the levelling-shelf as possible, and in front of the lamp.

A pool of emulsion, about half-covering the plate, is poured from the teapot. The glass rod is taken between the fingers and thumb of each hand, and dipped into the pool of emulsion right across the plate. The emulsion will run between the rod and the plate to each edge of the latter. By a motion of the finger and thumb of each hand the rod is lifted the smallest possible distance from the plate, and is rapidly moved first to one end, then to the other, the tips of the finger and thumb resting on the level table as a guide. This, if properly done, will cover the whole plate with emulsion; and if the plate be small—under whole-plate size—it is sufficient to slide it to the far end of the table to set. If the plate be large, the coating will not be evenly spread unless it is lifted, balanced on the tips of the fingers of the left hand, and gently rocked for a few seconds. By this method plates may, after a little practice, be coated with great rapidity. There is no need to wipe the rod each time it is used. Each ounce of emulsion must not be made to cover more than six or seven quarter-plates or three half-plates

The plates will "set" in a few minutes—that is to say, the emulsion will stiffen like a jelly—and will not run off the glass, whatever position it is placed in. They are now transferred to the drying box. They will take from six to forty-eight hours to dry, according to circumstances. When dry, they are ready for use.

If a very rapid emulsion be desired, the boiling may be continued for from one to two hours, the emulsion, after washing, be rendered neutral or slightly alkaline by the addition of about twenty drops of the ten per cent. mixture of ammonia and water, and be kept for a couple of days before coating the plates. We would strongly advise, however, that the beginner confine himself to a slow emulsion.

ELECTRICAL ACCUMULATORS OR SECONDARY BATTERIES.*

By Prof. OLIVER J. LODGE, D.Sc.

(Continued from page 347.)

SO far we have investigated the amount of chemical action in a Faure cell, when a given current is passed through it; but though this is important it is by no mends all that we want to know, for the same chemical action exactly will go on in every cell through which the same current is driven, and the chemical work which a given current can do is, therefore, essentially unlimited. But, of course, the more cells we have in series, the more driving power—or electromotive force—do we require to send the current through them; and the chemical work that can be done by a given current generator is determined, therefore, by its available electromotive force and current strength conjointly. In this respect chemical work is precisely in the condition of every other form of work, and, in fact, it cannot be otherwise.

Consider now, as our source of current, a dynamo-machine driven with the horse-power P. Of this power some is wasted in friction and in churning the air; another portion is spent in warming the exciting magnets and armature, while the remainder, which we will call p, is available for maintaining the current through the external circuit. What fraction p is of P depends upon the perfection of the dynamo, and indeed the ratio $\frac{p}{P}$ may be called its efficiency. We may, perhaps, surmise that a probable value for this ratio is as much as ¾, but it is not likely to be more. To measure p, we have only to measure the electromotive force in volts between the terminals of the dynamo and the currents in Ampères, which it is at the same time producing in the whole outer circuit, multiply the two together, and divide by 746. We will, therefore, take p as a known quantity.

Now take N Faure cells and arrange them, n in series and m abreast, so that they are equivalent to n cells, each m times the size of a single one. Of course $m n = N$. Let the resistance of each cell with its connecting wire be r ohms—the resistance of the leading cables need hardly be taken into account if they are thick enough to keep cool—then the resistance of the combination of cells is $\frac{n r}{m}$ ohms.

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* Condensed from the *Photographic News*.

* From the *Engineer*.

To drive a current of C Ampères through this resistance would require an electromotive force $\frac{nr}{m}$ C volts, which we may write nrc, if we put c for the current passing through each of the m series of cells. But this electromotive force is not enough to maintain the current for more than an instant; for directly the cells begin to charge, they each exert an opposition force e, which must be overcome. This opposition e may or may not vary during charging; but it probably does not vary very much after the first hour or so, and it may be considered as not far off $2\frac{1}{2}$ volts. It can be measured by connecting an electrometer to the terminals of a charged cell momentarily disconnected from the charging circuit. No time must be lost in taking this measure, or its value will diminish, and if the cell is short-circuited it falls off rapidly—probably because of the consumption of the hydrogen alloyed with the lead. It is its maximum value which is active in opposing the charging current, and this it is which we agree to call e in volts. The whole set of cells will offer an opposition force ne volts.

If the cells are not uniform we must determine the *average* values of e and r, but there is every possible reason for turning out the cells from the manufactory as uniform as they can possibly be made, and afterwards keeping them uniform by subjecting them to precisely similar treatment. Hence, the practice of replenishing the power of a working battery by occasionally adding an instalment of fresh cells is not to be approved on a large scale, unless it is carried on with regularity, a fresh one being put on at one end and a comparatively worn-out one simultaneously taken off at the other by some automatic time-keeper.

It is well known in ordinary voltaic batteries that if any of the cells are different from the others in any way, we get all the disadvantages which such difference may cause, and scarcely any of the advantages; in other words, one extra good cell in a series of poor ones is lost, and its effect swamped; while a single bad one among good ones chokes the lot. It is only like the links of a chain after all. Any difference—whether in size, or weight of lead, or closeness of plates, or time of charging, or of standing, or of discharging, or any temporary short circuiting of one cell more than of others—if it can produce harm it will, but if it tries to do good it can't. Hence every difference should be avoided.

Well, we were going to write down the E.M.F. necessary to force the current C through each of the m series into which we have supposed our cells to be arranged while charging, and it is

$$E = ne + nrc$$

the first term overcomes the opposition electromotive forces, the second drives the current against the given resistance.

The whole energy expended per second is proportional to E and to the whole strength of current, C, or mc, and is

$$EC = mnec + mnrc^2$$

The first term represents the useful work done, or the energy expended in overcoming chemical affinities, and in storing the current; or at least it represents this on the hypothesis that all the chemical substances decomposed assist the storage by being ready to recombine and drive the current back again whenever called upon to do so, and not before. If the cells are allowed to evolve gas while charging, or to stand a long time after charging, these conditions are not fulfilled, and some of the $mnec$ is lost. Hence, in saying that $mnec$ represents the useful work, one means that it does so under the most favourable circumstances, or that it represents its maximum value.

The second term $mnrc^2$ is certainly all wasted and goes to warm the cells. The proportion between the waste and the useful is therefore $\frac{rc}{e}$; and this shows the great desirability of keeping the charging current c weak, as well as for having the cells large and of low resistance. The horse-power available as current we have supposed to be p, and $p = \frac{EC}{746}$; hence, we may write the foregoing equation thus (remembering that $mn = N$):—

$$Nc = \frac{746\,p}{e + rc}.$$

This represents the total amount of chemical action going on in all the cells put together, for the current c is passing through each, and chemical action proportional to c is going on in each, therefore the total chemical action is N c. Looking at what N c is equal to, we observe that p is fixed and c is beyond our control; so again we perceive that the only way of getting the most effect at the least cost is to keep rc small. Now the resistance of a large Faure cell and connections need not exceed, I suppose, ·002 of an ohm, and the charging current sent through it may be kept as low as 4 or 5 ampères if desired; hence, as the value of e is 2·5 about, it is quite possible to make rc almost wholly negligible compared with e. We shall thus get out of the given horse-power the greatest amount of chemical action per second that we possibly can, viz.:—

$$Nc = 746\frac{p}{e}$$
$$= 300\,p \text{ say.}$$

The equations of last week, expressing the amount of total decomposition on both sides of a Faure cell when a given current is passed through it, may be now modified to express the decomposition produced in a whole set of similar cells arranged economically and subjected to the utilised horse-power p for T hours, by simply writing in those equations $300\,p\,T$ instead of C T.

As far as here appears, the number of cells does not signify, for if more cells are used, less will be done in each, and conversely. But we have just seen how important it is to keep c small, that is, to charge with a very low strength of current; hence the more cells charged at once the better. It seems difficult to use too many. The limit in series is reached when ne is nearly equal to the highest possible electromotive force of the shunt dynamo—that is, the number n must not exceed two-fifths of the maximum electromotive force available, expressed in volts. But it may be nearly as great as this with advantage There seems no limit to m, the number of cells that may be joined up in multiple arc, and apparently the more the better. But the "lead" wires and the armature of the dynamo must be of very low resistance, or they will get heated if m is very large, even though c, the current through each set of cells, is small. Edison's bar armatures seem just the thing therefore, or some of those machines which are made for electroplating purposes. The wire on the field magnets should be very long, so as to magnetise them strongly without shunting off too strong a current, even though it is driven with the highest available electromotive force.

The highest available electromotive force is the difference of potential between the terminals of the shunt dynamo when they are disconnected from the external circuit, so that the whole of the current produced in the armature passes through the field magnets. There must be some connection between the resistance of the wire on the field magnets, and on the armature, and the number of cells which will give the most economical result, though it is not a relation that is obvious to common-sense; but it can no doubt be worked out if we set to it, and I will try next week. Meanwhile let us put in a convenient practical form part of the result of this week's article, viz., that if the best arrangement is adopted in every way, no waste being allowed, and no secondary or useless chemical action permitted, the total amount of any substance of "atomic weight" w and atomicity k that can be decomposed or liberated, as the case may be, by p horse-power utilised as current in any number of cells, each of maximum electromotive force e, is

$$\frac{746\,p}{e} \cdot \frac{w}{12000\,k} \text{ pounds per hour.}$$

which becomes for Faure cells, whose e is $2\frac{1}{2}$ volts,

$$\frac{p}{40} \cdot \frac{w}{k} \text{ pounds per hour.}$$

For instance, 2·8 p pounds of litharge can be peroxidised, and also reduced, per hour, by the horse-power p applied to this purpose and to nothing else. Of minium the amounts are 2·1 p reduced, and 4·2 p peroxidised; that is, 6·3 p pounds of minium may be acted on altogether under the most favourable circumstances. Thus, if 5-horse power are utilised as current, 31·5lb. may be acted on in an hour, or a ton in 71 hours. To form 120 cells, each containing 28lb. of minium properly distributed between the two plates, cannot take less than T hours, where $6{\cdot}3\,p\,T = 28 \times 120$; which for $p = 5$ gives $T = 106$. But if the cells contain 14lb. of minium on each plate they will take longer—viz., at the very least $800/p$ hours.

ALBUMINOID SUBSTANCES.

RECENT researches by M. Béchamp on albuminoid substances, form the subject of an instructive report by M. Dumas, drawn up in name of a Committee of the Paris Academy. The gist of it is as follows:—

Among organic substances are those designated by the common name of albuminoid or gelatine-yielding substances; the liquid and coagulable, as egg-albumen, blood-serum, plant-albumen, milk-caseïn; the solid, as blood-fibrin, fibrous matter of muscles; lastly, the tissues that can be transformed into gelatine, and gelatine itself, at once the most interesting and the least known. As they are neither volatile nor crystallisable, their determination presents the greatest difficulties. Thus, their specific characters have been little known, their elementary composition is puzzling, the products obtained from them by means of strong reagents are complicated, and attempts to represent their constitution by a formula have proved unsatisfactory.

There has been of late, however, such strenuous endeavour to understand these substances, and results so important have been arrived at, that we may regard it as possible, and even probable, that ere long the real constitution of the substances, and the accurate definition of their constituents, will be discovered.

Though these substances do not crystallise, though they are not volatile, and though, finally, they enter into no well-determined combinations with bases and acids, yet they have a characteristic whereby they may be certainly distinguished from other matters: this is the action which they exercise on the plane of polarisation of light-rays. By the study of this property of different albuminoid substances, M. Béchamp has been enabled to divide them into species, which, while not absolutely determinate and comparable to those presented by volatile and crystallisable bodies, yet, at least, offer the first important results with regard to an orderly distribution of these interesting products.

The importance of this inquiry appears from the wide distribution of these matters in the animal and plant kingdoms. And when one considers that the analyses of these substances have led to the conclusion that there are in their molecules no less than 500 to 600 atoms of carbon, hydrogen, or nitrogen, one perceives how widely these bodies are separated from those whose study furnishes the groundwork of organic chemistry.

The first task in study of this group of substances consists in splitting up of the mixtures found in nature, and isolation of the individual bodies having determinate characters, such as one may consider as specific and essential.

Egg albumen contains at least three substances: one is precipitated by basic acetate of lead; the second by ammoniacal basic acetate of lead; the third is not coagulable in heat, is soluble in water, and insoluble in alcohol, with the aid of which it can be separated from its aqueous solutions. The first two substances have the general properties of albuminoid substances; but the third belongs to the group of ferments, and liquefies starch. The rotatory power of these three products is, respectively, 34°, 52°, and 78° to the left, and M. Béchamp has studied the compounds they form with acetic acid and hydrochloric acid, in which case they behave as bases.

The ferment discovered in egg albumen explains some phenomena during the period of incubation. M. Béchamp was led to seek it in other albuminoid products, and a general idea of his researches may be had when it is stated that he has succeeded in splitting up all albuminoid matters into two or three definite substances which have the properties of albuminous matters, and into a well-characterised ferment. "Why," he asks, "are all albuminoid liquids accompanied by these ferments? What relation exists between the abundant, coagulable, animal matters, which seem meant to furnish material to the organs, and those ferments, present in small quantity, which imply the approaching destruction of the alterable compounds with which they occur? Whence come these ferments? Whither do they go? What *rôle* have they to fulfil? All these are questions undoubtedly of deep interest, for one observes the ferments in the blood-serum of all animals, in the white and yellow of eggs, and in milk,—*i.e.*, in all liquids destined for formation and renewal of our organs."

The property of blood-fibrin, made known by Thenard, of decomposing hydrogen dioxide and oxygenated water, M. Béchamp has been enabled to refer to a certain constituent of the fibrin—viz., to the granular insoluble residue obtained after treatment of the body with hydrochloric acid; the part that is soluble in the acid does not possess the property. This insoluble substance is still albuminoid, and it loses its power of decomposing oxygenated water on boiling in water, but retains it unaltered an indefinite time when kept cold *in vacuo*.

M. Béchamp further gives the results of his investigations in extraction of the best-defined substances from the following albuminoid bodies:—Egg-yolk, egg-white, milk, blood-serum, peas-meal, white mustard, chick-pea, nut, almond, gluten, flour, red-blood corpuscles, muscle-flesh, and the crystalline lens. Similar investigations are worked out in bone and cartilage, which yield gelatine and chondrin. Lastly, there is an enumeration of all ferments whose presence has been observed in the products named, with which they so often occur, and their properties are specified.

While M. Béchamp has been engaged in these labours, the albuminoid bodies have been carefully studied by M. Schützenberger and, subsequently, by M. Bleunard. These have coagulated egg-albumen, exposed it at high temperature for a long time to an alkaline base, and analysed the products. It is known that, under these influences, urea is transformed into carbonic acid and ammonia, and oxamide into oxalic acid and ammonia. The researches of M. Schützenberger have proved that albuminoid matters behave similarly, and take hydrogen from water, to give up the nitrogen as ammonia; on the one hand, more or less complicated acids are obtained, which remain in combination with the baryta used; on the other, ammonia and complex bases, arising from the splitting-up of the albuminous substances, and from the hydrogenation of the nitrogen compounds they contained.

There are, however (the report points out), some difficulties about this action of alkalies, as indicating the constitution of albuminous bodies: one connected with the condition of the nitrogren present; another with the fact that the experiments are with mixtures.

The view has long prevailed that urea is a product of the destruction of albuminous substances of the blood and the tissue, and that this urea represents either the last combustion-product of these matters through respiration, or that it is connected with successive decompositions of them by ferments. Both processes might lead simultaneously to formation of urea. However that may be, M. Béchamp was shown, long since, that the oxidation of albumen by means of permanganate of potash furnishes a certain quantity of urea. In the present memoir he has taken up the question again, and he shows that all albuminoid substances possess this property; he also indicates reasons why several chemists have not recognised this fact.

The Committee desired that the principal experiments and results described in M. Béchamp's memoir might be repeated in their presence, and they were able to satisfy themselves of their correctness by personal observation.

EDISON'S ELECTRIC RAILWAY.

THE bed of Edison's Electric Railway at Menlo Park is as yet unballasted, so that a ride over its two miles of length is productive of unpleasant jerks and bumps. From the building next to the workshop at Menlo Park, where the steam-engine and dynamo-electric machines are placed, a narrow plank walk leads across the field toward the woods in the rear. In this are the wires running from the dynamo-electric machines to the railway track, distant perhaps a quarter of a mile. Here the wires are noticeable, emerging from their casing and communicating with the rails. At first sight the track appears to differ from an ordinary railroad only in its gauge, which is three feet six inches. But a closer examination reveals three distinctive features. Where two rails meet they are joined together on the sides. On each side of the joint is a strip of copper, the ends of which are nickel-plated. Outside these strips are screwed on flat bars of iron, the inner surface being also nickel-plated. Thus the current of electricity passes uninterruptedly from rail to rail. As this cannot be done at the switches, however, thin plates of copper are placed underneath the ends of both rails, so that the circuit is not broken. The frog in the switches is left out of circuit. It is only about 3ft. long, and as the driving-wheel of the engine is 4½ft. in diameter the wheel passes over the frog with no perceptible interruption. Near the improvised engine-house, which stands a short distance above the point where the wires connect with the rails, and about a quarter of a mile from that end of the track, the one passenger car of the railway stood. The engine was running up and down the track, conveying Charles T. Hughes, the superintendent, and dragging a small platform car loaded with rails and ties. In appearance the engine is peculiar. If an ordinary engine were cut in two midway of the boiler, the forward half discarded, and the cab reduced in size, it would present a tolerably correct representation of the electric engine. Its length is 15ft., and the height to the top of the cab 9ft. Of course there is no smoke-stack.

When a reporter took a seat in the cab the flat car had been left at the lower end of the track. Mr. Hughes raised the lever of the armature switch and the engine started. The engine ran evenly at the rate of eighteen miles an hour. No arrangement had been made for running at high speed, as Mr. Hughes was using the engine simply in construction work, and it had been dragging loads of three or four tons. The four dynamo-electric machines at the central station were arranged in a multiple arc instead of in series, as is done to attain a higher speed. Two miles of the road have been completed, extending toward Plainfield, and a mile remains to be finished. At the lower end men were engaged in ballasting the track. The road runs from an engine-house over a trestle about 12ft. high, through a swamp, and then through some fields, where there are cuts. Thus far the engine has done all that was expected. Yesterday, and on several previous occasions, it has proved itself equal to the task of drawing loads as heavy as could be applied, considering the character of the road and rolling stock. On Wednesday, with the dynamo-electric machines arranged in series, it ran at the rate of 41 miles and 4,000ft. in an honr, the highest rate that has as yet been reached. The rate of speed is estimated by the number of revolutions of the armature in the engine. The engine can be readily started, reversed, and stopped. In the cab, where the steam gauge is placed in the ordinary engine, is the armature switch. Raising the lever sends the current into the armature of the dynamo-electric machine in the front of the engine. If the lever is horizontal the circuit is broken, and if the lever is pulled down the current is directed into the armature in such a way as to cause it to revolve in the opposite direction, and the engine consequently moves backward. Mr. Edison intends to use an electric brake, but at present, in order to stop, the circuit is broken and an ordinary brake applied.

In examining the engine more closely, the reporter found two sheet-iron doors in the sides of what appeared to be the boiler, so that an inspection of the interior was easy. In front is a dynamo-electric machine; running lengthwise are the two legs of a large magnet, and the remainder of the interior is occupied with shafts and belting. An interesting feature is the course of the current and its transformation into motive power. It is taken up from the rails by the rims of the driving-wheels, and passes through copper clamps to the hub. Rubbing against the hub is a copper brush at the end of a horizontal rod, which has the position of the connecting-rod of an ordinary engine. The current taken from the hubs of the driving-wheels by these brushes passes along the rods to wires which lead to the armature switch in the cab. From this switch the two wires are conducted to the armature of the dynamo-electric machine in front. This machine may be said to fulfil a double function—in absorbing and storing up electric energy as well as in developing it. When the armature and bobbins revolve the power is transmitted by belting around a pulley on the same shaft with the armature to a pulley on a shaft under the cab. Thence belting runs to a pulley on the shaft of the driving-wheel. From the armature wires two smaller wires run to the coils of the magnet placed horizontally in the engine. These are the field wires, and through them the magnet becomes charged with electricity, and exerts a controlling influence on the armature which receives the greater force of the current. Without this magnet the armature would receive the full power of the current and would become so heated as to be useless; but the electricity in the magnet, which can be increased or diminished at will, tends to draw the armature toward it, and in reality causes it to revolve.

The total weight of the engine is four tons. The road, three miles long, will soon be completed and ballasted. One central station for every ten miles of track is Mr. Edison's estimate, the current being sent through the rails for five miles on each side of the station. After elaborate calculations in the case of the electric motor as compared with the steam locomotive engine, Mr. Edison claims that the ratio of mean economy for both is 4 to 8·93, or $55\frac{2}{3}$ per cent. in favour of the electric engine.—*New York Tribune.*

THE RELATION OF APERTURE AND POWER IN THE MICROSCOPE.*

By Professor E. Abbe, Hon. F.R.M.S.

I.—General Considerations as to Wide and Narrow Apertures.

THE question of the relative values of high and low apertures has been much obscured by the one-sidedness with which it has been treated. One party of microscopists—the "wide-aperturists"—having recognised that high apertures are capable of exhibiting minuter details than low apertures, conclude therefrom that *all* microscopical work must be done with very wide apertures, and that low-angled systems are worthless. Another party, relying upon the fact that there are many cases in which low or moderate apertures perform decidedly better than wide ones, generalise this experience and deny that there can be any essential benefit in very wide apertures, asserting that all observations, with the possible exception of resolving diatom striæ, can be done as well with low-angled objectives. The premises of both these views may be said to be true, but true *under conditions* only; and by disregarding these conditions both parties arrive at conculsions which are equally remote from a proper estimation of the requirements of scientific work with the Microscope. [As some suggestion appears to have been made when the above paper was read as to my views having undergone a change, I beg to remind my readers that the views above explained are those which I have professed since 1873—the date of my first paper on the subject. My advocacy of wide apertures for *minute* objects appears to have been interpreted as an advocacy of wide apertures for all purposes—a misapprehension which I am at a loss to account for, as nothing I have ever said or written could justify any such a supposition. All the catalogues of Mr. Zeiss issued since 1872 give practical evidence of this, as the objectives there specified (and stated to be constructed according to my principles and under my direction) include no low and medium powers, *except with low or very moderate apertures.*—E. A.]

My view of the question is based on the following considerations:—

1. Every given degree of minuteness of microscopic detail requires a given aperture in order to obtain a complete (or perfect) image, i. e. an image which is a *true* enlarged projection of the structure, exhibiting all elements in their true form and arrangement. The minuter the dimensions of the elements the wider an apertures is *necessary*—the larger these dimensions the narrower an aperture is *sufficient.* Structures whose smallest elements are measured by considerable multiples of the wave-lengths of light are perfectly delineated with low or very moderate apertures, and their examination with wide apertures does not improve their recognition. On the other hand, if we are dealing with objects whose dimensions (or structural elements) are equal to a few wave-lengths only, even the widest apertures hitherto obtained will not afford complete or strictly true images, but will show these objects more or less incomplete or modified. This general principle holds good in regard to objects of every kind, regular or irregular, isolated particles or composite structures, because the physical conditions of microscopical delineation are always the same.

The obvious inference from this principle is that the widest possible apertures must be used for the observation of objects or structures of very minute dimensions, low and moderate apertures for relatively large objects.

It may perhaps be said that the objects of microscopical research do not justify such a distinction of large and minute, since the works of nature are always elaborated to the minutest details, all coarse objects being composed of smaller elements, and these of still smaller ones, &c. This is quite true in regard to the objects considered as natural things, but not as objects of scientific research. The interest of research is not always directed to the ultimate elements, but is as often confined to the consideration of the coarser parts, and in such cases the observer is not only allowed, but sometimes compelled, to disregard everything which is not connected with the scientific aim of his investigation. To observe every object in nature throughout, from alpha to omega, is the privilege of dilettante microscopy only, which has no distinct aim. There are many lines of the most valuable scientific research (e.g. the greatest part of all morphological investigations) which have not to deal with very minute things. This kind of work can be completely done with low or moderate apertures.

To recommend the application of wide-angled objectives for every branch of microscopy, as has been, in fact, done by excited wide-aperturists, is no more to be supported than it would be to recommend the use of a magnifier to a painter for inspecting the tree which he proposes to delineate.

According to what has just been said, the only benefit of greater aperture is that it is capable of delineating *minuter* things. Now minute dimensions require high amplifications in order that they may be enlarged to a visual angle sufficient for distinct vision. Low figures of amplification cannot render visible (at least not distinctly visible) details which are beyond a certain limit of minuteness. Even if they are delineated by the microscope, they would remain hidden to the eye for want of sufficient visual angle. It follows, therefore, that wide apertures will not be utilised unless at the same time there is a linear amplification of the image, at least sufficient for exhibiting to the eye the smallest dimensions which are within the reach of such an aperture. On the other hand, a high amplification will be useless if we have small apertures which delineate details of dimensions only capable of being distinctly seen in an image of much lower amplification. We have here an empty amplification, because there is nothing in the image which requires so much power for distinct recognition. In the first case (deficiency of power) the large aperture cannot show more than a smaller one; in the other case (deficiency of aperture), the high amplification shows no more than a lower would do. Consequently:—

> *Wide apertures when high amplification is required; low or moderate apertures when low or moderate amplifications are sufficient or cannot be overstepped.*

2. The utilisation of a given aperture depends in principle on the amplification of the *ultimate* image which is projected by the entire microscope to the observer's eye. Now one and the same amplification may be obtained in very different ways since it is the resultant of three distinct elements: (*a*) focal length of the objective, (*b*) focal length of the

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* From the *Journal* of the Royal Microscopical Society.

ocular, and (*c*) length of the tube. Any definite number of diameters (say 1,000) can be obtained with a low-power objective (say a 1in.) as well, from a mere dioptrical point of view, as with a higher power (say ⅛-in.), by applying a sufficiently deep eye piece and a sufficient length of the tube. It is, however, well known that there is a great difference in the optical qualities of images which are produced under these different conditions. Forcing a high amplification from a low-power objective is always connected with a considerable loss of sharpness of definition of the image, owing to the magnification of the residuary aberrations, which are inherent even in the most finished constructions. It is, therefore, a well-established practical rule that a certain amount of amplification requires a certain power of the *objective*—higher amplification a higher power (shorter focal length) —in order to obtain the image under these favour-conditions which are necessary for their full effectiveness. This considered, the inference of the foregoing paragraph may be expressed in these terms :—

> *Wide apertures with objectives of short focal length ; low and moderate apertures with objectives of low and moderate power.*

As a detailed discussion of this subject will be found in the second part of this paper, it will be sufficient here to point out some notable facts of experience by way of example only.

With objectives of, say, 1in., and ½in., focal length, the lower and medium eyepieces in use will yield 40-80 and 80-160 diameters only. In order to obtain 150 and 300 respectively, very deep oculars (or an extra length of the tube) would be required. So far now as such objectives are intended for the lower powers mentioned above, an aperture of about 0·15 (18°) in the case of the 1in., and of 0·3 (35°) in the case of the ½in., are at all events more than sufficient for showing every detail which can possibly be recognised by the eye under these amplifications, and therefore wider apertures are useless. In point of fact, no observer will see anything more or anything better with similar objectives of say 0·40 (48°) and 0·75 (96°) respectively, than with the narrower angles indicated above, as long as the low and medium oculars are in question only. These latter apertures would require for their full utilisation, i.e. for convenient observation of the minuter details which are within their reach, amplifications of much more than 150 and 300 diameters. With well-made objectives of those apertures, such figures may be realised indeed, and details may be shown by means of deeper eye-pieces, which remain quite invisible with the lower angled systems ; but no microscopist can deny the inferior quality of the images obtained in this way if compared to those of equal amplification, which are obtained with these same apertures when the objectives have double the power and the oculars the half only. Structures of so simple a composition as diatom striæ may perhaps be tolerably displayed under such forced amplifications of low-power objectives, but with objects of somewhat irregular and complicated structure the deterioration of the image attendant upon a considerable enlargement of the residuary spherical and chromatic abberations by deep eye-pieces, becomes at once obvious even with the most finished objectives. In point of fact, no experienced histologist will ever use in ordinary work even an ocular amplification of the amount necessary for obtaining 100 diameters from a 1-inch objective or 200 from a ½-inch. He would be unwise if he troubled himself with inferior images whilst good images of the amplifications required could be obtained with equal, or even greater, convenience with objectives of the same apertures but half the focal length.

The above is an example of waste of aperture, or lack of useful power ; waste of power and lack of aperture are exemplified by every objective of excessively short focal length, e.g. 1-50 inch. Such a lens, even if immersion, cannot be made with an aperture of much greater numerical value than 1·0, in consequence of the technical obstacles arising with such very short focal lengths. Now the limit of an aperture of that amount is entirely exhausted, at all events with a power of 1,000 to 1,200 diameters, inasmuch as nothing of the real attributes of an object can be seen with that aperture under a higher amplification, which could not be as well recognised under the lower. A 1-50, however, will yield 1,500-2,000 diameters with the lowest eyepieces which are usually employed. The lowest attainable power is, therefore, an empty power already, and every useful amplification available with the aperture in question could be obtained under favourable conditions and with much less inconvenience by an objective of half the power, or even less.

3. The preceding shows that wide apertures can only be utilised in the observation of minute details, under high amplifications obtained with objectives of short focal length. Wide apertures are therefore useless when those conditions are not fulfilled, because in this case the same result could be obtained as well with low-angled systems. But as abundance *primâ facie* is no detriment, the foregoing considerations do not enforce any positive objection to the use of the wide apertures for every kind of work. There are, however, other points of view from which it becomes obvious that the application of wider apertures than can be utilised is not merely superfluous but is a decided disadvantage, inasmuch as they prevent the utilisation of some really valuable benefits which are the privilege of low and moderate apertures.

The first disadvantage results from the reduction of the depth of vision (or the "penetration" of the Microscope) which is connected with wide apertures. I have given in another place* a discussion of the circumstances on which penetration depends, and the formulæ which afford an approximate numerical estimation of the depth of vision in microscopic observation. These theoretical suggestions show (in accordance with the experience of practical microscopists) the reduction of penetration with increasing aperture under one and the same amplification, and especially when the amplification is not restricted to very small figures. Now there are many objects of microscopical research which do not require, and, indeed, do not even admit of high powers ; but demand for effective investigation as much penetration as possible. This is always the case where the recognition of *solid* forms is of importance, and, therefore, a distinct (at least a tolerably distinct) vision of different planes at once must be possible, whether the observation is assisted by stereoscopic devices or not. The greater part of all morphological work is of such a kind, and in this line of observation, therefore, a proper economy of aperture is of equal importance with economy of power.

(*To be continued.*)

ON THE PHOTOGRAPHIC SPECTRUM OF COMET (WELLS) I., 1882.†

By WM. HUGGINS, F.R.S.

ON May 31, I obtained a photograph of the spectrum of this comet, with an exposure of one hour and a quarter. On the same plate I took a spectrum of α Ursæ Majoris for comparison. The comet's spectrum on the plate consists of a strong continuous spectrum extending from about F to a little beyond H. I am not able to distinguish any of the Fraunhofer lines in this continuous spectrum The slit was rather more open than was the case in photographing the spectrum of the comet of last year; this would make these lines less distinct, but the lines G and H are well seen in the star's spectrum taken under the same conditions. We may, therefore, conclude that the part of the comet's original light which gives a continuous spectrum is much stronger relatively to the reflected solar light in this comet, than was the case in the comet of last year, and for this reason the Fraunhofer lines are not distinguishable.

Observations of the visible spectrum had already shown that the comet differs remarkably from the hydrocarbon type common to all the comets, some twenty, which have appeared since spectrum analysis has been applied to these bodies.

The photographic spectrum shows, as was to be expected, that this essential difference of spectrum exists also in the more refrangible region. The very strong ultra-violet group assigned to cyanogen is not to be seen on the plate, and the bright groups between G and *h*, and between *h* and H do not appear to be present.

The head of the comet was in sharp focus upon the slit, and the continuous spectrum with defined edges corresponds to the nucleus which in this comet was very distinct. In this continuous spectrum at least five separate places of greater brightness are seen, which very probably represent groups of bright lines, though they are not sufficiently distinct in the photograph to admit of resolution. That this interpretation is correct, seems probable, from the circumstance that these groups project beyond the strong continuous spectrum on one side. This side corresponds to where the light of the coma, on the side of the nucleus next the sun, falls upon the slit. We learn, therefore, that the light of this part of the coma consists for the most part in this part of the spectrum of these groups, as here on the plate only an exceedingly faint continuous spectrum can be seen.

It is not possible to measure with any useful accuracy the beginnings and endings of the groups, as they are too faint at these points. Measures as accurate as the circumstances would permit have been taken of the brightest parts of the groups. The wave-lengths of these brightest parts are :—
λ 4253
λ 4412
λ 4507
λ 4634
λ 4769

In the visible spectrum, the bright lines of sodium appear to have been strong, and it may be that some of the light of some of the groups may be due to this substance.

Prof. A. Herschel and Dr. von Konkoly showed long ago that the spectra of the periodic meteors are different for different swarms, and it does not seem surprising that we have now a comet, the matter of the nucleus of which under the sun's heat shows an essential chemical difference from the long series of hydrocarbon comets which have appeared since 1864.

Mr. Hind has kindly furnished me with the distance of this comet from the sun at the time the photograph was taken. The comet was then 42,380,000 miles distant from the sun, while the comet of last year was 69,420,000 miles when I obtained the photograph of its spectrum.

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* See *Transactions*, Vol. I. (1881), p. 689.

† Substance of note read before the Royal Society, June 15, 1882.

SCIENTIFIC SOCIETIES.

THE METEOROLOGICAL SOCIETY.

THE closing meeting of this Society for the present session was held on the 21st inst., at the Institution of Civil Engineers ; Mr. J. K. Laughton, F.R.A.S., President, in the chair.

The following papers were read :—

I. "A new Metal Screen for Thermometers," by the Rev. F. W. Stow, M A., F.M.S. This screen differs from the ordinary Stevenson in the following respects : 1. It is somewhat larger ; 2. It has a single set of double-zinc louvres ; 3. It is partially closed at the bottom to cut off radiation from the ground. The advantages claimed for the use of zinc louvres are : 1. The conductivity of metal causes the heat derived from the sun's rays to be distributed over every part of the louvres ; 2. The louvres being much thinner than those of wood, the circulation of air through the screen is not only much greater absolutely, but much greater also in proportion to the bulk of the louvres ; 3. The zinc louvres, therefore, are much more sensitive to changes of temperature than wooden ones. Comparative readings of thermometers in this screen, along with those in an ordinary Stevenson screen, were made during the summer of 1881. From these the author is of opinion that the Stevenson becomes unduly heated when the sun shines ; but this may be as much due to its small size as to the material of which the louvres are made. The thermometers in it are only 3in. to 5in. from the louvres at the back of the screen against 7in. to 8in. in the zinc screen. The roof, too, is single, and the box is open at the bottom. The author also says that there is no need to condemn all wooden screens ; but there does seem to be some reason to think that screens with metal louvres might be better.

II. "On the Effect of Different Kinds of Thermometer Cribs, and of different Exposures in Estimating the Diurnal Range of Temperature at the Royal Observatory, Cape of Good Hope," by David Gill, LL.D., F.R.A.S. Meteorological observations were commenced at the Cape Observatory in 1841, when the thermometers were placed in a well-ventilated crib, before a south window, through which they could be read. The buildings were unfortunately burnt in 1852. A small wooden house, with double roof, and affording a free passage of air, was then erected on the site of the old meteorological observatory. The instruments were placed in the middle of the building, and observations were recommenced on the same plan as before, and continued until the end of August, 1858. On September 1st, the thermometers were transferred to a crib erected in front of the S.W. window of the transit circle room. This crib is well ventilated, except on the side next the transit-room window; but the great mass of solid masonry in the immediate neighbourhood of the thermometers appears seriously to affect the range of temperature. For many years a Glaisher stand has been in use, and at the end of 1880 the author caused a Stevenson screen to be erected in its immediate neighbourhood. In this paper, the author gives results of observations made in the window, Stevenson and Glaisher screens, during the year 1881 ; from which it is evident that the exposure of the thermometers in the window crib gives a distinctly smaller, and on the Glaisher stand a larger, daily range of temperature than in the Stevenson screen.

III. "Some Account of a Cyclone in the Mozambique Channel, January 14th, 19th, 1881," by C. S. Hudson.

IV. "Rainfall of Frere Town, Mombassa, East Coast of Africa, 1875–1881," by R. H. Twigg, M.Inst.C.C., F.M.S.

Analysis of Arguzoid.—The following figures are the result of an analysis by Herr Hans von Jüptner of "arguzoid" :—Tin, 4·035 ; lead, 3·544 ; copper, 55·780 ; nickel, 13·406 ; zinc, 23·198 ; iron, trace. Its density is 8·109.

SCIENTIFIC NEWS.

THE death is announced of Dr. Hjaltelin, the distinguished physician of Reykjavik, so well known to all scientific explorers of Iceland.

The *Daily News* correspondent at Maritzburg reports the observation of a brilliant comet near the sun.

The bright line of sodium seen by several observers in the spectrum of Comet Wells has been traced by Dr. Hasselberg, of Pulkowa, to some distance in the tail.

The new Egyptian Minister of Public Works, Mahmoud Pasha Fallaky, is the director of the Cairo Observatory, and was specially deputed by the Khedive to observe the recent total eclipse at Sohag.

Prof. Johnstone Stoney gave, at a recent meeting of the Royal Dublin Society, an account of some experiments made by his son to determine, by means of indicator diagrams, the energy employed in driving a bicycle. The machine was an 'Xtraordinary, one of the upper links of which was replaced by a spring, a board carrying a paper being so placed that a pencil indicated the difference of pressure on the pedal. Prof. Stoney and his son have travelled about 2,000 miles since the beginning of the year, and the average amount of muscular energy required is found to be equivalent to 7·3 foot-pounds per minute, a great difference being found between rough and smooth roads, mud and stones, up-hill and down, and with or against wind. Experiment has shown, according to Prof. Stoney, that there is no actual dead point in the machine.

Mr. B. H. Thwaite, F.C.S., suggests the formation of a British Society of Textile Industry, on the model of that at Mulhouse, which has undoubtedly had a beneficial influence on the industries of Alsace. Such a proposal needs only the support of some of our influential manufacturers to become an accomplished fact.

The Royal National Lifeboat Institution, having, during the past 20 years supplied first-class aneroid barometers to its different stations with a success that has been highly encouraging, has determined to offer similar instruments at a small cost to owners or masters of fishing vessels. As the sole object of the Institution is to benefit fishermen, the instruments can be obtained only by bonâ-fide owners or masters of fishing vessels.

Dr. W. B. Carpenter is to deliver the next Lowell Lectures in Boston, for which purpose he will soon visit the United States, and extend his journey to Canada.

From Mr. C. V. Shadbolt, of Beechcroft, Chislehurst, we have a photograph taken from a balloon, at an altitude of 2,000ft., last Whit-Monday. The spot depicted is a little north of Stamford-hill Station, and the photograph, which in parts is sharp and distinct, shows the junction of the Enfield branch of the Great Eastern with the Tottenham and Hampstead line.

M. Louis Clerc's "Lampe Soleil" was exhibited on Saturday last in the vaults beneath the Royal Exchange. This lamp, it will be remembered, is a combination of the arc and incandescent systems, two short carbons of large section being inclined to one another at an angle of about 40°, with a piece of white marble held in a fireclay block in such a manner that it becomes incandescent through the heat emitted by the arc. The carbons and marble will, it is said, last for 30 or 40 hours without renewal, but the chief claims made for the lamp are that the light is soft and agreeable, while the absence of mechanism renders it the perfection of simplicity.

The Committee of the London and South-Western Railway Institute and Club purpose holding an Industrial and Fine Art Exhibition during September next. The Exhibition, which is "under distinguished patronage," will be on the same lines as that held at Westminster, and as the Institute possesses in its rooms at Brunswick House, Vauxhall, and the Lecture-hall adjoining, ample space for the display of exhibits, there is reason to hope that the exhibition will be highly successful. Forms of application and particulars may be had of the Secretary of the Institute, Brunswick House, Vauxhall, S.W.

A prize of £2,000, open to all, has been instituted by the French Government, to be awarded to whoever, in the course of five years following July 1 next, invents the most useful application of the Volta pile.

It has been lately proved by MM. Bichat and Blondlot that the plane of polarisation may be rotated by action of the current of discharge of a Leyden jar. A transparent body (heavy flint or sulphide of carbon) placed between a polariser and analyser, had a coil round it through which the current passed, and (the apparatus being arranged for extinction of the light), there was a sudden reappearance of light at each discharge. The authors analysed the phenomenon thus: A small mirror was rotated on a vertical axis before the optical apparatus, and the image in it of a vertical slit in the polariser, was watched through a telescope at each discharge. One thus sees a series of broad luminous bands, with narrower dark bands between, quite recalling the phenomenon observed with the light of the spark. In the latter case the discharge is known to be oscillatory, the bands corresponding with alternating contrary currents; and it was proved in the other case that the plane of polarisation is subject to successive contrary rotations; it oscillates about the normal position. (On turning the analyser one way certain images brighten and others fade, while the opposite rotation gives opposite effects.) Further experiments by a very sensitive method proved that the electrical and optical phenomena are simultaneous.

The wire rope railway system of Bleichert, of Leipsic, has lately been applied in Istria between the coal-mines of Vines, at Albona, and the small harbour of Rabaz. This is one of the longest lines of the kind in existence. Its total length is nearly four miles (6,100 metres), with a descent of about 753ft. (The greatest rise for the loaded waggons is 15 per cent., and the greatest descent 26 per cent.) The intervals between the supports vary between 66ft. and 500ft. The line crosses some roads, two streams, a cascade, and the head of a bay. The driving machinery is placed about the middle of the line; it serves only to set the line in work after long rest. During work, the motive force of the down-going loaded waggons suffices to draw up the empty waggons. The line is constructed for a daily despatch of 5,000cwt. The loading and unloading is done automatically. Before the terminal station, the waggons pass a steelyard. Three other lines, on the Bleichert system are being made on Austrian territory. The line at Aich (Carlsbad), constructed four years ago, is in constant work, and is said fully to meet requirements.

A new form of telephone, recently patented in Germany, is the Schward-Scharnweber telephone. (It is figured in the *Zeits. für Ang. Elect.*, No. 2, 1882.) A long, flat horseshoe magnet has, at the open end, four small iron cores, with conically wound coils round them, fixed with screws within it, so that the ends of the cores are close to the membrane. The ends of the coils are so connected that the induction currents strengthen each other. At the bend of the magnet a circular spring tends to press the magnet towards the membrane, and a screw fixes in any given position.

In a recent note to the French Central Society of Horticulture, M. Boizard recommends the vaporisation of tobacco-juice for destruction of insects in hothouses—a method he has successfully practised three years. A little of the juice is boiled about two hours over a small fire, then water is added, and the liquid boiled more energetically, till all is vaporised. No injury was observed even in the tenderest plants, such as *Adiantum*, *Blechnum brasiliense*, &c.; but if such be feared, while yet insects have to be got rid of, one may guard against too strong action by syringing (*bassinant*) during the operation. Flowers of orchids, &c., may be protected, if this be thought necessary, with paper-bags. Some of the insects fall on the ground, and one need not trouble about those remaining, for they are dead. The plants thus rid of insects are exempt from attacks for six months, at least as regards kermes and coccus. Pucerons, acarids, and thrips return sooner, and one must operate oftener for them; but less vigorous treatment will do. It is essential that the temperature in the hothouse be as low as possible. M. Boizard suggests that the method might be applied in open air, the vapour being distributed through a tube.

A series of experiments have been made by Herren Wolffhügel and Von Knorre with a view to explaining a fact observed by Koch, viz., that oil-solutions of carbolic acid are far inferior to aqueous solutions, of the same concentration, in disinfectant action. For a disinfectant to have full action, it must be able to fully penetrate the object treated; and water, by virtue of its greater capillarity, has doubtless the advantage over oil in this respect. Again, it was observed that carbolic acid was more freely given up by carbolic oil in water than by carbolic water in oil. This may be accounted for by the greater solubility of the acid in oil. How far this peculiarity of oil, and its less tendency to penetrate porous solid bodies and to mix with liquids, is to be regarded as the cause of the inactivity of carbolic acid in oil-solution cannot yet be measured, since one cannot tell how oil and water behave with regard to giving up carbolic acid to minute organisms. The authors consider, however, that oil should not, in general, be used as a solvent for carbolic acid where one aims at killing, within 24 hours, fungi adhering to water-containing bodies, solid and liquid, whether as spores or bacilli.

The French Meteorological Expedition to Cape Horn, recently organised, may be expected to make important additions, not only to meteorological, but to other branches of science during its year's sojourn in those inclement regions. Full directions as to meteorology are given in a paper by M. Angot (*Comptes Rendus*). The expedition will have a complete series of registering apparatus (for some instruments two series), so that direct hourly observations are considered unnecessary. Six a day will be sufficient, and the order is indicated. Among other matters, special attention is to be given to austral auroræ when they occur (a good many have been observed at Cape Horn); by means of photographs, sketches, measurements, &c., the phenomena will be fully observed. It may be here mentioned that while the French Transit Commission gave up the island of Cape Horn in the extreme south (though the most favourable from an astronomical point of view), on account of the uncertainty of the weather, and have fixed on the entrance to the river Santa Cruz, in Patagonia, instead—they have recognised the value of the opportunity this meteorological mission affords, and urged that instruments for observation of the transit on Dec. 6th, be supplied to its members.

The temperature which seems most favourable to the bacterium of the disease called *charbon*, is that of mammalia (37° C.). Birds, having a higher temperature (about 42°), do not take the disease under ordinary conditions. M. Pasteur, however, has developed it in fowls by lowering the temperature (keeping the feet in cold water). M. Gibier has now experimented with frogs, and finds that they "do not suffer after inoculation in the normal state; but if kept, after being inoculated, in water at about 37°, they may take the disease (five out of twenty did—most of the others died soon after immersion). The bacteria developed were remarkable for their great length, and this is attributed to the slowness of the circulation.

There has been a falling-off lately in the attendance at technical high schools in Germany. The number of students has diminished from 6,433 in the winter session of 1877-78, to 3,900 last winter; or 60 per cent. This is partly accounted for by the depressed state of industry; but, according to Prof. Grasshof, there is a superabundance of academically-educated engineers (*Techniker*), which has also, doubtless, to do with the result. The estimated annual number of these in demand in 1875 was 660; to this a total number of 2,300 students would annually correspond, and the number might be raised to 3,000, on including foreigners. Thus even the attendance at present is about 900 over the actual requirements. Prof. Grasshof thinks there are too many technical high schools in Germany—six would suffice—and too few technical middle schools.

IN districts where water is largely impregnated with lime iron tubes will not answer for locomotives.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

COMETS AND A COMMITTEE—MOTION OF SIRIUS—FORECAST OF STORMS—SUNRISE AT STONEHENGE ON THE LONGEST DAY—PROJECTING SOLAR ECLIPSES—DURATION OF AN ECLIPSE OF THE SUN—ζ HERCULIS—THE PEDOMETER—VIEWING THE SOLAR PROTUBERANCES—THE COMING TRANSIT OF VENUS.

[20212.]—Once more, I should like to ask "Penelope" of the *Birmingham Weekly Post*, the gentleman who "does" the science for the *Leeds Mercury* (or, in fact, any of the "good advertising mediums" of the Sunspot and Meteorological quackery) for information. Here we have had two large comets in perihelion within a comparatively few days of each other, and, coincidently with this, as cold and bitter a June as I remember—the Atlantic being crowded with icebergs, and snow having fallen in Scotland only last Monday! How is it, then, I would ask, that these two visitants of our system have so hopelessly failed to exert "considerable influence on the sun"? and that neither separately nor in conjunction have they "stirred him up, excited him, as it were, to action, and moved his latent heat and fire into unwonted energy"? Or, possibly, some member or members of the Brummagem "Committee," who investigate "Solar Physics" (for the benefit of one or more of their own number at Brompton), will supply this information, and so make a show of earning a part of the annual £500 of which the national pocket is picked for the maintenance of a wretched sham.

In reply to the question of "Paugul" (letter 20157, p. 328), the revolution of Sirius round a distant companion—or rather, as he says, about their common centre of gravity—supplies the only feasible explanation of the curious change in the observed direction of its motion with reference to the Earth.

I do sincerely hope that no one will follow the advice given by Mr. Gardner in letter 20163 (p. 329), and "look at Dr. Herschell's Weather Table" at all. It is a compilation of utter trash, and was repudiated by Sir William and Sir John Herschel successively. Moreover, as an illustration of the trustworthiness of your correspondent's own rules, it may suffice to note that we have had wind and rain enough, and to spare, at the beginning of June this year, instead of at the end of it. No one living can predict the weather in these Islands 48 hours in advance; and no vaticination of meteorological change for that or any longer period is worth the ink it is written with.

Mr. Stooke (reply 47032, p. 336) will find that the Sun will rise at Stonehenge on the longest day 39° 24′ 34″ to the North of East. I must invite his attention to the caution given to "Neo" in my letter (20150) on p. 326, should he employ a compass to determine this point.

I may tell "A. B." (query 47177, p. 339) that Loomis's "Practical Astronomy" does not give the means of finding the true time of New or Full Moon, but that it does give detailed and illustrated directions for graphically projecting the phases of a Solar Eclipse for any given locality. The method of constructing the maps of the passage of the Moon's shadow over the Earth, which are found in the *Nautical Almanac*, is very fully described indeed, in Chauvenet's "Spherical and Practical Astronomy."

"A. B." (query 47180, p. 340) should always mistrust the statements of Dr. Lardner with reference to astronomical facts when they are either uncorroborated by or opposed to the assertions of recognised authorities on that subject. Keith is correct as to the maximum duration of total darkness during a Solar Eclipse at the Equator. The famous Eclipse of August 17, 1868, was total in India for a little less than 7 minutes. It is the longest one of which any record exists.

I cannot help thinking that Mr. Herbert Sadler somewhat over-estimates the present distance of the components of ζ Herculis, in letter 20179 (p. 349). It will be observed that Mr. Muschamp Perry's measurement of this star, made as late as May 31st of the present year (letter 20181, p. 350), shows the stars to be only 1″ apart; but this estimate certainly errs in defect as much as Mr. Sadler's does in excess. I must persist in the belief expressed on p. 326, that 1·4″, or thereabouts, will be found to represent the present distance of this star very nearly indeed.

The Pedometer, concerning which "Don Carlos" puts query 47210 (p. 363), simply registers the numbers of steps, or movements of the body, made by the wearer. If, for simplicity's sake, we conceive the possessor of a pedometer to take a step of exactly one yard in length, then, by pushing the regulator either to the right or to the left, he makes 1,760 beats of the pendulum register one mile upon the face of the instrument—and so on. Obviously, though, if he were to make 1,760 vertical jumps, always alighting on the identical spot whence he started, his pedometer would record a mile, albeit he had never really advanced the fraction of an inch.

Mr. Loftus Wylde (query 47252, p. 364), will scarcely obtain any apparatus "at an accessible price," for directly viewing the Solar protuberances on the uneclipsed Sun; inasmuch as the only means of so viewing them is by the aid of a spectroscope of very great dispersive power, and by opening the slit widely when the red or blue parts of the Spectrum in which the well-known hydrogen lines are situated are in the field. Under such circumstances, a red or blue image of the prominence will be visible. The red end of the spectrum is that most frequently used for this purpose; and the eye should be further defended by a dark glass transmitting light of the same refrangibility as that emitted by the protuberance. In saying this, I am, of course, speaking of seeing the Solar prominences in their entirety. The way in which they are ordinarily observed is by the aid of the spectroscope, with a very narrow slit, which exhibits the bright lines of their component gas or gases superposed on the ordinary continuous spectrum. The star spectroscope made by Browning, the optician, answers excellently for this purpose with a small or moderate telescope, if such telescope be only equatorially mounted (so as to keep the image of the prominence sensibly stationary on the slit). My querist may study Proctor's little shilling book on "The Spectroscope," published by the Society for the Promotion of Christian Knowledge, with advantage.

Apparently "A Constant Reader" (query 47258, p. 365) does not regard the determination of the distance of the earth from the sun as of any "real practical value." Considering the fact that this distance is the unit of all astronomical measurements, supplies the sole means of determining the scale on which the solar system is built, and furnishes the solitary method of ascertaining the distance of the fixed stars from our system, astronomers, rightly or wrongly, regard an accurate knowledge of the solar parallax as of the greatest possible importance. As the time for the occurrence of the next Transit of Venus approaches, I will, with the Editor's permission, give some details as to the preparations for the observation of, and the method of observing, this phenomenon. This, however, can scarcely be done in a single paragraph in a hurriedly-written letter.

A Fellow of the Royal Astronomical Society.

ζ HERCULIS AS A TEST FOR 3¼IN. TELESCOPE.

[20213.]—Allow me to thank "F.R.A.S." and Mr. Sadler for the information they have been good enough to give with regard to the distance of the components of ζ Herculis.

I think it cannot fail to strike your astronomical readers, in connection with the question of the aperture necessary to divide certain difficult double stars, that it is quite useless to lay down any hard-and-fast rule in connection with this matter.

I think this is clearly shown by referring to some of the correspondence that has appeared in your journal during the past two years in connection with ζ Herculis.

For example, in your 31st Vol., p. 382, Mr. Sadler proposes this object as a proper test for a 3¼in. telescope; and, again, in your 32nd Vol., p. 278, Mr. Gardiner, a gentleman residing in the State of New York, actually states that he *has* divided this star with a 3¼in. object-glass. It must be noted, however, that Mr. Sadler assumes the distance of the components at that epoch (about 1880·49) to have been 1·5″; and if this had been actually so, there would have been nothing very remarkable either in Mr. Sadler's having proposed this star as a test, nor in Mr. Gardiner's having divided it. But it now appears (see Mr. Sadler's letter 20179, p. 349 of your current number) that in the middle of the year 1880 the distance was only 1·31″, and, therefore, beyond the reach of a 3¼in. aperture on theoretical grounds.

The next letter to which I would beg to call the attention of your readers is one written by your esteemed correspondent, "F.R.A.S.," which appeared on page 59 of your 32nd Volume, about three months after the date of Mr. Sadler's communication, above referred to.

Commenting on Mr. Sadler's letter, "F.R.A.S." expresses it as his opinion that no telescope of 3¼in. aperture could possibly divide this star at the time he wrote (1880·73), and in support of this opinion quoted his own failure to do so, using a very fine Dallmeyer achromatic of 4⅛in. aperture, power 400.

It appears from the above that, if Mr. Gardiner was not mistaken about his having actually divided this star with 3¼in., Dawes' rule, $\frac{4\cdot56}{\text{aperture}}$, is, in certain cases, not reliable. Again, that "F.R.A.S.," who, we all know, is an observer of great experience, should fail, about the same time, to divide this star, using a telescope of undoubted excellence, and the object being theoretically well within the grasp of his instrument, also tends to show the impossibility of laying down any fixed rule on the subject.

Referring to what Mr. Sadler says (letter 20179, page 349 of the current volume) as to the visibility of the *comes* of this star with a smaller aperture than 4in., I took the opportunity of a clear sky last evening (June 23rd) to test the question experimentally, with the following results:—4in. Cooke achromatic, power 225, aperture reduced to 3in. by a stop; *comes* just visible with close attention, and about in contact with the disc of primary. I then tried a 3¼in. stop, which made the *comes* rather easier, and gave a clear separation of the discs. The present distance is, however, according to Mr. Sadler, 1·55″, and therefore the above observations agree very well with the accepted theory on the subject. Had the distance been only 1·31″, I feel quite sure I should not have been able to detect the *comes* with a 3¼in. aperture. I am, therefore, forced to consider Mr. Gardiner's observation as a very remarkable and unprecedented one.

In my opinion, a close and rapid binary like the one under discussion is a most unsuitable one to be quoted as a test: at one time it is beyond the reach of a 4½in. telescope, and in a couple of years it can be divided by a 3in. Many beginners are unable to obtain the latest measures, and are, therefore, quite unable to judge as to what their instruments should show them at any particular epoch.

David Simms.

Limavady, co. Derry, June 24.

P.S.—Under date July 9th, 1876, in Canada, and using a 4½in. "With-Browning" reflector, I have noted this star as pear-shaped, with power 280.

WELLS' COMET.

[20214.]—Mr. Lane, in his interesting letter 20180, states that by the application of the graphical method he has seen reason to believe that a sensibly brusque change in the orbit of Wells' comet took place about April 23rd, and that such change would long remain undiscovered by the mathematical method. Now, in this latter assertion I cannot agree. Whatever accuracy the graphical method may possess, the mathematical must possess still more.

Such an alteration as Mr. Lane suggests can only be demonstrated by means of the mathematical method, carefully applied, making it clear that the path before and after April 23rd cannot be included in the same orbit. If Mr. Lane should do this, he will, I believe, be the first to point out the actual existence of anything of the kind.

I quite agree with Mr. Lane that such a change is quite possible from more than one cause as regards comets, and even—although to a less extent, owing to their small surface—planetoids may be found some day to exhibit such changes; perhaps also the major planets. **W. C. E.**

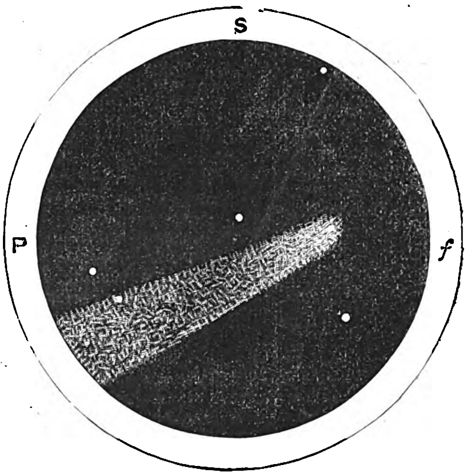
[20215.]—Being away from home for some weeks, I have not received my English Mechanic regularly, and, therefore, have been unable to reply to the remarks made by several correspondents with reference to my sketch of the comet as seen on the 13th May (letter 20037).

I think I can best reply to all by furnishing another sketch made on the night of the 20th May, when I had a most beautiful view of this interesting object.

Your valued correspondent, "F.R.A.S.," letter 20088, very justly remarks that my illustration, as it appears in the engraving, exaggerates the visible breadth of the coma in proportion to its length. It assuredly does so in a very disappointing manner. The fine shading off is utterly lost. Placing the nucleus on the edge of the field, I was able, on the 20th May, to trace the coma across the whole field of view, but so beautifully and so finely shaded off that I greatly fear be impossible for the engraver to do it justice in a wood-engraving.

May I take this opportunity of stating that a letter written to me from Oxford on this subject was accidentally destroyed before it came into my hands, and that, in consequence, I have not been able to reply to it? I very much regret this seeming want of courtesy on my part. **S. Mills.**

6, St. Mark's-road, St. Helier's, Jersey, June 19.



AN ENGRAVING-MACHINE.

[20216.]—SEVERAL years since a correspondent of the ENGLISH MECHANIC re-asked for the description of a machine for engraving. Frequent attacks of illness, and other circumstances, have prevented me from replying to the inquiry till now. About 60 years ago I constructed a simple apparatus of the usual kind, for taking silhouettes—viz., a brass rod passing through gimbals, and having at one end a wire for tracing over the profile, and at the other a pencil for drawing the silhouette on a piece of paper fixed to a hinged support, having a spring at the back to insure contact. This apparatus I converted, in 1872, into a somewhat rude machine for engraving. I forward a description and photographs for insertion in the ENGLISH MECHANIC, which may perhaps meet the wishes of your inquiring correspondent.

Fig. 1 is a photograph of one end of the machine, having a back or frame in which the words or figures to be copied are slipped. The figures, &c., are written on cardboard. This back is hollowed so as to curve the card according to the radius of the rod, and thus in some degree, at least, in one direction, to compensate distortion. The frame can be adjusted by the dovetail slide, so as to bring the tracing-point nearly into contact with the figures.

FIG. 1.

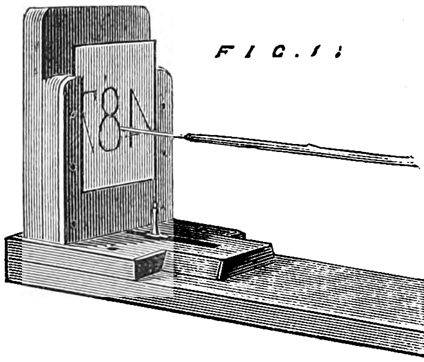


FIG. 2.

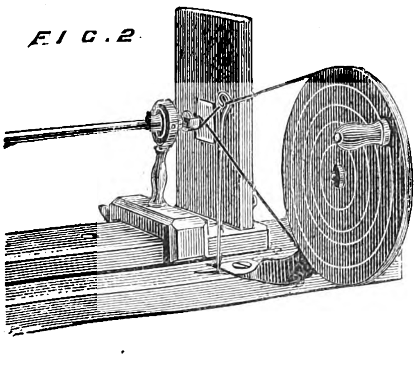
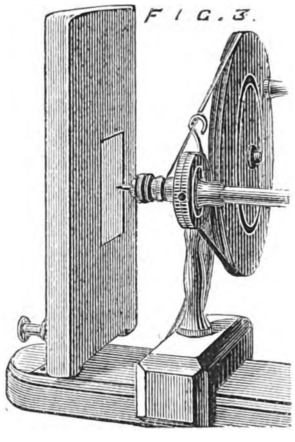


Fig. 2, which is supposed to be separated from Fig. 1 at some distance, in order that the representation may not be too large for your page, is a photograph of the other end of the machine, showing the rod passing through the gimbals, and carrying a small pulley and drill fixed to it by a brass frame. The pulley is, of course, driven by the large wheel and cord. The seal or metal, &c., to be engraved is fixed to a hinged back, and is kept in contact with the drill by the action of a spring behind.

Fig. 3 shows the drill and pulley, &c., on an enlarged scale, and from the opposite side. The length of the rod (staircase wire) which I have used is 2ft. 9in.

FIG. 3.



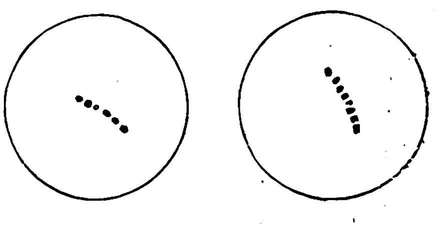
With this I forward a specimen of the work done by the machine, and also a zinc plate engraved by it, for the editor's inspection, to show the capability of so simple an apparatus. The elaborate and effective engraving machines of various makers are probably known to your readers. They are, in fact, pantagraphs, with attached drill. Your readers will also be aware that the exquisite microscopic engravings on glass by Peters are produced by a modification of the old silhouette tracer. In connection with the above subject, I may add that a simple, though rude, substitute for a pantagraph may be constructed on the above principle by merely supporting a light rod of wood (an arrow, for instance) on a pointed wire driven into a board, the rod having a tracer at one end and a pencil at the other. The subject to be copied is to be fixed to the cover of a book and brought into contact with the tracer by its weight, thus in some measure correcting distortion, at least, in one direction. The paper to receive the copy is also fixed to the cover of another book, and then in like manner meeting the pencil. An elastic band over the rod where supported by the pointed wire will prevent it from slipping.

N. S. Heineken.

TUBERCULOSIS.

[20217.]—As the bacillus of tuberculosis is engrossing such general attention at the present time, I send you the inclosed note and pictures (drawn with a camera from the microscope by Mr. Edgar Thurston), in the hope that, if published, they will interest a number of our readers.

The resolution into distinct beads, alluded to in the note, is an original observation. The lens was specially constructed for me by Messrs. Powell and Lealand, for the purpose of investigating micro-organisms, and may fairly rank as the greatest achievement in the science of microscopical optics.



The fine adjustment to the substage, referred to in the note, will be found most useful by those engaged in observations with wide-angled high powers.

THE ROYAL SOCIETY, Burlington House, June 21st, 1882.—Tubercle bacillus, showing beaded structure, from human sputum, × 2,300 diameters. Oil-immersion objective, by Messrs. Powell and Lealand, 1-25th, N.A. 1·38 (130° in glass). Microscope stand has a fine adjustment on the substage.

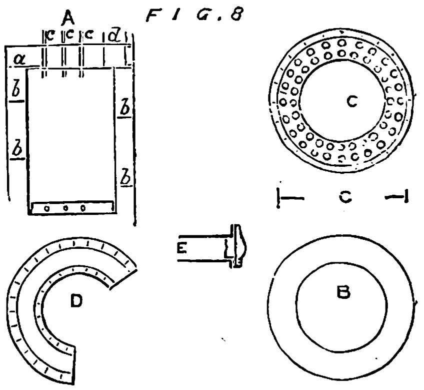
Edward M. Nelson.

THE TURKISH OR HOT-AIR AND VAPOUR BATH, AND THE SCIENTIFIC PRINCIPLES ON WHICH IT SHOULD BE CONSTRUCTED.

(Continued from p. 356.)

[20218.]—I REMOVED the cover of the large drum and fitted the small one inside it, so as to place it in the centre and have a space all round it. It only differed from Griffin's hot-air bath by being of a different shape and being constructed of different material. To keep the inner one in its place, I got a piece of thin sheet-iron, such as is used for making stove-pipes, and cut out of it a disc a little larger than the diameter of the larger drum, and out of the centre of it I cut out a circle 1½in. less in diameter than the smaller drum. This is so far illustrated in Fig. 8, A and B. My next step was to cut the edge of the large disc through, as shown on C of same figure, and to turn these snips alternately up and down; and by bending them out and in the disc was made to fit the inside of the outer case tightly. The next step was to rivet it to the bottom of the small chamber. Out of the same iron I cut three or four segments of rings, which, if complete, would have exactly fitted into the space between the two drums. These, as shown on Fig. 8, D, were rather over three-quarters of the circle. By placing them at equal distances apart, arranged so that the spaces in the ring left deficient, should always be over a portion that was perfect, they acted as checks to the passage of the heated air and products of combustion, and caused them to circulate round the inner chamber and heat the air contained in or passing through it. The outer surface of the big drum also yielded heat to the room in which it was placed by radiation. The disc at top, which I riveted to the top of the inner chamber, had a number of small holes punched in it. I next cut a hole 3in. in diameter in bottom of the outer drum—or, I might say, the top as it now

FIG. 8



A, two drums, one inside the other; △, inner chamber; *a*, iron disc shown in plan by C in situ in section; *b*, portions of rings shown in plan by D in situ; *c*, tubes through which the pure heated air escapes, shown also Fig 12; *d*, hole with flanged pipe to take stove-pipe; *f*, furnace, detail shown on Fig. 11; C, perforate iron disc; B, iron disc, before fitting and perforating; D, sectional stops to make air circulate round inner chamber; E, tube fastened in wall to take stove-pipe high up in bath-chamber.

stands in Fig. 8, and to it I riveted a gas-pipe of that diameter with a flange on it, which I also picked up for a few pence at the old iron-store; this was for fitting a 3in. stove-pipe, which served to convey the foul air and products of combustion to the chimney of the room through a hole made for that purpose through the wall. This hole was fitted with a similar flanged pipe, into which a plug, with a turned ornamental cover, fitted when the stove-pipe was removed. In rooms without a fireplace this could be passed through the outer wall.

I shall now describe my furnace, which I constructed out of an old gas-stove (see Fig. 9, A). I used it for long with the ring burner B; but after a time I removed the old ring burner and substituted for it one of Bunsen's burners as made by Griffin, and illustrated in Fig. 2 (974). I fitted the rose portion of this burner on an iron chamber, which fitted into the centre of the old gas-stove. This casting I made out of a casting from a pattern of my own invention, by which I was enabled to place the rose burner referred to in the centre, and when I required extra heat to light from one to three Bunsen burners with single flames, so arranged as to converge, and send a large volume of heat into the space between the two chambers. It soon burnt away the cover of the inner drum, into which I had fitted bent iron pipes, through which the fresh air from without was conveyed by connecting them by indiarubber tubes with the iron pipes, illustrated in Fig. 6, B.

FIG. 9

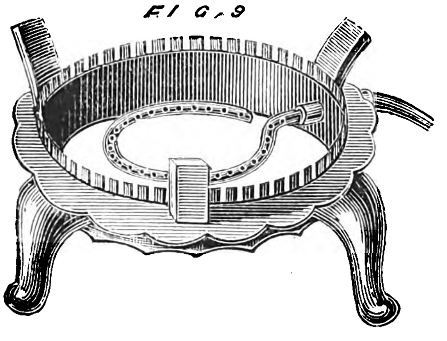
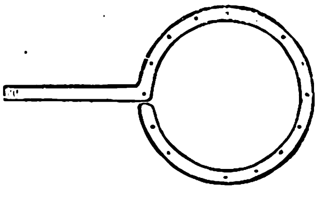


Fig. 9b.



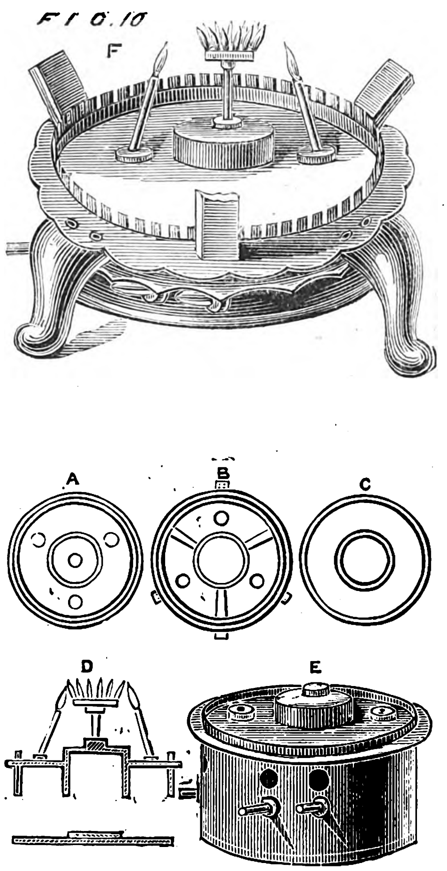
In Fig. 10 is shown the iron casting which made the chamber for the four burners. It was made in two parts, so that I could turn up the faces true in the lathe, and fit them together gas-tight. Each of the four burners had a separate supply of gas. With it any amount of heat could be procured; but I fancy it was very wasteful of gas, as during the time it was used the gas-bills were much higher than usual.

I have already stated that the bottom of the inner chamber soon burnt out. I replaced it with an iron casting which I had cast on three pieces of iron tube ¾in. in diameter. These were arranged parallel to one another across the casting, the upper portion of which was turned to fit tightly in the inner drum or chamber. It is illustrated in Fig. 11. A is a plan showing how the tubes were arranged; B is a plan showing its appearance from inside, and the holes for admitting the fresh air.

Through its inner surface I bored inch holes into each of the iron pipes through which the outer air passed into the chamber. This casting and its pipes could be made nearly or quite red-hot, but it should not be so—a lower heat is sufficient; it heated the air as it passed through. The stove-pipe had a damper for regulating the current, as the rose burner could be used alone with the smallest row of beads of gas visible, or with 12 large flames, and could also be supplemented by the three single-flame Bunsen burners, any heat from the mildest warmth to a heat far too intense for a bath could be produced at will.

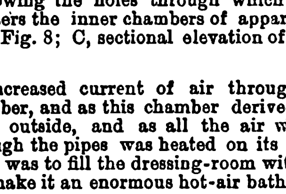
Having provided for the supply of pure air, I attached a long stove-pipe to the upper end of the outer chamber; this I led into the chimney of the room, as will presently be described, it acted like the chimney *c''* when fitted on *a* in Griffin's apparatus, already described and illustrated. The air which had warmed the inner chamber as it rushed through the chimney, created a draught which carried away the impure air of the dressing-room. As the doors and windows were carefully stopped and padded, the effect of this was to create an increased current of air through the inner chamber, and as this chamber derived all its air from outside, and as all the air which passed through the pipes was heated on its passage, the effect was to fill the dressing-room with heated air, and make it an enormous hot-air bath.

FIG. 10



A is a plan of the top of the gas-chamber, looking down on it, showing the four bosses to be drilled for the burners. B is a plan of the same from below, showing how the cylinder was divided into four separate chambers, so that each Bunsen burner might have its separate supply of air and gas; the bosses to be bored for the supply-tubes are shown (*a*). C is the plan of the lower casting, which fits into B; its section is shown at E. D is a section of upper casting, showing how the burners were fitted to it. E, elevation of compound burner, shown in section and apart in D. F, compound burner, fitted to gas-stove complete.

FIG. 11.



A, plan of furnace through which the air passes to be heated in part section, showing tubes imbedded in casting; B, inside view of casting showing the holes through which the hot air enters the inner chambers of apparatus, see △ of Fig. 8; C, sectional elevation of furnace.

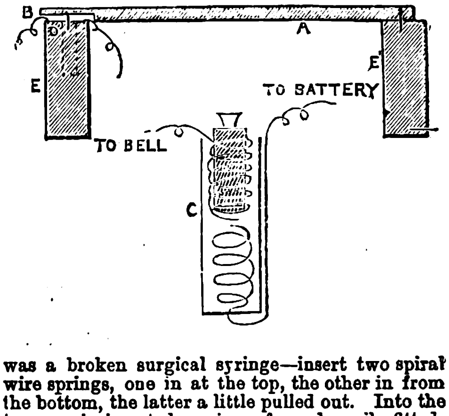
Gereb Admi.

(*To be continued.*)

BURGLAR-ALARM PLATFORM.

[20219.]—I see that you notice in the Mechanic of the 16th a recent American invention, called a "burglar-alarm platform." I have had one in operation for some months, which is satisfactory, details of which might be of use to some of our readers, the mechanism being very simple and compact.

At the parts of the room required for alarming the burglar, a plank is taken up, and a piece cut off the length of the distance between two, or three, or more joists, with 3in. or 4in. extra. This piece, A, must be cut so that each end rests on a joist; it must be planed down at the side a little, so as to fit in easy, one end to be cut down as shown in sketch at B. I take a glass tube, C, nearly 4in. long, and, say, 1in. diameter—mine was a broken surgical syringe—insert two spiral wire springs, one in at the top, the other in from the bottom, the latter a little pulled out. Into the top one is inserted a piece of wood, easily fitted, with a screw to regulate the movement of the higher spring. A hole is made in the joist E with a centre-bit 1¼in. diameter and 4in. deep, in which is fixed the tube C. The action is as follows:—On the floor being depressed by a person stepping on it, the screw which should be touching the floor underneath is pressed into the tube, the pencil of wood attached to it pushing the spring down, making contact with the lower spring, causing a bell to sound, which, if made continuous-ringing, will be an efficient burglar-alarm. This alarm is very easily made, and not liable to get out of order, the two springs reducing disarrangement of those parts to a great degree.



J. W. Fisher.

A DOUBLE TRICYCLE.

[20220.]—I would by no means advise "A Littlemore Mechanic" (letter 20177) to construct his tricycle to carry the riders abreast. This method, I think, will prove itself unsound, and quite go out, except for machines to carry four persons.

I have an idea as to the position of a second rider which I could scarcely state at length in these columns, but shall be glad to hear from "A Littlemore Mechanic" at my address here.

Winslow, Bucks. **W. H. French.**

GAS-ENGINES—ELECTRO-MOTORS.

[20221.]—I have chosen the subject of gas-engines in order to show to our two correspondents who have made calculations on my projected electro-motor, that they may be quite right "according to Cocker," and that yet, when an experiment is made in a different way, they may find out that their calculations have only been dealing with part of the truth. Let us assume they are testing power of a certain sized cylinder as a gas-engine. A proper amount of gas and air is admitted, and then exploded; they find this equal to so many pounds lifted so many feet high, and adding power lost by friction, might say this was one horse-power, and quite right too, as far as the truth had been ascertained on the matter. Let, now, the gas and air, previous to explosion, be compressed to a certain degree; they would then find (after deducting the power used to compress), that instead of one horse-power, three horse-power had been developed. But where has this power come from? At all events, we may be satisfied that that power had been latent in the gas and air; otherwise it could not have been given out. But our first experiment did not develop all the power existing in the mixed gases, neither can we measure the possible extent of power therein, until the utmost possible extent of compression is ascertained also. Then again, take chloride of nitrogen: here, to make this, we place a jar of chlorine gas over a solution of chloride of ammonium; the gas is absorbed, and a drop of liquid like oil is found to have formed. Take this, touch it with a certain substance, a most fearful explosion ensues, and no compression has been used. Now calculate the value, in power, of the two ingredients, used in the way of ordinary combustion; how small a fraction would it be of the explosive power referred to? So much for calculation. It seems to me not unlikely that substances containing nitrogen will yet furnish "the power of the future" under proper management; for explosion is supplementary to the ordinary calculations on combustion.

To return to the electro-motor, all I contend is, that to use the direct power of the electro-magnet (if practicable), must be more economical than part of the power delegated to an armature, or other extraneous body of iron.

Barry-road, S.E. **J. H. Huxley.**

VARIATIONS OF SPEED ON STEEP GRADIENTS.

[20222.]—The following timings of two of the up Midland expresses during last summer may prove of interest, as showing the difference of the running of a heavy train up steep gradients as compared with that of a light train, and the slight variation in their times down bank. From Luton the driver of the light train had time well on hand. Like many other correspondents, I should be glad if "C. E. S." could see his way clear to give us a diagram of the gradients on the Midland, and if you, Sir, would let it appear in our columns.

Booked Time.

Leaves Leicester.. 6.32 p.m.
Arrives St. Pancras 8.40 p.m.

Heavy train drawn by two engines = 17 or 18 at least.

Leaves Kettering .... 6.17 p.m.
Arrives Kentish Town. 7.42 p.m.

Light train not = 12 coaches.

Miles to London.				
99	Leicester.. leave....	6.50.30		
72½	Kettering pass ..	7.24	Kettering leave..	6.18.8
64¾	—	31.22	—	27.37
58¾	—	39.16	—	35.10
55¾	—	45.50*	—	39.30
49¾	Bedford..	52.50	—	46.40
41¾	Ampthill.	8. 4.25	—	56.25
30¼	Luton....	19.35	—	7. 9.40
21½	Harpenden	25.43	—	16.55
20	St. Alban's	30.45	—	21.50
15	Radlett ..	35.20	—	26.50
12½	Elstree ..	38.15	—	29.53
9½	Mill Hill..	41.27	—	32.54
7	Hendon ..	43.41	—	35.10
3½	Finchly-rd	47.20	—	38.38
1¾	—	49.40	—	40.48
Stppd at St. Pancras		8.52.35	Stpped at Kntsh Tn	7.41.15

* Stopped 50secs. at 58¾.8—2½min. lost in all.

V.

MEDICAL REPLIES.

[20223.]—(17212 and 47237.)—Each querist will probably find help from five drops of "Fowler's solution" taken in water twice a day (after the first and last meals). The drops must be measured accurately, and if the medicine disagrees, it must be left off. Otherwise it may be taken for some weeks, until disagreement occurs, or the disease is relieved. "Whitesmith" should eat less flesh food, and more vegetables.

(47224).—Probably a form of rheumatism of the tendon or bone, which will be relieved by taking five grains of iodide of potassium, and five grains of bicarbonate of potash twice a day in water.

Deafness (47239). — Unless querist has an accumulation of hardened wax in his ear, he had better put up with his infirmity. The best treatment for hardened wax is first to soften it, and then to wash it out with a finely-pointed syringe, so held as not to injure the membrane of the ear, which is stretched across the bottom of the passage like the head of a drum. To soften the wax use a mixture of half sweet oil and half paraffin lamp-oil, and instil ten drops into the ear every night for several nights running. Follow this by syringing out the ear with comfortably warm soap and water before going to bed. The passage of the ear should be quite clear down to the membrane, which is nearly an inch inwards from the external level, and can be distinctly seen like a disc of thin parchment when the ear is held gently open, and a good light falls into the passage. This is practically all that can be usefully said in regard to deafness and noises in the head, and cases not curable by skilful syringing after softening obstructing wax, rarely get much benefit from medical treatment. It is most unlikely that querist will get, by coming to London, any benefit which cannot be given by one of the best doctors in Worcester.

Weakness (47253). — Querist is probably a nervous, worrying fellow, much given to introspection and thinking of his ailments. Among such patients, there is a regular class who may be described as "worriers"—people who, although there are always plenty of other people to worry them, must take to worrying themselves and worrying every one around them. Such men are never any good until they stop reading medical books, and what they call "studiousness," and take to methodical, thorough-going *work*, and "do something." Many such men have a propensity for preaching; others—who have not time or strength to keep their own business going, to insure their lives for their families in case of their own premature death, or to build themselves up a permanent and comfortable home, instead of making the Sunday a "day of rest," can not be content without figuring in some didactic office on that day, instead of fitting themselves by rest and recuperation for doing their next week's business like model citizens. Read Carlyle, and avoid running to wind and tongue. Querist used "diagnosis" where he should use the word *description*, and this is a symptom of just that kind of "studiousness" which tends only to muddle-headedness.

James Edmunds, M.D., &c.

Grafton-street, Bond-street.

WILDBAD AND ITS CURES IN THE BLACK FOREST.—II.

[20224.]—To-day I am face to face with phenomena which entirely baffle my reason. Here is an instance. A man, wounded by a bullet, which was extracted, complains of much pain and distress in the healed region. Like many thousands, he bathes in these hot springs. After a time, the old cicatrice, or scar, dissolves; forth issues, in due time, a small piece of cloth which had been buried a long time in the flesh, and carried in by the bullet. What charm is this? How can the waters summon the old wound to reveal its secret, and dislodge the enemy? Why should diseased bones be often cured in the hospitals here, the huge swellings of chronic gout and rheumatism disappear, lameness from accidents be relieved, paralytic feet be recovered to such an extent, that Wildbad is seriously named the "cripples' bath"?

During the years 1840–1873, the number of baths given to poor visitors alone amounts to 447,642, of which 175,200 were taken in 1869. But in the year 1871, after the Franco-German war, 26,154 were administered; so that, including soldiers' baths, the free baths amount to 661,379. A fair argument for the goodness of the State arrangements, and the rare utility of the hospitals here.

One of the most interesting institutions of the place is the Herrn Hilfe (Herrnhilfe). Here, such a collection of pitiable objects I have never seen in the English hospitals. Most of them appear at once to my eyes utterly hopeless. I have the reports before me. Taking the year 1869 at random, there were, during the season, 161 patients of these—most of them—dreadful cases; 34 remained no better, 19 were cured, 23 greatly benefited, 85 much better.

The kind of cases were such as these—boys, girls, and women (avoiding technical terms):—

General weakness, scrofula (local), general scrofula, diseased bones, rickets, chronic disease of the joints (some rheumatic), enlarged throat, foot paralysis.

I shall now attempt to give some recent examples, which I have gathered either from the persons themselves or from their friends.

1. A gentleman had been afflicted with a stiff neck the whole winter, which resisted every remedy. Coming to Wildbad, *three baths* entirely cured him. (A case of local rheumatism.)

2. A lapidary had so violent a rheumatic swelling in both legs (to use his own words) he feared they would burst. This case was, doubtless, rheumatic gout. The Wildbad course entirely relieved him.

3. Mr. Robertson informs me his right foot and ankle were enormously enlarged with a similar attack. His Edinburgh doctor ordered him to Wildbad, with a most successful result.

4. A young lady was here totally lame from paralysis of the lower limbs, somewhat emaciated from long illness, and suffering. Mrs. M., of Frankfort, now here, informs me she was perfectly restored here; and the last time she saw her she had married, become tall, stout, and robust in a marvellous manner.

5. A gentleman is now here who is a walking marvel. Some years ago, when about twenty-one, he was struggling in play with a comrade at an open window some 10ft. above the parterre. He was suddenly thrown backwards, bent his spine over the sill, and toppled over into the garden. His injuries were severe, his limbs were paralysed; he lay helpless in bed for many months. He was brought to the Wildbad baths, and was almost completely restored; married the daughter of one of the leading physicians here, and is, indeed, quite a walking advertisement for the place.

I am informed by Dr. B., who resides here, that a very severe case of eczema, in which the leg and ankle were enormously swelled, and which had resisted all previous treatment for three years, was cured by the baths in less than a month. He partly attributed this result to the purity of the water containing so little salts as four grains to the pound. The result of twenty-seven years' experience here (he says) is very much in favour of the efficiency of the baths in cases of broken bones united, but attended with stiffness and pain—in all kinds of wounds, especially of a military nature, and in every case of chronic rheumatism, causing pain and stiffness. I could easily multiply recent cases of relief, but these are a very fair sample.

I have already detailed a few cases descriptive of the type of disease adapted for a trial of these baths. I shall now briefly recount what some other physicians have observed:—"Wildbad is to Schlangenbad what the reality of a place is to its panorama." . . . It is superior to most of the principal Spas of Germany in the beauty and romance of its environs. . . . Nature has done everything for the invalid in this Spa."

Dr. Granville relates: M. Berchthold, 26 years of age, after a severe fall, experienced an affection of the right hip. Four months afterwards, excessive pain accompanied his walk with crutches. In five months he could not press upon his heel, but in thirteen he experienced the most dreadful sufferings. The second bath at Wildbad caused him pains in the loins, the third increased it to excess; he was compelled to leave the bath and be placed in bed. In a few minutes a great sense of coldness was followed immediately by copious warm perspiration around the hips. In an hour he left his bed without a stick, free from pain. Herr Berchtholt now walks upright and straight, as though nothing had happened. He relates another. (Be it remembered his expenses at Wildbad were only eleven shillings and fourpence.) Cases of this kind must then have been very plentiful. I was returning from visiting the Royal Chambers. I addressed a lady with whom a boy of 14 years was walking slowly, with a hope that the invalid might derive all the benefit she could wish. Yes, truly she replied, "Mon fils vient de jeter ses béquilles aujourd'hui même; we are in high spirits. . . The physicians at F—— looked upon him as lost. . . I have reason indeed to bless these baths, and I am happy. . . . Il etait perdus de tous ses membres, et le voilà maintenant qu'il se promener!"

G. W. Royston-Pigott, M.D., F.A.S.

(*To be continued.*)

MR. WASSELL'S SPECULUM TESTING.

[20225.]—So many able writers have touched upon this subject, that it would be presumptuous in me to take up your space by more than a few remarks. I have been employed for many years in making specula, and for a long time felt the great need of just such a friendly union of talent and experience as Mr. Wassell has collected, and which I look upon as a remarkable instance of the *chivalrous spirit* an esteemed contemporary (*Musical Opinion*) has said the English Mechanic has done so much to foster among its readers.

I have tested my specula in every conceivable way, but have found the one mentioned by Mr. Bell as the most reliable. I am also quite of his opinion that an exquisite figure can only be obtained by a kind of intuition which is the result of long experience, rather than by any mathematical formula, though I do not underrate the advantages derivable from having a correct formula to start with, feeling as I do that if I had had the same advantages as will shortly be within the reach of our readers, it would have saved me years of uncertain plodding. It is, therefore, with great pleasure that I send a 6in. speculum for Mr. Wassell's examination, and wish him every success in his meritorious endeavour to place a reliable formula within the reach of amateurs.

D. Richards.

132, Duke-street, Liverpool.

MR. SCOTT RUSSELL AND THE VIENNA DOME.

[20226.]—In reply to letter 20206, page 357, I may say that I feel very much surprised indeed by the conclusion arrived at—viz., that expansion and contraction are to be disregarded, as far as relates to atmospheric changes of temperature. I can state as a fact that when the first railway was laid down in Australia, from Melbourne to Geelong, that the rails were laid as is usual in this country, and when the sun shone upon them they expanded immediately, and having no room, some bulged inwards and others outwards, and the engine speedily got amongst the sleepers; the rails had to be almost all lifted, and space left for expansion. I am also confident that I read in the *Glasgow Mechanics' Magazine*, years ago, that the Britannia Tubular Bridge across the Menai Straits expanded and contracted no less than 11in. between summer and winter. But I think that it is easy to understand that in the case of a dome, the principal expansion would be upwards, and not outwards. I suppose that the writer is aware that it would be a very risky performance to go into a smithy early in the morning (before sunrise), and to pick up a bar of iron from the floor and attempt to straighten it by blows without first taking the chill off it, and that said bar could be proved to be shorter before it was warmed, which can easily be—Q.E.D.

June 23. **J. J. A., Liverpool.**

CHIME-CLOCK MAKING.—II.

[20227.]—The frames being mounted, we will next proceed to make the weight-barrels. These are each formed of stout tubing, 1½in. long and 2in. diameter, with caps to fit in each end. These caps have flanges cast on them, rather larger than the inside of the tubing, to allow for turning true when attached to the arbors. The arbors are made of 5-16in. round steel, roughly filed up to an octagon for about 2¾in. of their length; drill three of the caps truly with the flanges, using a drill that will allow the octagon portion of the arbor to be driven tightly into the caps. Centre the arbor, and set them as true as they can be got; turn the flanges to fit the tubing, the ends of which should also be turned true; drill the three remaining caps, and turn their flanges to fit tubing. These caps will form the ratchets for winding, and should be much thicker than the front ones. The barrels may now be put together, and pins put right through the tubing and flange to secure them. It is also advisable to run some soft-solder in to insure all being fast together; next put the barrels in the lathe and turn the whole true. The barrels are now ready to be grooved for the line, and the ratchets cut. The grooving may be done in a screw-cutting lathe or fusee engine. They will each require 16 turns for eight days, and are best cut with a left-handed thread, so that the weights may be out of the way of the pendulum when they are nearly down. The ratchets are, of course, best cut in a wheel-cutting engine. When this is not practicable, they may be cut with a three-square file, no very great accuracy being necessary, providing the click gets fair hold of each tooth. The teeth must be cut so that each barrel winds the same way that the hands of the clock travel. Having completed this, pivot the barrels into the frames, allowing a little end-shake between the shoulders of the pivots and the frames. The barrels for the hour and chiming-trains must be pivoted-in so that there is room between the caps on the winding end of barrel and the frames for the wheels next above them; but the going-barrel must be pivoted close up to the front frame to allow of the centre and third wheels being put behind the great wheel. Leave the front or winding ends about ¼in. diam., and 1½in. long.

The wheels and pinions are next wanted. The sizes of wheels may be taken from Fig. 1 (that has been reduced by the engraver to one-third the full size). The numbers of the teeths are as follow:—

Hour.			Going.			Quarter.		
144	pin.	12	144	pin.	12	144	pin.	12
80	,,	10	80	,,	10	80	,,	8
72	,,	8	75	,,	10	72	,,	8
56	,,	8	30 'scape			56	,,	8
8 pins in pin-wheel.						nut of 40 on chime-barrel.		

We shall also require a wheel about the same size as the pin-wheel of 80 in the hour striking train, cut with 78 teeth, to carry the locking-plate; also a brass pinion with 8 teeth to drive it.

W. Baldwin.

110, Richmond-road, Dalston, London.

ON THE FLOW OF WATER FROM A PIPE WITH A FLAP.

[20228.]—Trusting that a few further remarks upon this subject will not weary your readers, I venture to put the observations contained in my last communication into more of a mathematical garb, assuming, as the cause of the phenomenon, atmospheric pressure on the inner surface of the flap.

We will first consider case (1), and find an expression for the horizontal thrust of atmospheric pressure necessary to move the flap through a given angle (θ).

Let W represent the weight of the flap, and T_t the tension at the hinge. Then the tension at the hinge, when the flap is drawn out of the vertical through an angle θ, will be, $T_t = W / \text{sin.}\ \theta$. Resolving this tension into its two components, we have a horizontal thrust, $T_h = W \text{ sin.}\ \theta / \text{sin.}\ \theta_1$, where θ is an angle made by the flap with a horizontal line. If θ_{11} be the angle made between a line tangential to the curved surface of the water and the flap, we have for the atmospheric thrust, $T_a = W. \text{ sin.}\ (\theta = \theta_{11}) / \text{sin.}\ \theta_1$.

By applying these formulæ to the case in question, I obtained for the atmospheric thrust a pressure of 58·32lb. This result, it will be seen, does not tally with that stated in my last letter (which should be 570in. lb., and not 5·70lb.); but it must be remembered that in the present instance the pressure merely represents the actual force necessary to move the flap through a given angle, the force being supposed applied at the bottom, whereas in the former case the force was supposed to be distributed over the surface. This, doubtless, accounts for the variance.

Case (2) was that in which the flap was in contact with the water, and did not alter its position on the pressure being removed. There is nothing phenomenal with regard to this, as it may be attributed to molecular forces, which we will call T_c. In case (3) the flap was pressed close to the mouth of the pipe, and, on pressure being removed, returned to the same position as in (2). In this case there must be the inequality,

$$T_c \text{ cos. } \alpha > \left\{ \frac{W. \text{ sin. } (\theta - \theta_{11})}{\text{sin. } \theta_1} + I \right\}$$

where α is the angle of capillarity, as we may suppose the tension acting *ap* the flap, and I the moment of inertia of the flap, which, by using the notation of the integral calculus, is, $I = \int\int x^2 . dxdy$. (*Vide* Rankine's "Applied Mechanics," &c.)

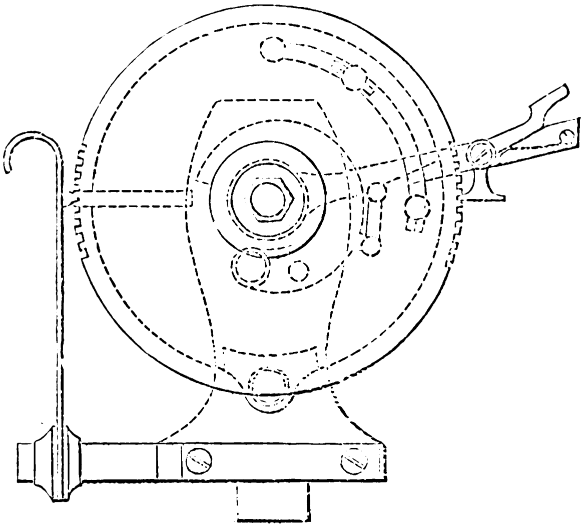
Case (4) can be accounted for in the same manner as (1).

C. H. Romanes.

Worthing, June 20th.

AUTOMATIC COUNTING APPARATUS.

[20229.]—The sketch represents the end-view of the Automatic Counting Apparatus, one-fourth actual size. The care and attention necessary in counting with the division-plate and spring-index pointer is familiar to all using the lathe for ornamental purposes; and many a beautiful work has been seriously damaged, or entirely spoiled, by an error in fixing the pointer in a wrong division, either through defective light, interruption, or other cause. To remedy this, various contrivances have been had recourse to, but all have failed in one respect or another. I have recently made an apparatus, designed by a member of the Amateur Mechanical Society,* and exhibited at the last Conversazione of the Society, which most completely effects the desired object of rendering an error impossible.



The apparatus consists of a sleeve fitting on to the mandrel, on which a handle moves freely. To it is connected a lever, acting on another forming a large portion of a circle. The latter, when at rest, is eccentric with the axis of the mandrel, but becomes concentric when the straight lever is pressed on. A wheel, accurately divided, also fits on to the sleeve, and is secured by a washer and nut; into the wheel gears a pawl connected to the handle. Against the lathe-head is a disc carrying two stops: on the one the handle rests, and by the other the required number of divisions is regulated. A detent, connected with a spring, fits into the space between the teeth, and keeps the whole perfectly steady.

In using the apparatus, all that is necessary is to raise the handle till the pawl drops into the required division, then to bring the movable stop on to the handle and fix it. Before depressing the handle the lever is pressed down, by which the detent is released from the wheel, and the whole moved downwards till arrested by the other stop, when the detent automatically falls into the proper division of the wheel, and the mandrel again becomes fixed.

The great advantage of the apparatus is that in working it is not necessary to look at it after it has been set, and the handle can be raised and depressed without the position of the lathe being changed. Mr. Ashton has since added two other levers, the one counting backwards, the other counting either way; but in the latter the detent is let into the divisions of the wheel by releasing the lever, and does not drop in automatically as in the others. Wheels of any number of divisions may be made, but one of 120 and another of 96 will accomplish nearly all that is required. I have also made from the design of the same gentleman a universal cutting-frame requiring no guide pulleys: it takes a much deeper cut than others, and will cut into shoulders and angles.

Henry S. Frost,
Engineer, Lathe, and Tool Maker,
45, Mortimer-street, Cavendish-square, W.

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* Mr. Ashton, of Park-square.

SCREW-CUTTING IN AN ORDINARY LATHE.

[20230.]—To cut screws with an ordinary slide-rest we fit change-wheels to the face-plate or catch-plate of lathe. We lengthen the screw of the slide-rest, and upon it we fix corresponding change-wheels. A swing frame is required, and with a few change-wheels, a variety of threads can be cut accurately.

Thomas M. Bear.

Britannia Works, Colchester.

CHEAP BUNSEN BATTERY—COPPERING CARBONS.

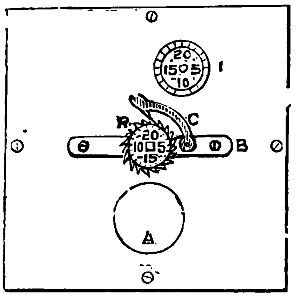
[20231.]—Cut a piece of sheet-copper to just fit in the bottom of a salt-jar; to this solder a piece of copper wire a foot long. attach this to the copper terminal of a Daniell or Meidinger cell; cover the copper for the depth of an inch with crystals of sulphate of copper, then fill to an inch above the crystals with sulphuric acid; dilute with 10 parts of water; twist a wire round the carbon and lead it to the zinc of the battery; place the carbon in the salt-jar so that it rests on crystals and leave for about three days, when it will be well coppered. The copper should be bright red. After coppering each carbon, add a few crystals of sulphate of copper. If this method is too slow, I will give one by which they can be coppered all at once; but the apparatus won't be near so easily made, and will cost more.

H. T. B.

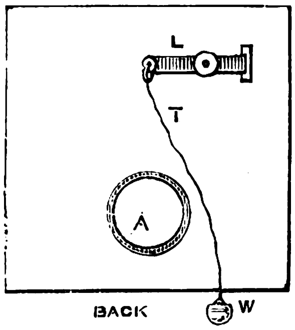
BEAUMONT'S PHOTOGRAPHIC SHUTTER.

[20232.]—Perhaps the following description of an instantaneous shutter I have just made may interest the photo. readers of "ours." It is made to suit a half-plate lens, and the revolving disc is shaped in the aperture so as to give the foreground of the picture about three times the exposure of the sky. There is an index on ratchet R, also on friction-screw I, for adjusting the disc to any desired exposure at will. To make the exposure, I have introduced a rather novel arrangement—viz., a piece of sewing-cotton, to one end of which is fastened a small button, weighing about ½ drachm, the other end of thread is attached to lever L, as shown. The button is not heavy enough to pull off the catch by its own weight, but when dropped from the hand pulls down the catch lever L, releases the disc, and makes the exposure. Description: F F are two pieces of mahogany, back and front respectively, 6in. square, ¼in. thick; these are screwed together, ⅛in. apart, between which the disc D revolves, disc 5in. diam.; A A A, aperture, 1¾in. in diam.; B, bar, carrying C, click; R, ratchet, fixed on the end of box containing spring, not shown; S, screw for tightening or slacking friction-spring inside shutter; L, lever, for holding disc ready for making the exposure; T, cotton thread, with small button or weight attached. There is also a small arm on the disc-axle in front of ratchet, not shown, for setting the shutter, and a catch for holding the aperture open while focusing.

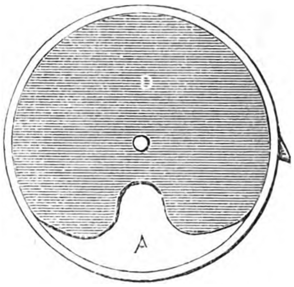
The above shutter, when made, is adjusted and indexed so that it can be set to go off in any desired fraction of a second. How to divide the indexes:—Take a circular piece of thin white cardboard about 6in. dia., and black it by means of a candle about ½in. from the outer edge. Make a small hole in the centre, and fix it on spindle of revolving disc. Now get a tuning-fork of known note (a C fork makes 256 vibrations per second) and on the end of one of the prongs gum a strip of pointed cardboard. The shutter is now set to go at its slowest speed, the fork made to vibrate is held with the paper point just touching the cardboard disc, and the shutter let off. The paper point on the fork will scrape away the soot in a wavy line, each wave representing one vibration of the fork. Now, if there are 25 waves to an inch, and the shutter at the same radius moves through the space of 5in. in opening and closing the lens, it will be 256 ÷ 25 × 5 = 2, or half a second. The indexes are now marked at this place. The shutter is then set to go off at its quickest rate. Suppose this gives 3 to the inch, then 256 ÷ 3 × 5 = 17, or the 17th of a second. The indexes are again marked, and the spaces between the two divided.



FRONT



BACK



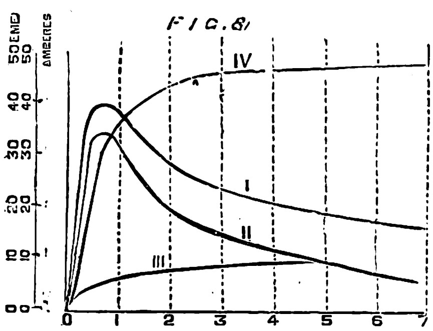
It will be seen that the exposure is adjusted to any desired time by merely turning the indexes to the figures required. I have tried to make the description as lucid hs possible, and anything not quite clear shall be glad to explain, or will make them to order. **C. R. Beaumont.**

Cooper-street, Withington, Manchester.

NOTES ON DYNAMO-MACHINES.—V.

[20233.]—39. In note 19 we have referred to the action of the shunt dynamo. This action is represented by the curves in Fig. 8. These curves result from a number of experiments with a Siemens machine, running at 500 revs. per minute, of these dimensions:—Helix 24 part commutator, 336 convolutions of 2·5mm. wire, ·4014 Siemens units resistance. Field-magnets 2,240 convolutions, 3mm. wire, 4·46 Siemens units resistance. Distances on the horizontal line represent resistances in the outer circuit in Siemens units, and the scales on the left-hand side measure the E.M.F. and current on the ordinates 1, 2, 3, 4, &c. Curve I. represents the total current flowing through the helix, which at the brushes is divided into two, a current represented by curve II. in the outer circuit, and a current represented by curve III. flowing round the field-magnets. Curve IV. gives the E.M.F. in volts.

FIG. 8.



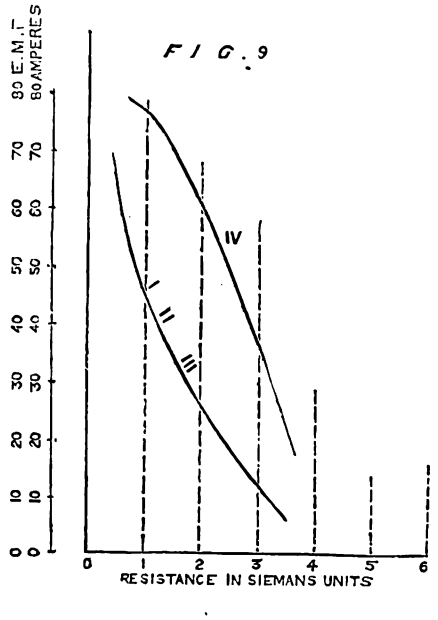
40. That we may be better able to compare the shunt with the ordinary dynamo, to represent the action of the latter, let us take curves, Fig. 9, drawn in a similar way. This dynamo is of the ordinary type, and constructed by Siemens to the following dimensions:—Helix 24 part commutator, 336 convolutions of 2·5mm. wire; ·4014 Siemens units resistance. Field-magnets, 512 convolutions of 5·5mm. wire, ·3065 Siemens units resistance. In this diagram curves I., II., and III. correspond the current flowing through helix, field-magnets and outer circuit being the same. Curve IV., as before, gives the E.M.F. in volts. As the resistance in the circuit is diminished, it will be observed that here the current rises much more rapidly than in the shunt dynamo (see Note 19). In Fig. 8 the current is fairly constant for a resistance of from 3 to 4 or 4 to 5 ohms, while in Fig. 9 the curve representing the current is very steep, and a small change in resistance makes a considerable difference in the current. A careful comparison of Figs. 8 and 9 will make the action of the two machines plain without further explanation. In the ordinary dynamo, the E.M.F. is greatest when the machine is short-circuited, in the shunt when the circuit is open, or, in other words, when the resistance is a minimum in the ordinary dynamo, the E.M.F. is a maximum; in the shunt, when the resistance in the outer circuit is a maximum, the E.M.F. is also a maximum.

41. Curves such as we have described ought to be supplied by the makers with each dynamo-machine. These provide all the formulæ necessary for the particular machine, and tell at a glance what the machine can do and what it can not do. The curves ought also to guide us in the choice of a machine. It is obvious that the shunt-dynamo gives the best results as far as steadiness of current is concerned when working under a varying resistance.

42. The shunt-dynamo is extremely useful for incandescent lighting, since, owing to the E.M.F. increasing with the resistance, any number of lamps, from one up to the maximum number, can be lit up. If the incandescent lamps are arranged in parallel circuit, and the current through each lamp is to be constant, the generator must be arranged so that the total current flowing is proportional to the number of lamps alight, or, in other words, C × R (where R is resistance in the lamp circuit), i.e., E.M.F. at terminals of machine must be constant, and something must be done to satisfy this condition.

43. To understand how the current through each lamp varies as the total number of lamps is varied, let us take the machine the curves for which are represented in Fig. 8. Suppose we have 30 incandescent lamps of 30 ohms resistance each, equal to a total resistance in lamp circuit of one ohm. According to the diagram, we will have a total current of 32 ampères, or a little over 1 ampère through each lamp. Let 15 lamps be extinguished; the resistance is now 2 ohms, and current through each lamp 1·3 ampère. If other five lamps be put out the current through each of the remaining ten will be 1·4 ampère. Finally, let the lamps in circuit be reduced to five—the current through each will now be 1·6 ampère. The light will vary in a much greater ratio than the currents, also, the resistance of the lamps will not remain quite constant, as we have assumed. The way in which the resistance varies with the current will be considered further on.

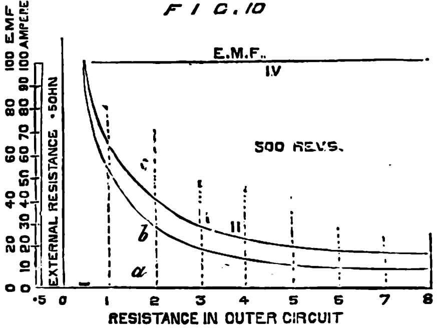
FIG. 9.



44. A comparison of Figs. 8 and 9 will show that, with the ordinary dynamo, on extinguishing a number of lights, those remaining will become dimmer instead of brighter; consequently, the speed of the machine will have to be *increased* and not *diminished*, as in the shunt dynamo. In Fig. 8 the current curve is not steep enough to satisfy the condition of Note 42, and in Fig. 9 the curve is too steep.

45. Fig. 10 shows the curve for a magneto machine or a dynamo, the F-magnets of which are excited by an auxiliary machine. The total E.M.F. is 100 volts. The current curve is somewhat similar to that for the shunt dynamo. Taking incandescent lamps of 30 ohms resistance each, for 60 lamps, we have 1·6 ampère through each; for 30 lamps 2 ampères, for 15 lamps 2·5 ampères, for 10 lamps 2·8 ampères, and finally, for 5 lamps, over 3 ampères through each. In drawing this curve it has been assumed that the E.M.F. remains constant; but, strictly, this is not true for all currents flowing through the armature. As the current in the armature decreases the E.M.F. increases a little, because the magnetic field produced by the current in the armature tending to neutralise that created by the current round the field-magnets is reduced. The case is then somewhat worse than appears from the curve. On the assumption that E.M.F. remains constant, however, a curve for speed correction has been drawn, represented by the dotted line. The E.M.F. is proportional to the speed consequently for a fixed resistance (say, 2 ohms), the current is also proportional to the speed. *a c* represents the current we obtain at 500 revols. with 15 lamps, but *a b* is the current we desire to have, so that the lamps may be of the same brilliancy as when there were 60 in circuit. Consequently, as *a c* is *a b*, so is 500 to the required speed.

FIG. 10



46. Where there is a number of machines, all working different circuits and driven from one engine, it is impossible to reduce the speed of any particular machine. The most convenient way to diminish the E.M.F. in the case of the separately-excited machine would be to switch a resistance into the circuit of the exciting dynamo. If working with a shunt-dynamo, the plan adopted by Edison, of introducing a resistance into the shunt-circuit might be employed. But in all these cases, that C × R may be constant, something must be done, either in the way of reducing speed, or introducing resistance. It is easy to have an instrument recording E.M.F. at terminals of each machine, which might ring a bell when the E.M.F. varied appreciably, and thus call attention, so that the requisite adjustment might be made, or some system by which the resistance might be introduced mechanically, might be devised. These details, we shall not, however, consider at present.

E.

CONNECTION OF BATTERY CARBON.

[20234.]—I beg to bring to the notice of the readers of the English Mechanic a simple and effective plan I have designed for the connection of battery carbon. A binding-screw may be used, or in lieu thereof, a piece of bright copper wire with the end flattened. But now for the description of the plan. Bore from the centre of the top of the carbon (a block is most suited for this plan) a ¾in. hole for about 1in. down, with a ¾in. drill or centre-bit. Then melt some lead over the kitchen fire, and pour it into the hole, filling it. The binding-screw may be put in the lead when it is still melted, or held while the lead is being poured around. The carbon, preparatory to the leading, should be slightly enlarged at the base of the hole, as shown at Fig. 1, or better still, as at Fig. 2, which has two holes bored at right angles to the large one, with their ends stopped up with any suitable material, such as a cork or piece of wood. This plan prevents the lead falling out, as it contracts when cold. The binding-screw may be easily removed, as it leaves a thread in the lead-top. This plan is a very simple one, and saves a great deal of lead, as in the other methods a lead cap is melted right around the carbon head, thus using a larger quantity than in the plan I have set forth. In a carbon plate which is too thin to allow of a hole being bored in the top, a hole may be sunk in the flat side right through (and countersunk each side), thus having the binding-screw at a right angle to the carbon. I hope this will be of some use to our readers.

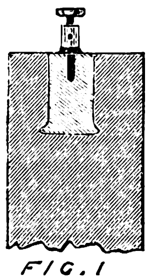


FIG. 1

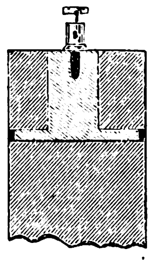


FIG. 2.

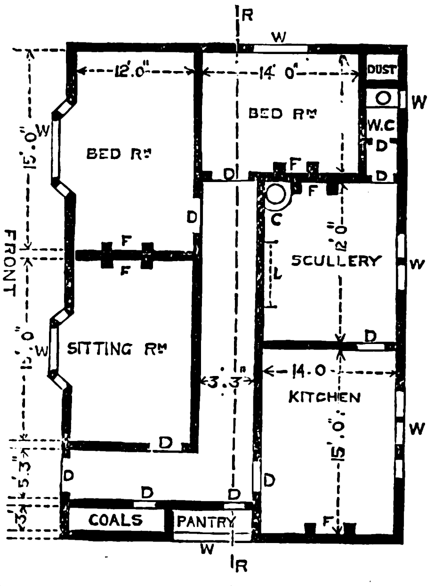
Beetle Crushers.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[46398.]—**L. and N.W. Engines.**—955, Charles Dickens, Feb., 1882, stationed at Manchester (16); know nothing of others.—DUBLIN.

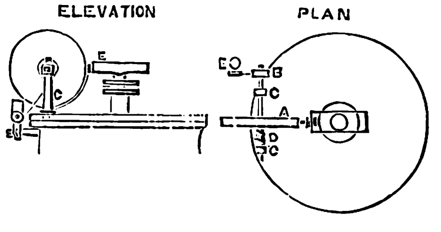
[46403.]—**Cottage Building (U.Q.)**—"Employment" has a very good notion of a cottage. Five rooms 14ft. square would, I should say, form a very fair sample of a house. Here is a possible arrangement of such a house. The various quantities of different materials may be easily computed by drawing out the sketch on a very elementary form. I should think the cost would be about £500, if put to competition.—DITTON.



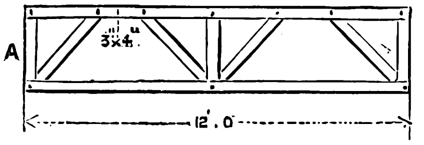
F, fireplaces; C, copper; L, borrowed light; D, doors; W, windows; R, ridge of roof.

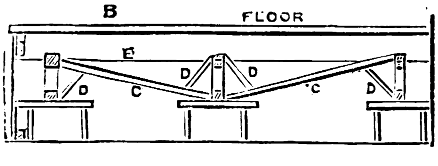
[46648]—**Chimney on Girder (U.Q.)**—If the chimney-breast does not project more than the thickness of the wall, it may be either brought out on corbelling in narrow steps, or built upon a 3in. York-stone landing, the full length of the breast and full width of wall. If anywhere in the Metropolitan district, do not forget the 20th section of the Metropolitan Building Act.—DITTON.

[46470.]—**Diagrams of Oscillating Engines as on London River (U.Q.)**—"An Old Fitter" will at once see by my rude diagram how the diagrams can be taken, as I have often taken them—but cannot say if as on London river, as I am too far North for that. A, large spider-grooved wheel, circumference a fraction more than length of engine-stroke; B, small grooved wheel, circumference sufficient to give indicator necessary travel; C are two brackets screwed into cylinder-cover, with bearings for spindle, on which the two grooved wheels are keyed; D, small spiral spring fastened on spindle and at C, so as to keep cord tight at F; E, supposed indicator; F, piston-rod head, with small pin where cord is attached to, and working over the large grooved spider-wheel.—CARINO.



[46505.]—**Movable Stage (U.Q.)**—For movable stage 36ft. by 24ft., frame together nine trusses, as A, of 3 by 3 timber for sills, uprights, and struts, and 3 by 4 heads; set these trusses upon the tables, as shown on B, and connect together with ties C, 3in. by 2in., three to each truss, firmly secured by hooks and eyes or pins, and stiffened by pieces D, 3 by 2, which are fixed to the trusses A by hinges, and secured to ties C by cabin-hooks. The joists E, 7in. by 3in., to be notched down over trusses so as not to shift, and placed 12in. apart. The floor may be of 1¼ boards, ledged and tongued in pieces, 3ft. by 12ft.; these pieces, if screwed down to joists, each with six screws, will keep all firm. The front can be filled in with boarding, ledged and tongued, and screwed at intervals to the ends of joists. Cost about £50, and will pack into space 24ft. by 4ft. 6in. by 4ft.—DITTON.





[46804.]—**Furniture Cleaning.**—Some cold tea, the leavings after your breakfast, if you have not been draining your teapot too dry, will remove a great deal of "nasty black stuff" from your furniture. Wet a small piece of soft woollen or linen rag in the tea, then wash your chairs, or tables, or bannister-rails; then dry with a very soft duster and plenty of "elbow-grease." It is a valuable remedy for cloudy spots. Never rub with "varnish" or "polish" without a washing first.—H. O'B.

[46828.]—**Railway Brakes.**—The G.W. vacuum brake is created by ejector, and maintained by pump, and, I believe, differs only from the Midland in the construction of the cylinder. It is a two-minute brake, but some cylinders take longer to leak off than others. I once timed a cylinder to four minutes, the wheel being locked for two yards when the train started. The only complaint the drivers make against this brake is that it does not "hold" long enough, which (as on the Midland), is the result of the power leaking away in so short a time. They are all of opinion that the brake would be much more serviceable if it would remain on until released. In order to apply the brakes on each carriage as nearly as possible at the same moment, a valve is provided in each van, so constructed that any sudden increase of pressure in the pipe instantly causes the valve to open automatically and admit a supply of air after which it closes again by its own weight. The driver is required to have 10in. of vacuum on starting, and not less than 20in. when the train is running, and in descending inclines the vacuum brake is to be used in preference to the hand brakes. I hear the L. and N.W. are fitting a vacuum brake to their Irish mails. Can Mr. Stretton say whether this is correct, and, if so, what brake it is? I think they have made a great mistake in not fitting the Westinghouse to their stock—a system we should like to see adopted by this company.—NORTH STAR.

[46847.]—**Equation.**—I do not think that the introduction of the arithematical progression into the solution of this interesting problem helps us in any way. By its aid, Mr. Davies proves that $zx = 9 + xy/2$; but this can be obtained directly from equations (c) and (d); so we have the same difficulty as before—viz., the *signs* of the two sides of the equation after completing the squares and taking the square roots. My meaning will be made clear by the following equation:—

$$(5 - 4) = -(3 - 4)$$

which is evidently correct; square both sides, and we get

$$(5 - 4)^2 = (3 - 4)^2.$$

Now take the square roots, and note the signs which I will put in words to prevent mistake.

$$\begin{array}{c}\text{Minus}\\ \text{or}\\ \text{plus.}\end{array}\left\{\;5 - 4\;\right\} = \begin{array}{c}\text{plus}\\ \text{or}\\ \text{minus}\end{array}\left\{\;3 - 4\;\right\}$$

This is only correct if we take the upper signs or the lower for *both* sides. It will not do to take the upper sign of one side and the lower sign of the other side, unless each side happens to be $= 0$; but in the problem we are trying to solve, we cannot take this for granted. This shows us that it is quite possible to solve a quadratic in the usual way, but that the result may be misleading unless we attend to the signs of both sides. As a further proof of the fallacy of this method of solving the problem, let us take the same original equations, but with different values for the symbols; suppose $x + y + z = 21$; $x^2 + y^2 + z^2 = 153$; $zy = 3x(z - y)$. It will be found that $x = 6$, $y = 6$, $z = 9$, will satisfy all the equations; but if the method of solution as given by Mr. Davies be adopted, we will obtain $xy = 24$, $zy = 72$, which is evidently wrong.—M.I.C.E., Bath.

[46847.]—**Equation.**—Mr. Lane Davies' second solution (p. 358) is identical with his first (p. 226); for, though by multiplication he obtains from (c) and (d) an equation (β) which is independent of either separately, he substitutes in it a value of zx, which is derivable from (c) and (d) jointly, and thus obtains an equation that can depend only on the result of eliminating zx from (c) and (d), viz., $\frac{1}{2}xy + \frac{1}{3}yz = 9$ (e). The substitution might just as well have been made at first, and then the equations to be multiplied together would have been, as in the first solution, merely varying forms of the single equation (c). The method is thus practically an attempt from one equation (e), of the form $\frac{1}{2}xy - 3 = +(6 - \frac{1}{3}yz)$, to obtain another $\frac{1}{2}xy - 3 = -(6 - \frac{1}{3}yz)$ independent of it, and shows that Mr. Lane Davies has not yet quite mastered the fallacy underlying the school-boy-proof, that $1 = 0$, which is of the same nature. His mistake in the second solution is in taking the value of zx from the "progression" without tracing its origin, the progression itself being absolutely useless. Mr. Lane Davies does not, however, quite understand (p. 312) when equations are identical, so that he may not at once assent to the above criticism; but that his method is wrong may be proved by showing that it leads to an infinite number of solutions. After substituting the value of zx in (β), reducing the square and dividing throughout by 3, he adds 36 to each side to make it a perfect square; if instead, we add $27 + n^2 - (n - 3)\,xy$, and $(n - 9)^2 + \frac{2}{3}(n - 3)\,zy$ to the left and right-hand sides respectively, n, being any number whatever, and these quantities being equal by virtue of equation (e), we again make both sides perfect squares, in the form $(\frac{1}{2}xy - n)^2 = (9 - n - \frac{1}{3}zy)^2$, whence the method would give $xy = 2n$, $zy = 3(9 - n)$, and so $xz = 9 + n$, their values being 6, 18, 12 only in the particular case when $n = 3$. That this special case should suit the original equations is only by accident; if for 11 and 49 in equations (1) and (2) were substituted $47/10\sqrt{5}$, and $769/20$, we should still get equations (b) and (c); but would have to take $n = 6$. We should get the above indeterminate values of xy and zy by directly solving (e) in the ordinary way: if then, having found that of xz by substitution in (c) or (d), we deduced the values of x^2, y^2, z^2, and substituted them in (2), we shall get $\frac{2}{3}n(9 + n)/(9 - n) + 6n(9 - n)/(9 + n) + {}^3/_2(81 - n^2)/n = 49$, or $49n^4 - 282n^3 + 1782n^2 - 23814n + 59049 = 0$ as the biquadratic equation whose four roots are required to give us the necessary four values of x, y or z. One of these is 3, another 6·977811 very nearly, and the others imaginary.—R.E.B.

[46859.]—**Indigo Blue Dyeing.**—The difference between R. Holliday and Sons' method, which was invented by Lalande and Shützenberger, and the woad vat consists in the use of bisulphite of soda, zinc dust and lime instead of woad, &c.; the process is protected by patent, and the only license fee required is an undertaking to buy the chemicals from R. Holliday and Sons, who give all particulars, and, if required, send a dyer to teach the process. The advantages are that one vat answers for both woollen and cotton by using it either hot or cold, according to the material to be dyed. The vat is set in a very short time, and the bath can be exhausted—*i.e.*, all the colouring matter can be made to combine with the fibre.—S. J. Simpkin.

[46875.]—**Model Electric Engine.**—The distance between the magnets being 5-16in. only, I should not make the keeper thicker than 1-16, which would leave a stroke of ¼in. This would make the mass of iron of the keeper objectionably small, and I advise you, therefore, to place your magnets 3-16 further apart and to make the keeper ¼in. thick, which would leave the stroke unaltered. Make the middle part of keeper 5-16in. thick, and screw into its centre a rod 3-16in. thick (B E in the sketch), the other end skewing into a boss at the lower edge of the beam. B E should have a projection of the side turned towards F and M M M, with a 1-16 hole for a pin, to which is connected by means of a fork-joint one end of a 1-16 wire. This wire, I believe, is what "R. W." has denoted by N. The other end of N is similarly connected to a boss and pin on F, the latter turning on a pivot, which may be formed by a stud screwing into one of the fly-wheel standards (I I in the sketch). "R. W." has indicated the pivot in Fig. 3 just above wires 2; find its best position by trial. All the connections are distinctly shown by "R. W." in Fig. 2. The length of your crank should be half the stroke of C, which is about 3-16in. (Rather small, I think.) I hope these few remarks will be useful to you, although it is more likely that by this time "R. W.'s" engine made many a thousand revolutions.—R. Kanthack.

[46929.]—**Iron in Water.**—As no one else has replied, I venture to suggest that, as ferrous carbonate is held in solution by the presence of free carbonic acid, the addition of milk of lime to the water would precipitate it very quickly. Probably, if arrangements could be made for blowing air through the water, the same effect might be produced; but that might be more expensive than the adoption of Clark's process for softening water. Nun. Dor.

[46932.]—**Telegraphic Engineering.**—If Mr. Shone would write to the Secretary to the Postmaster-General, or to Mr. Graves, the engineer-in-chief, he would no doubt obtain an intimation of whereabouts he would find the information as to the telegraphs engineering service. Failing a reply from either of those gentlemen, which is unlikely, I should write direct to the Civil Service Commission, Cannon-row, S.W.—Nun. Dor.

[46936.]—**Steam-Launch.**—On p. 410, No. 875, you will find some details which may assist; but in the last three or four volumes there have been many replies about steam-launches.—Nun. Dor.

[46940.]—**Soap-Making.**—Many thanks to "Pygmalion Phibbs" for his able assistance. I have now got the book he recommended, and find it will be of great service. I should be glad if he would give me an instance of a "standard acid solution." That would be of use to me. Mr. Edward Thomas Scott's warning has surprised me, as I understood the duty was taken off some years ago.—Svenska.

[46947.]—**Lesson in Assaying.**—In Vols. XII. to XV., there are several papers on assaying, chiefly lead, copper, and silver, which appear to be just the kind of hints the querist wants. As to a book, I suppose he could have nothing better than "Mitchell's Manual of Practical Assaying," published by Longmans.—E. G. M.

[46950.]—**Composition Gas-pipe.**—This piping is made of an alloy of lead and tin, but the proportions vary in different factories, and are kept as trade secrets.—E. G. M.

[46955.]—**Marine Steam Boiler.**—This querist should consult the indices of the last four volumes or so; he will find a great many hints about launch-boilers, some of which may assist him.—Essar.

[46960.]—**Model Electric Lamp.**—The engine and boiler described could not be made to give sufficient power to work a dynamo-machine capable of supplying current to an electric lamp.—Nun. Dor.

[46982.]—**Colouring Screw-Heads.**—If "Steadfast" will refer to p. 54, No. 861, he will find full directions for blueing watch-screws—an art that has been frequently described. As to the blueing-pan, anything in the shape of a thin iron pan, to be held over gas or a charcoal fire, will answer.—T. P.

[46989.]—**Stoppage in Pipe.**—The best remedy is to prevent the accumulation. The pipe should be 4in., laid direct to the drain, without the slightest bend, if possible. A "small quantity of water running day and night" is exactly the mistake so frequently made in sanitary arrangements. A thorough flush at intervals of, say, six hours or so, would be immensely preferable. The spirits of salts is good, but it is the "flush" of water that should be seen to in all cases of drain-pipes. The application of driblets, or constant trickling, is both wasteful and useless.—Nun. Dor.

[46993.]—**Consumption and Homœopathy.**—There are, no doubt, special hospitals for consumption, but scarcely one in which a specified drug is used. Above all things, avoid becoming an inmate of a consumption hospital; but seek rather to increase the strength by fresh air, good food, and, if there is any truth in Koch's hypothesis, by inhaling the vapours of antiseptics. You may take the whole contents of a homœopathic medicine-chest without deriving any benefit.—Oxon.

[47023.]—**Sea-Sickness.**—A pinch of saffron, folded up in thin paper or muslin, and worn next the skin, just upon the pit of the stomach, is a remedy for this troublesome and ofttimes dangerous malady. It is surely worth trying.—H. O'B.

[47050.]—**Hot-Air or Vapour-Bath.**—If Isabelle Stuart will write to me direct, I will send her the full description of a simple, costless system, by means of which instantaneous cold, warm, hot-air bath, cold, tepid, warm, shower, or pulverised water, or steam-bath, can be obtained at will in every house, either plain, perfumed, or medicated, without extra expense; also the the means of modifying, ventilating, perfuming, medicating, warming, refreshing, drying, &c., the atmosphere of any apartment at will—it being the object of a patent of mine. She will be at liberty to work it in a hygienic establishment, or to use it personally, and make it public.—Ch. Rabache, Morchain, par Nesle, Somme, France.

[47070.]—**To Mr. Allen.**—I should like to make a remark on the statement made by Mr. A. H. Allen that arsenic is such a common impurity in aniline colours, that it is hardly fair to the English manufacturers, since they use the arsenic method for the production of magenta: the poisonous body is, however, removed before the magenta is in a saleable state, and the hydrochlorate of rosaniline formed. It would be interesting and instructive to hear what quantity of arsenic has been found in samples of the aniline colours produced by any one firm of "coal-tar dye manufacturers." Besides this, the greater number of aniline colours are produced without arsenic; among them I may mention the azo colours, of which the consumer has a variety of colours or shades, from yellow to red and also brown; the greens are not produced by using arsenic, neither is eosine and its nitro-derivatives, both beautiful reds, some having a fine blue shade: bromine is present in these. Saffranine is not made with arsenic—another pretty red. Diphenylamine blues, and the blues derived from methyl, benyl, amyl, and ethyl diphenylamines, are free from arsenic, since none is used in their production. Arsenic acid is not used in making violets. May I ask what colour is produced by the use of arsenic beside rosaniline?—S. J. Simpkin.

[47098.]—**Engine Queries.**—To find the angular advance of an engine, draw a circle (Fig. 1), A D B, to represent the path of the crank-pin, at a scale of 3in. to 1ft.; draw also a smaller circle, whose diameter, E G, shall be the exact stroke of the slide-valve, and represent the path of the eccentric. Now, let A C be the crank, erect a perpendicular, B C, at right angles to A C D; now, with dividers, mark off a distance C H in C D, so that C H equals the lap and lead added together; erect H *h* parallel to C B, join C *h*, then the angle D C *h* represents the angle of advance. To find angle of crank and corresponding position of piston entails a long explanation, taking up too much space here. If the angularity of the connecting-rod is to be considered, however, if "Phenix" only wants an approximation, the following diagram will do, leaving out the connecting-rod or considering it of infinite length:—Let the circle A B D (Fig. 2) be drawn to any scale of the path of the crank-pin, then A D will represent the stroke of the piston. Assume that B C is the crank at half-stroke, the piston will be at half-stroke also, and C will represent its position; let now the crank move to positions E and F, and draw lines, E *e* F *f*, parallel to B C; the points *e* and *f* will mark the position of the piston, and C E C F the angularity of the crank, and so for any position of either required. With regard to the third question, either I have misunderstood it or you have not put it clearly, for hydrostatic pressure depends upon the height of the water; therefore, I do not see what the inclined base has to do with it. A column of water, no matter what diameter, 33ft. high will indicate about 14·8lb. per square inch pressure upon its base, or any pipe there connected.—Fred. Walker.

FIG. 1.

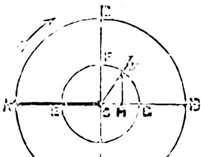
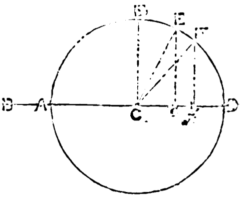


FIG. 2.



[47126.]—**Electrical.**—You can easily cover up the cells in winter, pour on the surface of liquid some paraffin, and then put some tow or wadding around the jars, or put the jars in a box filled with sawdust, or lined with felt all round lid as well. You will have no trouble with them then in the coldest winter.—W. J. Lancaster.

[47126.]—**Electrical.**—Frost does interfere with the working of Leclanché batteries to a serious extent. I once fitted some up in an exposed place, and they were ruined by the frost in winter; whereas some of the same cells placed in a bedroom have been working over two years, and at the present moment ring the bells sharp. It is of the utmost importance where amateurs place these batteries; and another matter worth their notice is: I make all my cell connections with solder (or else have the binding screws outside box), as a frequent source of failure is corroded connections; joining cells together, the sal-ammoniac quickly attacks the brass should any get spilled.—Electra.

[47138.]—**Tapering.**—I should advise "Experimenter" to get a large-size steel pencil-sharpener, and, if too small, use it as a model in having a larger one made. It consists of a simple piece of coned steel tube, with one edge sharpened, and the price is usually one penny at any stationer's.—John Hale.

[47142.]—**Marquetry.**—In answer to the latter part of "J. K.'s" query, he should write to Harger Bros., Settle, Yorks., for specimens and prices of marquetry veneers.—Collodion.

[47143].—**Aluminium.**—If Wm. John Grey knows a good and easy method of separating the aluminium alloy, and would divulge the same for a consideration, there is no reason why he should not be paid; but as to my demand being "rather a cool request," I cannot see where the difference lies between my query and a thousand others which are constantly asked and kindly and gratuitously answered by some of "ours," although "something for nothing" is not very often attainable. I quite believe with Mr. Grey, that when I can work my invention it will be very remunerative, especially as I believe there is a great future for aluminium in the manufacture of electrical apparatus, &c., its lightness, conductive power, and non-oxidisable qualities being far superior to the metals usually employed. Unfortunately for me, I am in no way connected with metallurgical skilled labour, and the difficulty of developing my discovery will, no doubt, consist in my not being able to meet with someone to work it for me. I know, but have not yet tried, the separation of Al and Zn by volatilising the Zn; then there is cupelling also—both, I think, expensive processes. I have obtained the metal nearly pure, owing to its melting point being higher than Zn. At the melting point of Zn the Al separates out if the heat is not increased: but it is rendered brittle, and I find it very difficult to keep the temperature even. Then, again, there are other metals, as I before stated (an impure alloy); these have to be separated, but I have no doubt the alloy as formed will prove valuable. It is much harder than zinc, does not oxidise, and will take a high polish.—Zelia Naien.

[47144.]—**Bending Wood.**—"W. P." should make a steam-chest of good, sound, red deal, about 1½in. thick, of convenient size, to hold what he has to steam—say, 3ft. 6in. by 9in. Put white-lead on the joints in nailing it together. Put some kind of simple safety-valve to it, and connect to large tea-kettle, with lid temporarily fastened down. Best kind of wood for bending, ash and elm. I should have said his steam-chest should be made with one end loose for putting stuff in which can be fastened with screws.—Collodion.

[47147.]—**Photographic.**—The size of any object produced on the screen is dependent on the length of focus of the lens employed, and the distance of the lens from such object. The size of the object may be increased either by lessening the distance from the object, or by using a lens of longer focus. A ½-plate lens being of longer focus than a ¼-plate one, will, of course, give the objects in the same view larger. The lengthening of the camera may be from the front. One of Messrs. Lancaster's lenses could no doubt be used with your camera. Write to them for particulars.—N. Mackie.

[47147.]—**Photographic.**—The size of the object on a photo. depends upon the focus of the lens, and the distance you are from the object. Thus, on a ¼-plate view, the distance is of course minute, whereas on a ½-plate the distance, though bearing exactly the same proportion to the foreground as in the ¼-plate, will seem to be much more distinct. You must, in photography, train your eye to pick out subjects that harmonise. Don't get just one object in the foreground and then an immense stretch of distance; the smallest object imaginable, thrown into the picture at the right spot, makes a bad picture into a good one. A dog even, or a horse, or, better, a human being, makes the view much more interesting. Look and study all first-class paintings, and you will find that the paintings have a harmony in all the details; some one part arresting the attention, and yet not at the cost of all other parts of painting. Try to select subjects well grouped, so that distance is broken. The instantograph lens can, of course, be used on any camera, but you cannot use a ½-plate lens on a quarter camera; better get rid of present camera, and get a ½-plate one; then you can take either ¼ or ½-plate views at will.—W. J. Lancaster.

[47148.]—**Fogging.**—You must look further for the cause of your plates fogging. The smell of size would not affect them, particularly in the short time they must have been exposed to it.—N. Mackie.

[47148.]—**Fogging.**—I should very much doubt two thicknesses of black twill being light-tight. You should have a thickness of ruby cloth. I have had light through three thicknesses of twill, &c., and one cannot be too careful in using the gelatine plates. Why don't you develop with pyro., bromide, and ammonia?—then you can restrain with the bromide, and may obtain a thin negative, from which you could obtain a transparency and then a stronger negative.—W. J. Lancaster.

[47149.]—**Changing Plates.**—As a very little cement at the corners of the plates would answer the purpose named, I should say that glue, gum, or anything almost, might be used without detriment to the films. But how do you intend to insure the plates being firmly and evenly pressed against the rabbet of the dark slide?—without which the image would be more or less out of focus. —W. Robinson, Jun.

[47149.]—**Changing Plates.**—You can fasten your plates very securely together with small well-gummed labels at the corners, and the slight amount of moisture required will not hurt the plates; but if you use double backs I don't see how you will be able to use plates thus cemented, unless you pick out plates of exactly the same thickness, the thickness together being equal to exactly the distance apart of the rabbets of the slide.—N. Mackie.

[47149.]—**Changing Plates.**—Probably a thin band of liquid glue would do all you want; but you would require a piece of black cardboard between each pair of plates; then, if the glue was brushed along one end of the cardboard, and this laid between the two plates, you would be able to remove it without damaging either of the plates. The French polish would not hold, I am afraid, sufficiently to keep the plates from moving their relative positions. Have the plate-box made to carry two plates in each division.—W. J. Lancaster.

[47150.]—**Steam-Engines.**—It is required to compare the values of two arrangements of engines, viz., a compound engine with cylinders 16in. and 28in., 50lb. of steam in boiler, 60 revs. per min., stroke 3ft., and a coupled engine with 2 cylinders, each 15in. dia., 22in. stroke, 120 revs. per min., both condensing engines. The greatest power in the compound engine will be when the high-pressure cylinder works with full steam; the areas of the cylinders are nearly in the proportion of 3 to 1. The stroke of each being the same, the expansions are therefore 3, the co-efficient of which is ·666, the average pressure will therefore be 50 + 15 × ·666 = 43·29lb., say, 43lb. The area of the large cylinder is 615·7in., then 615·7 × 43 × 360ft. per min. / 33,000 = 290 h.p. theoretically. In the coupled engine each cylinder would have to exert 145 h.p. each area of 15in. cylinders = 176·7in., the speed being 440ft. per min. Then 33,000 × 145 / 440 × 176·7 = 61·5lb. average pressure in each cylinder; then 61·5 / 65 = ·947, the co-efficient of expansion which represents ·7 of the stroke which the steam would be admitted in each cylinder. To compare the two engines, we must calculate the amount of steam required for each arrangement. In the compound engine we have the area of the high-pressure cylinder = 201in., then 201 × 36 × 2 × 60 revs. = 868,320 cubic inches of steam = 502·5 cubic foot per min. In the coupled engine we have the area of each cylinder = 176·7in. and 22in. stroke. Then 176·7 × 22 × 2 × 120 × ·7 = 653,083 cubic in. per min. = 377·9 cubic ft., and for each cylinder 377·9 × 2 = 755·8 cubic ft. Then—

755·8 cub. ft.	required per min. in coupled engine
502·5 cub. ft.	required per min. in compound engine
253·3 cub. ft.	balance in favour of compound engine

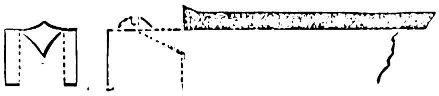
—J. H.

[47152.]—**Field-Glass.**—I am afraid you are mistaken about the object-lens of field-glass. If the spots are not air-bubbles, then they are on the surface of the flint, and are due to oxidation; these will have to be polished off, and are beyond your power. You had better ask some optician to tell you whether the marks are between the lenses or not before you attempt to alter it, as in all probability you will only injure the lenses instead of improving them. I shall be pleased to tell you how to remove the markings if you feel that you would like to attempt the job.—W. J. Lancaster.

[47164.]—**Microscopic.**—You can use a double-concave lens at the lower end of sliding tube, or if you have no sliding tube, mount it so that you can place it 3in. above the object-lens. A Barlow lens is better than a double-concave, but I have no doubt you will find the latter all you want. You might get several of them from any optician, say 6, 9, and 12in. focus, and each about 1in. diameter; then a simple cell could be made by yourself to carry the lenses, and you could occasionally use two together for increasing power more than the one lens alone.—W. J. Lancaster.

[47166.]—**Glazier's Diamond.**—You can have your diamond reset; send it to a good man, and I have no doubt you will be able to use it for years; only don't abuse it again.—W. J. Lancaster.

[47174.]—**Pedal Reeds.**—I believe that I can answer one of the questions here put—the last. My instrument (one of Cramer's) has underneath 2⅓ octaves of 16ft. notes to the pedals. These were slow in speaking, and more reedy than I liked. I conceived that the slowness might arise from the fact that the air enters on three sides, and thus blocks its own passage and delays the rarefaction underneath required for the first vibration of the tongue. I therefore took all the notes out, and pressing down the tongue of each, I, with a triangular file, held at about an angle of 60° from the top surface, filed so as to make a triangular cavity in the inner part of the end of the frame from side to side. I then adjusted the tongue so as to remain in a line with the top of the frame, so that the wind only entered at starting in one direction—namely, towards the free end of the tongue. I should say, however, that I also adjusted the frame closer to the tongues by means of chisel and hammer judiciously used not far from the edge. Anyone who is not in the habit of making adjustments of harmonium notes, nor had experience, had better be careful how he undertakes to make these alterations. The result of this I am quite satisfied with, as the notes are not at all slow in speaking, and the reediness is somewhat less, as might be expected, seeing that the triangular cavity does not cut off the wind so suddenly as the straight end did formerly. This, I think, would be an improvement throughout all scales, as I found by trial on an octave of Bourdon, the American twist did not improve the quickness of speech, but otherwise; and by no plan the same object is effected as to reediness. Anyone, however, adopting my plan had better try a note or two first to satisfy himself.—J. H. Huxley.



[47175.]—**Varnish.**—Shellac varnish, 1 part; alcohol, 2 to 4 parts. Or seedlac, 2oz.; sandarac, 1oz.; alcohol, 1 pint.—N. Mackie.

[47175.]—**Varnish.**—In reply to "[illegible]," I copy from an article in the *Bazaar* "On Argentic Gelatino-Bromide Dry-plates; their Manufacture, &c.," by Wm. Starkey Downes:—"Methylated spirit, 30oz.; place in a stone bottle; add 1oz. shellac; then place the bottle in hot water for 15 or 20 minutes, and well shake; next, add gum sandarac, 2½oz., well powdered; gum benzoin, 2oz. Shake well at different times, and let stand a day or two; then filter.—Collodion.

[47175.]—**Photo. Varnish.**—You cannot do better than as follows:—½ pint of white, hard, spirit-varnish, and 1 pint of methylated spirit. Mix cold, and when dissolved filter clear through the ordinary filtering paper. Now varnish a negative, and you will find the varnish [illegible] brittle. Add ¼oz. of castor-oil, and you will have a varnish that is hard and tough, and nearly colourless, one that I have used for the past 15 years. Photographers, note.—Old Photo.

[47190.]—**Fernery.**—There are so many details to be carefully attended to in keeping a nice fernery, that would take several pages to enunciate, and if you want to be successful, I would recommend you to get two books, "The Fern Garden," by Shirley Hibberd, and "The Window Gardener," by John R. Mollison. Both of them contain a mass of good information, and without it you will fail. Don't take everybody's advice about keeping the ferns healthy; everyone of your friends will advise you, and everyone different to the others. Fern-keeping is very similar to the story of the old man and the ass, who, you know, in trying to please everybody, lost his ass; and it is equally certain that if you continually change the regimes of your ferns you will lose them.—W. J. Lancaster.

[47196.]—**Gas v. Electricity.**—I beg to inform Mr. Grey that I don't keep tom cats—they are too gaseous. On the first page of our last number we see how gas is improved by incandescence, but this is not done without employing a motor to actuate the blowpipe, and which would add to the cost, as in the production of the electric light. It is the cost of the driving-power that stands in the way. So long as incandescence is produced, the purity of the gas is of no moment (vide Mr. Sprague's remarks), hence I infer that the gas that will produce the most heat is really the most efficient. Is not this the case with hydrogen gas? The copper and zinc battery evolves hydrogen, but if not in sufficient quantity to burn, could easily be made to do so by adding more zinc filings. After all the air has been driven out of the jar or bottle, it would burn through a suitable burner, and might be sufficient (this is the question) to produce incandescence when aided by the two poles of the electric jar. The wires could come through the top sides of jar, and carbon or platinum be the incandescent medium. I know the electricity would be small, but I do not know what effect would be made by burning the two elements in one combination. If anyone is going to try, let him wait twenty minutes after the gas is evolved and the jar closed, before he lights the burner (a tobacco-pipe through the cork will do); by that time the air will be driven out and no explosion will take place. You can buy a bottle with three necks at most chemists, arrange a stand for platinum or carbon, &c. But perhaps all this has been tried: if so, I only want to know the result so far as the incandescent light is concerned. —Fiddler.

[47201.]—**Instantaneous Photography.**—"Tyro" thanks "Ditton" for his reply, and will be glad of any help. The plates were the "Lancaster" extra rapid dry plates.

[47201.]—**Instantaneous Photography.**—There is little difficulty in obtaining instantaneous photographs of clouds. Your failure is probably owing to one of the three following causes:—Too slow plates, too small aperture in lens, or too weak developer.—W. Robinson, Jun.

[47206.]—**Dry-plate Developer.**—Citric acid would be useless, as it does not keep well itself. A little nitric or glacial acid would be better; but in strong solution, 25gr. or upwards pyro. keeps a long time without any addition. Methylated spirit in the proportion of one part, to two or three of water, materially assists in keeping solutions of gelatine good, and has no injurious action on prints.—W. Robinson, Jun.

[47210.]—**Pedometer.**—This instrument does not indicate speed, but distance only. It is regulated according to length of stride. I have one divided into spaces indicating 80 yards, and regulated it thus: Measured a distance of 10 yards, and walked over the space in my ordinary step. I found I took 12 steps = 96 steps in 80 yards. I then altered regulator till 96 beats of lever moved indicator one space (indicating 80 yards), turning screw to right, for slower, or *vice versâ*. Of course, the shorter the step the slower it must be set.—G. M. J. B.

[47210.]—**Pedometer.**—If yours is an ordinary pedometer, then the larger dial will give yards, and the smaller dial miles. You will have to regulate it so that when you have walked a measured mile then the fingers both indicate one mile—that is, the small finger points to 1, and the larger finger has gone once round and points to 0; if this finger is on either side of 0, then you must regulate the little screw at the back until the indications agree with the measured distances.—W. J. Lancaster.

[47216.]—**The Berliner Violin.**—We must wait a reply from the U.S. Perhaps the instructions given will make it an easy matter for all.—Fiddler.

[47216.]—**The Berliner Violin.**—I took off the finger-board of a violin, and made an affair somewhat similar in shape to a horse's collar, with a tang to it, which tang was glued on to the neck, and then the finger-board on top of that. This was made of mahogany, about ½in. square, and when strung up and bowed, it vibrated and interfered with the tone. But I believe that if it were made stronger in section, it might improve an inferior new fiddle; but, in the mean time, I am calmly waiting to see "any new violin that could compete with my old Klotz."—J. J. A., Liverpool.

[47217.]—**Induction Coil.**—Yes, connect the microphone with the primary coil, and the telephone with the secondary coil.—Albert Smith.

[47217.]—**Gaiffe's Medical Induction Coil.** Frank Smith can use this with his telephone. The primary, battery, and microphone form one circuit. The secondary is in circuit with telephones, line and return wire. You will require a switch to cut battery out when not in use.—George Tolman.

[47217.]—**Gaiffe's Medical Coil.**—You can use it in circuit from the microphone thus: Couple wires from microphone and battery to the larger binding screws of Gaiffe's coil; then connect line and earth, or the line telephone wires, if you don't use earth, to the binding screws, to which ordinary handles are attached.—W. J. Lancaster.

[47218.]—**Circulating Decimals.**—If Mr. A. J. Smith will write to me, I will send him a copy of a small pamphlet on this subject, which I had printed for my pupils, and which may give him the information he wants.—C. W. Bourne, The College, Inverness.

[47220.]—**To Mr. Lancaster.**—You can use the 3 layers of 16; you are not making an induction coil, and 5 or 6 layers of 16 would not matter; however, I would not now go beyond 3 layers of 16. You can increase the number of 30 and 34 with good effect. See that the connections at the end of each wire are clean and well soldered and insulated, or you will most probably fail.—W. J. Lancaster.

[47225.]—**Cup-and-Ball Microphone.**—Probably there is an accumulation of dust in the cup. A good shaking would perhaps dislodge the dust, and the rubbing of the ball against the surface of the carbon would bring it back again to its best form.—W. J. Lancaster.

[47225.]—**Cup-and-Ball Microphone.**—Is it quite clear that the fault is in the transmitter, and not in the receiver? Both receivers and transmitters sometimes fail, partially in consequence of the shrinkage of the wooden cases, when the diaphragms are unequally nipped, and a slight buckle in the diaphragm is the result. However, (1) shake the microphone well; if this does not effect a cure, (2) partly unscrew the microphone, so that the diaphragm may take its proper position, then screw up again tightly; if still unsatisfactory, (3) take off the diaphragm, remove the ball, and rub it round between two pieces of fine glass-paper; with a peg and some fine glass-paper, rub round the inside of the two cups; blow away all dust, and put together again. The cup-and-ball microphone clearly works by make and break, and as it consequently does not act as a tension regulator in a closed circuit, is not within Edison's patent; and the electro-magnet receiver is, by Bell's disclaimer, excepted from his patent. I may add that a microphone made with two conical pegs and a ring, which completes the circuit between the pegs, acts almost as well as the cup and ball microphone.—H. B. T. Strangways.

[47226.]—**Picture-Frame Making.**—A jack-plane is utterly unsuitable for fine work of any kind. You should use a trying-plane at least 2ft. long, and kept perfectly flat and sharp. I use an iron-soled and brass-boxed plane, with a single iron turned upside down and set at a very much less angle than ordinary plane irons are, and this, if kept sharp, is simply delicious on the frail, foreign, plaster-bottomed mouldings.—J. J. A., Liverpool.

[47226.]—**Picture-Frame Making.**—I don't know who your correspondent is, but my case is exactly the same. I am a practical man, and have a thorough knowledge of cabinet-making, tools, &c. I have, for amusement, just started picture-frame making for the decoration of our walls of school-room, dormitories, &c. Instead of making mitre-block and shooting-board, &c., I purchased same from Savory, Caxton House, Cirencester, buying the best. I have been at it two weeks, but cannot produce a true mitre. I am very anxious to have your opinion, because I have a lot of first-class pictures, &c., and want to make some really good frames. I find, by testing with a new 9in. square, that the angle pieces on the shooting-board are not fixed square. I should also like to know the best method of putting frames together—viz., how to hold one side secure while you glue and brad the corner, so as to bring the mitre true and flush.—J. F. Newland.

[47227.]—**Size and Power of Boilers.**—In reply to "J. H. W.," ·693 is an error, and should be ·846, which will bring the result to about 101 h.p.; ·846 is found from the formula 1 + H / R. This will not affect the boiler calculation.—J. A.

[47228.]—**Telephone.**—You will require 1oz. of 36 silk-covered wire, bobbins 1½in. in diameter, ½in. wide.—Albert Smith.

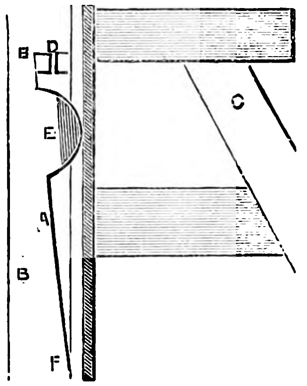
[47228.]—**Telephone.**—I have used 10 and 100 yards of 35 wire. You had better make your bobbins ⅝in. diameter by 5-16th. Fill with 35 wire winding it double; that is, *two* wires side by side.—George Tolman.

[47232.]—**The Merlin Patent Bicycle.**—A small drum, actuated by the levers and straps, runs loose on each side of the wheel. Each of the drums has a pawl, which engages a ratchet on the axle. The action is as follows:—When the lever is pressed down it draws the drum round forwards, the pawl engages the ratchet, and takes the wheel round too; but when the stroke is finished and spring in the drum brings it back to its former position, ready for another stroke, the clicking sound is prevented by means of a small piece of leather, which deadens all sound.—G. R. T.

[47234.]—**Weight of Girders.**—I do not think it would be profitable to make a box girder 12ft. long, which would break with a weight of only one ton. It would be a mere pipe, and impossible to put together with plates, angle iron, &c. A rolled joist would probably answer for so small a weight.—M.I.C.E.

[47236.]—**Object Mounting.**—If "A Constant Reader" will publish his address I will send him some of my mounting medium. I have mounted volvox and anatomical objects, and they are as fresh now as when they were first put up; the great thing is, the objects mounted in this medium do not require any preparation.—Albert Smith.

[47241.]—**Thief Detector.**—B is the pillar to which the gate C locks; A is a brass spring, fastened to the pillar at F; E is a half-ball of brass, soldered on to the spring A; H and D are two small squares of copper, D being screwed into the wood. Solder two pieces of wire to D and F. When the gate C is opened the half-ball E, with the spring A, flies forward, and makes contact at D. When the gate is shut, the spring is pushed back, and breaks the circuit. I hope this will suit.—B. Goren.



[47242.]—**How to Get Rid of Mites.**—Give a good coating of carbolic acid or a good coating of paint; gas-tar is a good thing.—Albert Smith.

[47243.]—**Dry-Plate Photography.**—In crown-glass, of which your lens is most likely made, I believe the chemical focus is usually about 39-40ths of the visual; but, as I said before, I think the exact distance can only be found by actual trial. Of course the ground-glass of the focussing-screen might be arranged as you propose, but it would be spoiled for use with an achromatic lens. Camera-making being quite out of my line, I regret that I cannot give you particulars for making dark slide, but I think you will find some information in recent back numbers.—W. Robinson, Jun.

[47245.]—**Electric Bells.**—Better look to your connections and contacts. Are they platinum-pointed contacts? Your batteries are evidently in good condition. See to earth or return wire.—George Tolman.

[47246.]—**Private Telegraph Wires.**—They are strained with a vice made for the purpose. Iron does not stretch. What do you mean by keeping tight? Do you mean copper? If so, it must be hard "drawn" wire. Insulators can be fixed close to wall, but must not touch.—George Tolman.

[47147.]—**Photographic.**—Any lens of longer focus than the one you have will proportionately increase the size of the image of distant objects; and if your camera has a movable front, it will be quite feasible to lengthen it in the way proposed; but scarcely so otherwise.—W. Robinson, Jun.

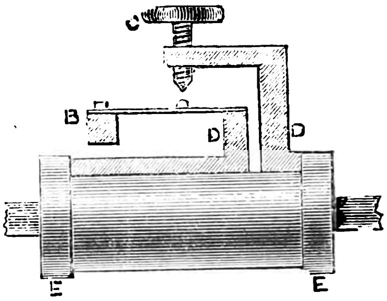
[47148.]—**Fogging.**—This is hardly likely to have been caused in the way you suggest, but is more probably owing to light having got to the plates in some way or other. What do you mean by "awaiting ferrous oxalate to redevelop"? If you have already developed and fogged the plates, better not waste any more time or chemicals on them.—W. Robinson, Jun.

[47249]—**Putting Steel Tongues in Concertinas.**—The cause of the tongues breaking is evidently because they are filed too thin near the rivet. The querist should have stated whether it is the treble or the bass notes that do break. Had he done this, and given his mode of fixing them in, I could have given him a definite reply. I do not approve of placing steel tongues in a concertina that has previously had brass ones. On the other hand, I do not think that it would be wise to put a brass tongue into an English concertina which has all the other notes of steel. I have repaired quantities of concertinas, but have never done such a thing. Try good spring brass, and hammer it well before cutting the vibrator out; then be careful in filing it, and, above all, take care not to file too much away from the rivet end. With these few hints you ought to succeed. The steel tongues only require careful filing, and some degree of knowledge in fixing.—G. Fryer.

[47250.]—**Galvanising Boat-Irons.**—I would suggest that the cause of your failure is that you didn't use pure zinc, as I have found that cuttings or scraps of ordinary sheet-zinc will not make good "soldering fluid," and I procured a lump of pure zinc from a galvanising establishment, which proved quite satisfactory. The sheet zinc is, I believe, alloyed in order to make it more tractable when rolling.—J. J. A., Liverpool.

[47254.]—**Electric Commutator for Intermittent Action.**—You will require a governor fixed on the axis of the ring armature, for which the design given below will answer as well as any. A, wooden cylinder on axis of armature; B, governor weight fixed on a spring, which flies out at the proper speed, and makes contact with the set screw C; D D, supports for the set screw C, and the spring and hammer B; E E, brass rings, connected one to each of the above; contact-springs from the frame of machine must press on the rings E E, and the springs are then to be put into circuit with the armature-brushes. You must use a magneto and not a dynamo machine if you want to succeed, and you will also find the Planté is more practical than Sutton's battery.—J. Sutcliffe.

[47254.]—**Electric Commutator for Intermittent Action.**—You can do this by having a pair of engine governors, so that when the speed slackens it will cut the storage cells out of circuit, and *vice versa*. If you require the current equal to, say, six Bunsens, then you must use twelve storage cells.—George Tolman.



[47257.]—**Bookbinding in Vellum.**—Parchment or vellum is quite unsuitable for books with limp covers and edges cut flush. Leather or cloth is more suitable for this kind of binding. No one, with any knowledge of the trade, would do such a thing. Vellum is often used for account-books of various sizes, but such books should have rather stout boards, and on no account be cut flush. By this, I mean that the vellum should be turned in, and squares allowed for the books if possible.—G. Fryer.

[47257.]—**Bookbinding in Vellum.**—The cause of the curling up mentioned is owing to the vellum not being lined; all parchment work, whether limp or boards, ought to have the vellum lined with white paper. Let "Argent Sable" paste a sheet of paper on his vellum, and allow to dry under a weight; then use the vellum in the usual way for limp work, and after the work is covered let it stand twelve hours under a light pressure, before cutting; he will then, I think, have no occasion to complain of the unruly behaviour of his covers.—Arthur E. Morris.

[47261.]—**Arsenic in Wall-Papers.**—Boil some specimen, and test the extract thus:—1. To a small portion of the solution add a drop of HCl of H_2SO_4 and H_2S: yellow precipitate. 2. Add $AgNO_3$: pale yellow precipitate. It is well to add also, drop by drop, a very dilute solution of $(HN_3)H_2O$. 3. Add $CuSO_4$, instead of $AgNO_3$: pale green precipitate.—R. Kanthack.

[47261.]—**Arsenic in Wall-Papers.**—The most simple method is Reinsch's test: boil some of the paper in a porcelain dish with some dilute hydrochloric acid and a strip of bright copper; the copper displaces the arsenic from the solution, and a dark grey compound of arsenic is deposited upon the copper: a blank experiment should be made first, because the acid sometimes contains arsenic.—Albert Smith.

[47261.]—**Arsenic in Wall-Papers.**—Immerse a piece of the paper in a strong solution of ammonia in a white plate or saucer; if the ammonia becomes blue, copper is present. Then drop a crystal of nitrate of silver into the blue liquid; if arsenic be present, the crystal will become coated with yellow arseniate of silver, which will disappear on stirring. This is an easy test, and may be performed by anyone.—F. S. Harrison, Alresford, Hants.

[47262.]—**Wheel-Grease.**—The following is a good recipe:—Mix one part of very fine blacklead, ground perfectly smooth, with four parts of lard. Camphor may be added, but is not absolutely necessary.—W. Henly Richmond.

[47264.]—**Lightning Conductors.**—See "Report of Lightning Rod Conference" (Spon), reviewed in English Mechanic, January 13th, 1882.—G.

[47264.]—**Lightning-Conductors.**—$\frac{3}{8}$ copper rope, stapled to building (without insulators); spread the ends out at the top, which should be attached to a copper tube or rod built in the building for stability. For earth, dig a hole 4ft. or 6ft. deep, 3ft. square, about 10ft. away from the bottom of structure; unravel the end of rope, place in the bottom of hole, and fill up with good hard foundry (not gas) coke.—George Tolman.

[47264.] — **Lightning - Conductors.** — The Lightning Rod Conference Report—the result of several years of patient research, by some of our most scientific men—recommends a wire-rope conductor of copper, $\frac{1}{2}$in. size, as the best form to use. A recent patent, referred to in the Report, is meeting with much favour, on account of its being easy to test after being erected. The conductor should be attached to the chimney by copper staples or strips, without insulators, and at the bottom connected to a 3ft. by 3ft. copper plate, imbedded in soil likely to be always damp, 6ft. or 8ft. below ground. It should make what is technically known as "good earth." At the top a copper rod of some 6ft. high, having a slightly-blunted point, and a circlet of finer ones a foot below is best. Fuller information given if letter addressed to 71, Albert-road, Dalston, London, E. —Yorkshire.

[47268.]—**Bellows for Brazing.**—I asked, a month or so ago, for information respecting the right kind of leather to use in making double bellows, and the reply I got was, "Ask for best strained sheep-skin." I have not begun my bellows yet, but the plan I thought of was to have the feeder on the top and the reservoir at bottom, the needful pressure being obtained by a strong chair-spring. This, I think, is neater, and more portable, and the pressure to the feeder can then be applied direct. My idea was to have a balanced brass valve and a brass seat, but I think yours is preferable as it is much simpler. Fletcher's little pamphlet "On the Use and Construction of the Blowpipe," is very useful.—Nemo.

[47268.]—**Bellows for Brazing.**—The leather for these should be calf, oil-dressed; the joint with the wood is made by getting the surface of the wood perfectly smooth, putting a layer of dubbin between the leather and wood, and nailing close with special broad-headed nails, the heads touching each other, or nearly so. To make tight bellows, to stand heavy pressures, is a matter of considerable difficulty, requiring experience. Brazing with blowpipe requires some practice, and if powdered spelter is used it should be mixed with wet powdered borax into a paste, gently heated until the borax is dry and fused, and then the full power of the blowpipe applied. If not treated this way, the spelter is burnt, or oxidised, and at once becomes useless. For small work it is better to use an alloy of equal parts of coin silver and copper, melted together and rolled into a thin sheet. This will make an edge to edge joint, which will stand bending, hammering, or rolling out.—Thos. Fletcher, Museum-street, Warrington.

[47269.]—**Electric Motor for Tricycle.**—It is not possible to store power by a dynamo-machine, in connection with the wheels of a tricycle, to any advantage. I have been informed that the French electric tricycle ran on a smooth level surface, and is not very suitable to go uphill. It was worked by a bichromate battery of large surface, and is only likely to be used as a curiosity. If you want a practical motor, I would advise a gas or air-engine. Both have the disadvantage of being rather warm; but a coiled spring would be better than any electric contrivance for a tricycle.—J. Sutcliffe.

[47273.]—**Lines of Force.**—You will find this described with two illustrations on page 152, No. 891, Vol. XXXV.—George Tolman.

[47174.]—**32ft. Pedal-Reeds.**—Let me know the size of your 32ft. reeds, and then I shall be able to furnish the desired information. Also let me know the number of reeds that you intend to add, and also a brief description of the instrument you wish to apply them to.—G. Fryer.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last "Ditton" has answered 46103, 46505, 46618; "Carino," 46470.

46652. To "Clerkenwell Clockmaker," p. 161.
46653. Finishing Flax, Twine, and Cord, 161.
46695. Spark Condenser, 162.

46933. Photographing Monuments in Cemeteries, p. 218.
46939. Eames' Locomotive, 218.
46940. Sidebotham's Axlebox, 218.
46961. Soluble Oil, 249.
46970. Grain Dresser, 249.
46971. Soluble Essence of Lemon and Cinnamon, 249.
46980. Brakes, 249.
46992. Organ Query, 249.

QUERIES.

[47274.]—**Illuminating Clock.**—Can any correspondent tell me how to illuminate a 3ft. clock-dial, iron, outside in front of a bay window? Could a light be put inside of room and act on a reflector in front of clock, and so cause the light to show on the figures? The clock is 12in. from the window-glass. How large would the reflector be? Also, what kind of light?—Light.

[47275.]—**Oak Graining.**—Will some practical painter give me full particulars on oak-graining as to mixing the graining? I have tried brown umber mixed with oil, and I find it is too dark; and I am at a fix what to mix it with. I want to mix the umber with table beer (or turpentine, one painter told me). Will someone be kind enough to tell me what I am to lighten it with, and then I want to know how the over-grain is laid on?—An Amateur.

[47276.]—**Electrical Indicator.**—Will some of "our" friends please describe a water-level indicator? I wish to construct one for a reservoir one mile away from the pumping station, and 260ft. elevation. As the level is constantly changing, it should be capable of denoting the rise and fall respectively, as they occur, and to within, say, 3in. The reservoir is 9ft. 2in. deep from overflow to floor. A sketch would be a great help to me. Also, one of the receiving instruments.—Troubled.

[47277.]—**Engine.**—I have a cylinder 2$\frac{1}{4}$in. stroke, 1$\frac{3}{8}$in. dia., that I wish to fit up myself. Will any able reader instruct me a little the best way to make the slides, as the piston is cut off for a crosshead? Also, the weight of the flywheel, and would it work sewing-machine?—T. B.

[47278.]—**Patented or Not?**—If I put an iron tube round the bobbin of an electro-magnet, am I infringing on anyone's patent? I saw some at the Crystal Palace treated so, and they were marked patent. Is it not a very old idea?—Bobbin.

[47279.]—**Spoilt Glass Shelves.**—When making some alterations to my shop-window, I put some glass shelves away for future use, not having occasion for them at the time. Thinking the only thing I had to guard against was breakage, I stored them in a cellar, leaning against the wall, not in a particularly damp place. On examining them after several months, preparatory to using them again, I found them covered with cloudy spots and patches. I have tried every means I can think of to clean them, but without success. They look as if they were dirty, and it seems as if the polish has been eaten off the surface of the glass. Can any fellow-reader suggest the reason, and say what can be done with them?—J. E. A.

[47280.]—**Legal.**—To Mr. Wetherfield.—I have an iron-foundry of my own: I and my brother worked it as partners. We dissolved, and now he has built himself a foundry. Can he legally take the name of my foundry and call his foundry by the name by which the old foundry we jointly worked 16 years is known?—G. B.

[47281.]—**Tricycles.**—Can any of your correspondents say from his own experience what are the comparative merits for hill and level work of lever and chain driving tricycles? The Challenge tricycle No. 1 is an elegant machine, with one large wheel behind, and two small wheels in front. The large wheel is driven by two foot-levers, and being in the centre-line of the machine, this method seems to have some advantages. I observe, however, that the lever arrangement is very rare, nearly all tricycles being driven either by a chain or cog-wheels. All the other Challenge tricycles are so driven. If any of your correspondents can throw light on the subject, I shall be obliged.—B.

[47282.]—**A Foreground Query.**—I wrote a few months since to the Slade Professor at Oxford about the following subject; but the big man was, I suppose, too exalted to stoop to the consideration of a matter of such trifling interest, as he took not the smallest notice of my letter; I confess I regretted that Mr. Ruskin was not still the occupant of that chair of State:—Suppose I am sketching a scene, say a house or church with foliage at a distance of two fields, and do not wish to include more ground than half that distance, the building being more picturesque than when viewed more closely. In such a case the herbage, &c., of the distance—i.e., the field immediately in front of the building, is indistinct, with no visible leafage. If left thus in the picture, it seems to demand more detail; but if such detail is given, the result is, that the building, instead of appearing at a little distance, necessarily comes forward, because the detailed foreground immediately in front of it predicates the nearness, also, of such building, and the latter now demands to be treated as itself a foreground object—quod non erat desiderandum? In point of fact, no one sketching a scene sees the detailed leafage at his feet.—Then query? Ought it to be represented in detail, unless the scene is absolutely and solely a bit of foreground?—Country Sketcher.

[47283.]—**Launch Tubular Boiler.**—I want to know what is the specific gravity to which sea-water should be kept in a launch boiler (tubular). When should the water be changed, and in what manner is this done under steam?—J. F. E.

[46284.]—**Modelling in Plaster.**—I have taken and been a reader of your valuable journal for several years, yet I am not aware that the subject of modelling in plaster or any other material has been fully treated of. Now I should be glad if some one of your numerous correspondents well acquainted with the subject would give us a full account of it.—An Amateur.

[47285.]—**Gymnastic Apparatus.**—I inserted a query some weeks since asking for the manner in which ash bars up to 7ft. were bored for inserting steel rods. The answer "Jack of All Trades" kindly gave was hardly what I required, as he only informed me of the pattern of drill. What I require is the most approved machine for doing this work. If it is not possible to describe it in the answer to queries column, perhaps some obliging correspondent will inform me of the maker of the machine, or where I could have the bars drilled. I shall be very greatly obliged by this information.—Gymnastic.

[47286.]—**Chromograph.**—I have lately made one of these as follows:—10oz. glycerine, 2oz. gelatine, 1oz. kaolin, and a little salicylic acid with 8oz. water. I find after the first few copies they get very indistinct, and am afraid I have not quite sufficient of one of the articles: I should be glad to know which. The qualities of the materials used were the ordinary chemist's, not the "commercial." While on this subject, I may state I find a 10 per cent. solution of hydrochloric acid very useful to remove the old copy, just rubbed lightly over with a sponge.—Gymnastic.

[47287.]—**Magneto-electric Machine.**—Please give precise detailed instructions to wind wire on bobbins of above? Also, at what part of revolution should spring working on flats of spindle make and break contact? Having repaired a machine, cannot get it to work, and think fault exists where referred to. Ordinary upright machine for medical purposes.—A. Matthews.

[47288.]—**Drying-Racks for Dry Plates.**—Could any of our numerous readers kindly give me their experience in drying plates on their ends? I find the plates do not dry evenly if too close on the racks. I prefer them dried on their backs, but cannot dry half the quantity at a time.—J. R. Brown.

[47289.]—**Sulphur Casts.**—What is the proper mode of mixing colour (e.g., vermilion) with the sulphur, so as to avoid the patchy appearance on cooling? The results when fresh from the mould seem perfect: but on cooling and exposure, the polish disappears and the colour deadens.—J. P. H.

[47290.]—**Calculating Machine.**—Will anyone kindly oblige by directing me how to make a reckoning wheel such as is used in the railway clearing-house Euston-road, or any other easily-made calculator?—W. D.

[47291.]—**Boiler Ends.**—Kindly give me rule in plain figures for calculating the flat end of a boiler unstayed, the diam. of which is 5ft., thickness of plate $\frac{9}{16}$, single riveted to shell.—John.

[47292.]—**Bunsen's Battery Connections.**—Will any correspondent say how I could connect my carbons with copper wire or slip, otherwise than by using a clamp? If it can be done by depositing copper on the top and then soldering, kindly give instructions for soldering, as I have been told spirits of salts should not be used for battery connections.—Bond.

[47293.]—**Pump Query.**—Will some reader say what clearance the ram of a pump has to have from the bottom of the barrel, of the following descriptions:—Diam. of ram 12in., 2ft. stroke, and running at 38 revols. per minute; heat of water 120°. Is the speed too high?—No Name.

[47294.]—**New Combination of Altazimuth and Equatorial Mounting.**—Will Mr. Godfrey or "F.R.A.S." oblige us with a proper description, with figures, of the "Smeaton block"? I remember the latter correspondent making an illusion to it some months ago.—J. C. L.

[47295.]—**Decimal of the Year for Astronomical Observations.**—I should be glad to know how this is calculated. Mention is made in Vol. XX. that it belongs to the year with which it is associated, but nothing more.—J. C. L.

[47296.]—**Object-Glass Making and Correcting.**—Thanks to "O.V." for his kind reply to my query; his quotation for Chance's discs is quite correct for that size. May I now appeal to "Prismatique" whether he will go into the matter when he sends his promised letters on object-glass making? and if he would like to read the letters by Mr. Godfrey I alluded to in No. 899, I should be pleased to send him the numbers containing them.—J. C. L.

[47297.]—**Taking Cold.**—To Dr. Edmunds.—The last few months I have had an almost continued cold in the head, and now and then a slight cough. I am at the counter, and, of course, subject to the usual draughts of a shop. I am very thinly thatched, and perspire very much, and with very little exertion, and think that has something to do with the cause of colds. I wash my head in cold water every morning, and have just taken to my cold sponge bath for the summer. I don't wear a cap in the shop, and don't want to. Can you advise any remedy?—Is it debility, as I have felt a considerable languor for some time?—E. S.

[47298.]—**Examination of Malt.**—I want to examine malt chemically, but the filtration of the infusion, by means of the ordinary funnel and filter papers, occupies more time than I can spare. Will someone kindly inform me by what means I can effect this process with more rapidity?—Phœnix.

[47299.]—**Lantern Optics.**—Will any of the numerous optical correspondents of "ours" kindly answer the following?—When the source of light (lime-light) is placed within the principal focus of condenser, the enlarged disc of light on screen is well and sharply defined; but when placed in the principal focus, so as to give a parallel beam, the disc on the screen becomes dimmer and loses all sharpness of definition; in fact, is not a disc at all. Is this the usual experience? If not, where is the fault? If so, why should not the disc be equally well defined when a parallel beam is used as when a divergent one is used, as in the first case stated above?—M. A.

[47300.]—**Proportions of Cylinders.**—Would "Tubal-Kain" kindly answer the following questions? I wish to know the rule for finding out the proportion the high-pressure cylinder ought to have to the low-pressure cylinder in compound engines? Also, the advantage of working with dry steam, and the advantages of wet steam? Also, the rule for finding the temperature of any given pressure of steam? Please don't use algebra.—A Beginner.

[47301.]—**Vacuum Tubes and Coil.**—Will any of our correspondents kindly tell the probable cause of flashing or dancing in vacuum tubes? When everything is apparently in order, and the coil in great force, I am often troubled with a dancing or winking of the tubes, like gas light when there is water in the pipe. The cause of this, and how to avoid it, would much oblige—W. R. C.

[47302.]—**Contracted Tendons.**—Will any medical correspondent of the "E. M." kindly inform me what remedy I can apply for the following ailment?—The tendons of two of my fingers in the palm of one hand are so tightened as to contract the fingers so that they cannot be straightened, and on the tendons a hard lump or swelling has formed, and a similar hard lump has commenced forming at the foot of the thumb in each hand just below the joint in the palm of the hands.—Tropics.

[47303.]—**Rusty Water-pipes.**—I have some 1in. iron water-pipes which have been in use several years, and the water through which often comes away rusty, and is a source of great annoyance to me; in fact, causing spots of ironmould to appear on the goods which I immerse in the water. Can this be remedied in any way? I have adopted many means to try and clean the pipes, but with no satisfactory results as yet. A suggestion from any of ours will be thankfully received.—Puzzled.

[47304.]—**Division Plate.**—Will some correspondent oblige by answering the following?—I have a 5½in. centre lathe, to which I want to add a division plate. The pulley on the mandrel is mahogany, and is 7in. dia. I thought if I had a plate cast and screwed it on to the face of the wood pulley, it would answer. What would be the best metal to have, and how thick? What would be best numbers to have, and how am I to divide it? I have overhead motion and drill-spindle. What would be the best form of drill point to drill the plate with?—E. J. L.

[47305.]—**Photography.**—To Mr. Parkinson.—Would you kindly answer me the following, and oblige? I have taken several enlargements on bromo paper, but not one free from white spots. I thought they were caused by dust on the paper before exposure, and I was very careful afterwards; but still I had spots. Cause and remedy? What shall I use to spot out? Also, what should I use for spotting out silver prints? If there were dust on the lens, would it show on the paper or on taking a negative? On May 26, you stated you used Edwards' developer: Do you find it suits different makers' plates, and would the action be slower if the bromide of potash were increased, as one formula I have gives the bromide 200 grains?—F.

[47306.]—**Slide-Rests.**—As I have previously made some remarks on the plan of dividing the nut of the leading screw of a slide-rest, I should like to supplement them by asking Mr. Evans, apropos to his article on slide-rests, whether it is expedient to apply this means of correction to a new tool, however advantageous it may be for the repair of an old one. My objection is this: by dividing the nut into, say, two equal parts, all the work of the screw motion is thrown on one-half of the thread of the nut; and this, whether the parts are screwed up or not, and as a well-made screw and nut will work for a long time without any "back-lash," it seems a pity by dividing the nut to hasten the time when this will arrive. I should say it was better to wait until the nut is sufficiently worn to call for the remedy.—M. A.

[47307.]—**Mildew on Vines in Greenhouse.**—I have had the mildew in my greenhouse three years running, and lost the whole of the crop. The grapes are covered with a white film, and the leaves are spotted as if burnt. I have tried fumigation with sulphur and lime, and other supposed remedies, but to no purpose. I have now a splendid show of fruit, but the mildew has just made its appearance. Can any reader tell me how to stop it and save my grapes?—Amateur Gardener, Cheltenham.

[47308.]—**Inflamed Throat.**—To Dr. Edmunds.—About two months ago I had inflammation of the throat, which relapsed several times. At present I feel a constant desire to swallow or expectorate. Health fairly good.—North.

[47309.]—**Clarionet.**—I should be obliged if any of our readers would kindly tell me how to determine (theoretically) the dia. and length of bore, the distance between the holes, and the diam. of same. I wish to make a clarionet about a quarter-tone flatter than those in general use, and as I cannot get an instrument to take pattern from, I am forced to seek information where I can. I have looked through two works on acoustics but have found no such information. Should be glad to know if there are any books on the subject. I should also like to make my own reeds, and would like to know how to choose the cane, and how to proceed.—Old Blow-Hard.

[47310.]—**Naturalisation.**—Is a Frenchman by being "naturalised" as an Englishman thereby exonerated from military service in France? Could they imprison him if he went to France after failing to appear to serve when summoned? And has the French Government power to confiscate any property he may become possessed of in France?—Kanet.

[47311.]—**Cannon.**—Being about to cast a gunmetal cannon 2ft. long, and 1in. bore, I wish to know what thickness the metal ought to be at the breech end, so as to insure safety.—E. A. L.

[47312.]—**Dynamo-Machine**—To George Tolman.—Will you please give your opinion of arrangement of field-magnet? The core of F.M. is ½in. by 3in., bent to shape and screwed to soft iron pole-pieces 5in. long. My armature is of the Gramme form, and is 5½in. by 2¾in., and consists of 8 coils of 16 c.c. wire, 4 layers of 15 rows each, giving 30ft. on each coil. What amount and size of wire should I wind on field-magnet? Should it be arranged as shunt or circuit machine? Any suggestions as to better form of F.M. (to work with pole-pieces which I have by me) will be gladly received. Thanks for former answers.—In Want of Help.

[47313.]—**Tests for Bicarbonate of Soda and Tartaric Acid.**—Will some correspondent tell me how to test bicarbonate of soada and tartaric acid for commercial purity? I require them for mixing with flour, and find that some samples do not act as efficiently as others.—Novillo.

[47314.]—**Rotation of the Earth.**—How many times does the earth rotate in the 365 days forming the year, fractions corrected by leap year being disregarded? It appears to me if there are 365 alternations of day and night in the year, the earth must rotate either 364 or 366 times.—Cymro.

[47315.]—**Harmonium Pan.**—Will someone kindly give instructions for making a pan for harmonium to contain 2½ sets of reeds?—Gotha.

[47316.]—**North Pole of Electro-Magnet.**—Suppose I hold a bar of iron with its axis in a line with my sight, and commence to coil by winding in the direction of the motion of the hands of a watch, which end of the bar should I begin at—the distant or the near end—to make a true north and south polarity? State which end is north.—Pan Jack.

[47317.]—**Lewis' Incandescent Gas-Burner.**—To Mr. J. T. Sprague.—I have read your article on the new gas-burner with great interest. I am looking out for a good effective light for large shop and warehouses, either electric or some improved system of gas. The present gas-burners I consider very undesirable: in fact, unworthy of the age we live in. Can you confer a further favour by giving an idea of the cost and permanency of the "platinum wire cap," and the best means of supplying the compressed air? Can it be done by a small gas-engine, and what power would be required for, say, 50 burners of 50-candle power? Can the compressed air be economically stored, or would it have to be supplied as required?—D.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, June 28, and unacknowledged elsewhere:—

H. Layton.—Hillman, Herbert, and Cooper.—Lurgan Mechanics' Institute.—Photo. Artists' Co-Operative Association.—J. K. Smythies.—E. B. Fenessy.—Serg.-Maj. Connors.—J. A. Maclean.—Arthur Hinde.—S. Norman.—Rogator.—H. B.—S. Taverner.—Ajax.—S. J.—Plumber.—Arthur Smith.—Air.—Dusty.—F. Rowe.—Cleaner (Salisbury).—Jack of All Trades.—Alfojoe.—F. H. H.—H. Field.—Student.—Ditton.—Crytax.—Nuda.—Veritas.—Seaweed.—Meteor.—Manchester.—Fred Walker.—T. H. Espin.—Enquirer.—E.—S. J.—Poor Scribe.—G. F. Finn.—R. T. B.—A. Stanley Williams.—C. Townley.

Frederick Petersen. (No, vulcanised paper is not celluloid. The manufacture of the latter has been frequently described.)—M. J. (Add water to the recipe given on p. 317. 2. Benzol, turpentine, Castile soap are among the many revivers used.)—Yelrum. (By means of blocks of lignum vitæ, which are grooved to fit into grooves on the shaft. The tremulant is scarcely suitable.)—Erin-go-Bragh. (They are all worked on the principle illustrated on pp. 87, 111. See also p. 224. The switch is an arrangement of brass rods connected to the different wires, so arranged that by the insertion of plugs any two wires can be connected together.)—Troubled One. (A number of recipes for eczema in last two volumes. Anointing with clarified beef-suet and powdering with oxide of zinc, repeating the coatings one over the other, is recommended; but you might try vaseline ointment.)—Troubled. (Several medical coils described recently. See p. 313. There are not so many ways of connecting up that you should be long puzzled.)—A Beginner. (Question cannot be answered. Make the hammer hit it hard; but perhaps it is a soft-sounding bell, and is as loud as it was intended to be. 2. As to making a telephone, you must look through recent indices, and choose for yourself.)—John C. Newbold. (No one can answer such a question without examining the motor, and your sketch does not give even an idea of its construction.)—Albt. Wyles. (The author will, doubtless, correct.)—G. H. H., Derby. (Such a recipe would be worth a trifle. Clean them up with the finest glass-paper, and polish with whiting and spirit. Then expose to sunlight behind glass. Some makers put whiting into the glue, others dry whitelead, using very pale glue.)—Salopian. (Of course, the two surviving sons share equally; the eldest son's claim is preposterous.)—Ch. Rabache. (You flatter us, we fear; but we must leave the establishment of a French counterpart of "ours" to some Frenchman. We fear our English subscribers would respond very slowly to your idea. We cannot spare space for the reproduction of reply 46051, and under the guise of a reply to 47053, we do not see our way to admit your dissertation on spectrum analysis.)—J. A. Jeffrey. (Should be glad to have the photograph.)—J. J. Rathbone. (Are you sure the bankrupt did not get his discharge? If so, you had better consult a respectable solicitor, and take action at once—that is, if the debtor is worth powder and shot.)—Senor Espanol. (We cannot insert queries as to prices, &c.; but why not write to Lancaster and Son? See their advertisement on back page.)—A. Illingsworth. (Not if it has been obtained honestly, as most probably it has; still, just now, people should be careful.)—Ferro-Carril. (Why should we occupy valuable space with reproductions of illustrations which can be obtained elsewhere, or of well-known objects in museums, which can be seen at any time?)—Pater. (The confinement and long hours *would* injure her, and unless she worked hard she would not make a living.)—Cymro. (You have simply confused yourself by rotating it once in a revolution. The question in its simple form is inserted.)—George. (A foot diameter has a circumference of 3·141ft.)—John Hale. (1. Bunsen; 2. A matter for experiment; 3. Depends on how the zinc and acid is bought; 4. Would have to be cleaned daily; 5. See 3; 6. As large as convenient, not smaller than No. 16; 7. About 4s. 6d. a cell, plus the cost of charging.)—Pan Jack. (Has any one said that it is not?)—W. Ebrington-Knight. (See p. 20, last volume, and the indices.) S. T. Smith. (You have not followed the instructions, and expect impossibilities. See p. 308, and recent back numbers. Must have a coil if you want shocks.)—Tinker. (If your query was received, it was inserted or answered here. As it appears to be only about solder, it is probable you were referred to back numbers. Look in the index to Vol. XXXIII., and you will discover references to a number of papers on solder and soldering.)—A Down Mechanic. (Fuchsin is a hydrochlorate of rosaniline; Hofman's methyl violet is prepared from rosaniline, iodide of methyl, alcohol, and potash. Both are be had of any dealer in dye-stuffs.)—Experiments. (You run great risks of having your questions dropped into the w. b. You might, at least, write plainly. We cannot discover whether you want to make or analyse extract of safflower. Probably you will find the questions answered in Slater's "Manual of Colours and Dye-Wares," just published by Lockwood and Co., Stationers' Hall-court, E.C.)—Mariner (See p. 308. You will have all the materials ready to hand. The zinc will be useful for certain purposes—cutting up into rods, for instance—or you can melt and cast to shape required. Thompson's "Electricity and Magnetism," Macmillan, and our back-numbers for practical hints.)—Tent Maker. (They use preparations of cochineal, combined with starch, and salts of tin. You could print on the material with ink, or use stencils. The methods used by calico-printers would be expensive and troublesome without proper plant. A good vermilion red is made with 5lb. vermilion to 1 gallon of thickening, the latter being a mixture of gum dragon and egg-albumen. The colour is faster the more albumen is used, 4lb. of albumen and ¾lb. of gum dragon to the gallon of colour being the best. After printing, the fabric is dried and steamed for an hour.) Paulatim. (You should consult the back volumes, and procure the catalogues of the makers who advertise in our columns. Nothing less than a 3in. back-geared lathe would be of much use.)—Electrician. (The weight and gauge vary to a certain extent with the size of coil. In No. 797, p. 410, there is a table of dimensions, &c., of coils described in this paper; on pp. 15, 16 of this volume, and on p. 313 dimensions, &c., of different coils are given.)—Junius. The rule is to make the layers as thick as the core, and twice its diameter for length. Perhaps you have not wound the wire correctly, and perhaps you have not battery power. Suppose the iron rod is ⅜in., then make the limbs 2in. long and fill bobbins 1in. in diameter and ¾in. long—that is, the groove in the bobbin should be ⅜in. by ¾in.)—Catarrah. (See Dr. Edmunds' paper on p. 441, No. 851.)—Harry A. Dix. (Varnish paints; but none will last very long.)—Sandblast. (See p. 235, No. 400, for an illustration of the sandblast. You can soften leather by soaking in water.)—One in a Fix. (We presume you really mean nickel, not nickel silver. Nickel is readily dissolved by nitric acid and by aqua regia, also by sulphuric and hydrochloric acid. Either your acids have not been strong enough, or your metal has been in too large pieces. 2. It ceases to work when the circuit is broken, but local action goes on.)—O. (The answer would be, Certainly, for if it gives any current at all it would work it. 2. Shellac varnish carefully applied is all that is required.)—A Constant Reader, Manchester. (The question has been answered many times in nearly every volume. See p. 110, No. 785; p. 313, No. 793, and more recently p. 240, No. 868, and p. 253, No. 869.)—Manchester. (Vitremanie is properly burnt-in glasswork, but you mean, we presume, the method of sticking coloured pictures on windows. That is done by varnishing the print with Canada balsam, or some other crystal oil varnish until transparent. The tools required are very few. See p. 100, No. 498. Materials of artist's colourmen generally.)—An Amateur Tinker. (We answered you on p. 341. For japanning tin, see No. 868; for cold brazing, see p. 81 of this volume.)—A New Subscriber, Longton. (Sprague's "Electricity: its Theory, Sources, and Application," E. and F. N. Spon, Charing-cross, 8s., but we believe it is out of print, and a new edition is being prepared. The present volume commenced with No. 885.)—E. M. (The addition of strong soapsuds to boiler feed may help to prevent the plates corroding; but it will also help to burn them by forming a layer of non-conducting slime between them and the water. Keep the plates clean by purifying the feed-water, and by frequent washing out.)—THOS. M. (As the object is to impregnate the leather, the slowest drying would be the best, provided it is not one of those qualities that never dry properly.)—AN AMATEUR. (See p. 496, No. 853.)—J. E. (A cheap and simple metronome was described and illustrated on p. 216, No. 841.)—PISCES. (Nos. 851 and 852 contain several recipes for aquarium cement. Both can be had.)—PRAGMATICAL. (For Holtz machine, see p. 179, No. 840; for the Voss machine, p. 335, No. 846.)—THOS. M. (1. Such a will would be perfectly valid. Two witnesses are required who must not be legatees. 2. Not necessary. 3. Trustees are not necessary. 4. The will can be revoked at any time by simply making another. It would cost you very little to get a respectable solicitor to make the will, and would be safer every way.)—W. H. P. (The Act can be procured from the Queen's printers, Spottiswoode and Co. We do not know the title, and do not think it applies to the cases mentioned.)—DESPONDENCY. (Try bathing them daily with water, in which Tidman's sea salt has been dissolved; very probably the weakness will pass off in a couple of years or so.)—J. J. ALLINGHAM. (No; half a crown.)—DUTCH SUBSCRIBER. (If you can answer Mr. Lancaster's questions, he will probably give the information asked for; but we cannot go to the expense of illustrations which would fill half a column that he may see what the camera is like.)—ELECT. APPRENTICE. (Mr. Tolman will, doubtless, supply parts, &c. He advertises in the "Sale Column." You had better ask the other questions privately. We cannot repeat matter already published.)—CELER ET AUDAX (Any of the makers who advertise in these pages would supply you. Such tires as you suggest would interfere very materially with the speed.)—J. H. HUXLEY. (You had better re-write the letter and make a fresh drawing—if you think it worth while. On the whole, we hardly think it is.)—S. CALTON, BEETLE CRUSHERS. (In type.)

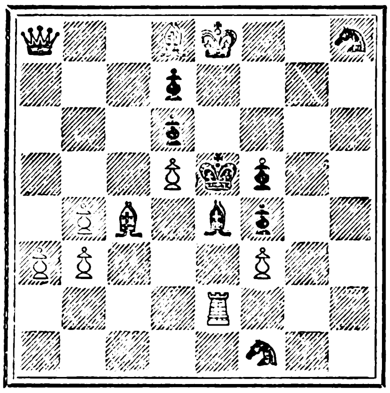
F. H. H.—B. B.—Nunquam non Paratus.—Tony B.—J. R. E.—Arthur E. Morris —M. Jonson have replied to queries already similarly or adequately answered.

CHESS.

ALL Communications for this department must be addressed to the Chess Editor, at the office of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCLIX.—By J. PIERCE.

Black.



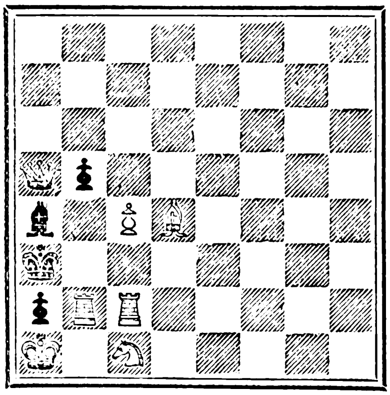
White.

White to play and mate in three moves.

PROBLEM DCCLX.—By "J. N. B."

From Brentano's *Chess Monthly*.

Black.



White.

White to play and sui-mate in three moves.

SOLUTION TO 755.

White.	*Black.*
1. Kt K R 6	1. Anything
2. Kt Q B 4	2. Anything
3. Mates accordingly.	

In this problem the K should be at Q B sq. and P at Q 3 to make it sound.

SOLUTION TO 756.

White.	*Black.*
1. Q to Q R 7	1. Anything
2. Mates	

NOTICES TO CORRESPONDENTS.

D. A.—Your solution to 756 is correct, as also those to 755. It is unfortunate the latter problem is so marred.

GAME recently played by correspondence between two amateurs (Steinitz Gambit):—

White.	*Black.*
1. P to K 4	1. P to K 4
2. Kt to Q B 3	2. Kt to Q B 3
3. P to B 4	3. P takes P
4. P to Q 4	4. Q to R 5 (ch)
5. K to K 2	5. P to Q 4
6. Kt takes P	6. B to Kt 5 (ch)
7. Kt to K B 3	7. Castles
8. K to Q 3	8. P to K B 4
9. Kt takes Q	9. P takes P (ch)
10. K takes P	10. B takes Q
11. P to Q B 4	11. Kt to K B 3 (ch)
12. K takes P	12. Kt takes Kt (ch)
13. P takes Kt	13. R takes P
14. B to K 3	14. B to Q B 7
15. R to Q B sq	15. P to K Kt 4 (ch)
16. K to B 3	16. Kt takes P (ch)
17. B takes Kt	17. R takes B
18. R takes B	18. R takes Kt
19. P to K Kt 3	19. R to Q 5
20. B to K R 3 (ch)	20. K to Kt sq
21. K R to B sq	21. B to Q 3
22. B to K B 5	22. P to K R 3
23. K to Kt 2	23. R to K B sq
24. P to K Kt 4	24. B to K B 5
25. R to K sq	25. R to Q 7 (ch)
26. R takes R	26. B takes R
27. R to K 6	27. B to Q B 8
28. B to K Kt 6	28. K to Q B sq
29. K to B 3	29. B to K B 5
30. P to K R 3	30. P to Q B 4
31. R to K 7	31. R to Q sq
32. B to K 4	32. B to Q B 2
33. B to B 5 (ch)	33. K to Kt sq
34. B to Q 7	34. P to Q R 3
35. R to K R 7	35. B to K 4
36. P to Q Kt 3	36. B to Q 5
37. R to B 5	37. R to Q 3
38. B to K 4	38. P to Q Kt 4
39. K to K 2	39. P to Q B 5

Game abandoned as drawn.

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Every Workman connected with the Building Trades requiring a situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden London, W.C.

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OUR EXCHANGE COLUMN.

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Oil and Limelight **Dissolving View Apparatus** for Screw-cutting Lathe, Twist Drills.—D. W. N., Ernest Cottage, Peyton-place, Royal Hill, Greenwich.

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Two horse-power **Vertical Engine**, with two cylinders, complete, equal to new. Will exchange for good Bicycle about 50in.—SIXSMITH, Jackson-street, Oldham.

Powerful **Intensity Coil**; for good Field Glass, model engine or offers.—SPENCER, 26, Dysart-road, Grantham.

Jigger Sawing Machine (new), separate counter shaft; exchange, Boiler or screw-cutting lathe.—2, Etruria-street, New-road, Battersea, S.W.

Saw Spindle, 2in. circular, new, 2 pulleys, gun-metal bearings, V. journals, bright. Exchange lathe.—2, Etruria-street, New-road, Battersea.

Engine Cylinder, 2¼in. dia., 4in. stroke, round brass crank, reverse motion, bright. Wants cleaning. Anything useful.—F. BYNG, Queen-street, Halesowen, near Birmingham.

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Wanted, a good screw-cutting **Lathe**, in exchange for new Furniture or Ironmongery, or 36in. Facile Safety Bicycle, nearly new.—R. WAYCOTT, Paignton.

Wanted, one or two horse-power **Gas Engine**, in exchange for new Furniture or Ironmongery.—R. WAYCOTT, Paignton.

I will exchange two sets of ½ horse-power **Engine** CASTINGS, one part finished, one in rough, for some good offers.—GOULD, 3, Keen-street, Warrington.

Screw Steamer, engine, boiler, safety-valve, compass, steering gear, wheel and screw, 2 3 bladed screws, splendid worker; for anything useful.—E. HOLT, 11, Ford-street, Miles Platting, Manchester.

"**Wonders of Geology**," 2 Vols., "British Cyclopædia," 4 Vols., "Brewster's Optics," "Herschel on Astronomy," "Daniell's Chemical Philosophy." Offers requested.—SMITH, 30, Mulberry-street, Bradford, Yorks.

Wanted, good 54in. **Bicycle** in exchange for complete Photographic Apparatus. Suit amateur.—W. FENN, 22, Seward-street, Goswell-road, E.C.

Prize Drawing.—First prize: new Printing Outfit, value £30. Second prize: Two Electric Lamps and Battery. Winners' names in E. M., 29 July. Tickets one shilling; 12 for ten shillings; 26 for £1. Will exchange for anything useful.—M. BARNARD, Henfield.

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"**The Night-light Clock.**" Illustrated and described on page 370, No. 813. Price, carriage free, 5s. 6d.—F. ROBERTSON, 13, Greek street, Soho, W.

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Metallic A and E **Violin Strings.** Acknowledged success. Six, post free, 1s.—JOHN ELARCO, 36, Kelvin Grove, Liverpool.

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2½-horse **Vertical Engine,** Pump, &c., £10, or exchange small Screw-Cutting Lathe.—38, Victoria-street, Sheffield.

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Bench Drilling Machine, very strong, invaluable to amateurs. Securely packed for 30s.—BEECHING and GOOSE, Mareham-le-fen, Boston.

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15 Vols. "**English Mechanic.**" unbound, XVII. to XXXI, inclusive; price 15s.—H., Haseldene, Barnet.

Musical Glasses for Sale, as played by professional performers with the fingers.—82, Cobden-street, Leicester.

Splendid set of **Gas Engine Castings,** cylinder 2¾ bore, 4½ stroke, cheap.—T. WARROP, Patterdale, Penrith.

100ft. Glass, cut to size, packed, delivered to rail, 14s. 6d. picture quality, 17s. 6d.—HOLMES, 149, Essex-road.

Harmonium (Organ), 10 stops, swell, 9 guineas, cost 18.—L., 2, Westow Hill-terace, Upper Norwood.

Gentleman's English Silver Lever **Watch,** new, value £8, will take half.—13, Kemble-street, Prescot, Lanc.

Electro-Motor Engine, working model, post free 6s.—J. SUTCLIFFE, 53. Cedar-street, Hulme, Manchester,

Photograph, new and old Eddystone Lighthouses, 7 by 5, post free fourpence.—PUMPHREY, Publisher, Birmingham.

Ross's **Cabinet Lens.** £17 10s., quite new, for £10.—W. SHARPE, Chemist, Madeley, Salop.

Bicycle, 52in., lamp, £3 5s.—H. MAYES, 3, St. John's Hill-grove, Wandsworth, S.W.

Aneroid Barometers on François' list, 5in. open face, silvered dial, thermo on dial, nickel case, 30s.

Electro-Magneto Machines on François' list Good machine, 10s. Powerful machine, double magnet, 21s. 6d.

Gold and Gold-plated **Eyeglasses,** Pebble Spectacles, &c., on FRANCOIS' List. Wonderfully low in price.

Field and **Opera Glasses** cannot be surpassed for quality and for price incomparable.—FRANCOIS.

Model **Steam Engines,** &c., &c., on François' list. "Do not bid me speak; see, and then speak yourselves."

Upon receipt of post-card **A. François,** Devonshire-place, Ryland-road, Birmingham, will forward list free.

Gutta-percha Tissue, best, quite new, free 1s. 4d. per square yard.—W., Brewery House, Nenagh, Ireland.

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Slide-Rest, 3½in. centre, quite new, 40s.—CHARLES GOULDING, Walkergate, Beverley.

Haydon's **Cutter Bar,** by Buck, of London, quite new, 7s.—CHARLES GOULDING, Walkergate, Beverley.

Electro-motor Engine, working model, post free 6s. Large sizes for power to order.—J. SUTCLIFFE.

Bichromate Batteries, constant current, 1s. 6d. to 3s. 6d. each.—J. SUTCLIFFE, 53, Cedar street, Hulme, Manchester.

Pair of new 1in. **Taps,** one 1¼, one 1⅛, one ¾, 22s.—3, Keen-street, Warrington.

To Microscopists.—Good collection Volvox Globator, Stentor Polymorphus, Cyclops (male, female), larva of Ephemeridæ. Post free 6 stamps.—GEORGE PARRY, Mersey road, Rock Ferry.

Steel Balls for bicycle bearings—¼, 5-16, ⅜, 1s, 1s. 2d., 1s. 4d. per dozen.—W. TOLMAN, Wolverhampton.

Small **Dynamo-Machine Castings,** as described last week. All sizes.—GEORGE TOLMAN, Dynamo Manufacturer, Wolverhampton.

The Cuttriss **Electro-motor,** 30s, the cheapest and most powerful for size, guaranteed to drive any domestic sewing machine.—CUTTRISS, Electricians, 85, New Briggate, Leeds.

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Excelsior **Model Engines.** Cheapest in the world. Vertical, Beam, Horizontal, Compound, Marine, Locomotive, &c.—Prices on application.—SKINNER and Co., Park Works, Alexandra-road, Manchester.

Ferns.—Hardy Dorsetshire Ferns, ten varieties free for 1s 2d. doz, bargain.—A HALLETT, Sturminster-Newton, Blandford.

Ancient **Cross Bow,** used at the Eglintoun Tournament.—Apply G. FERRISS, 618, Rutherglen-road, Glasgow.

Binocular **Microscope,** by Swift, London, nearly new; cost £17, price £11.—J. BARTON, 108, Portland-street, Manchester.

Blecnum Spicant and Parsley **Ferns,** 1s. per dozen, free.—JAMES DOVE, Low Fold, Ambleside, Westmoreland.

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Boats.—Excellent Model Steamers, Machinery and Hulls, ditto. Splendid 1 H.-P. Engine, tubular boiler and fittings, £15. Several unfinished half-horse, 30s.—CAPLATZI.

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Launch Engines, different sizes, good and cheap. State requirements—JOHN MIDDLETON, 16, Hope-street, Glasgow.

J. J. Allingham, Mechanical Engineer, 91, White Rock-street, Liverpool, makes and repairs model machinery, etc., and is open to undertake agencies for sewing machines, bicycles, tricycles, fretcutters, wringers, etc., etc.

Double Oscillating Cylinder **Engine,** 2 H.-P., with governors and forward stop and reverse motions, 8in. stroke. Cranks square and all bright. Also 2 H.P. Boiler and fittings, plain fire-box, with cast-iron bend chimney and damper. The lot at Leeds for £15 New 3 years since, and only been worked 7 hours a week. Premises coming down.—WARNES BROS., 2, 6 Wellington-street, Leeds.

¼ horse-power Horizontal **Gas Engine Castings** and FORGINGS. Lithograph 3 stamps.—A. DORRINGTON, West Gorton, Manchester.

Half horse-power Horizontal **Engine Castings,** 32 parts, ports cast in, 12s. 6d. Design.—A. DORRINGTON, West Gorton, Manchester.

Three-Jaw Chuck, suit 4in. to 6in lathe, Castings 2s. 6d. Working drawing six stamps.—A. DORRINGTON, West Gorton, Manchester.

Model Horizontal **Engine Castings,** cylinder 1½in. by 2in., price 6s. Working drawing 12 stamps.—A. DORRINGTON, West Gorton, Manchester.

Send for **Lists** of Model and Small-power Engine Castings to—A. DORRINGTON, West Gorton, Manchester.

Wanted.

Wanted, Manufacturers' names, price-lists, and discounts off amateurs' and brass furnishers' lathes and tools, model engines, and castings.—THOS. B. LINLEY, Manufacturers' Agent, 573, George-street, Sydney, N.S.W., Australia.

Wanted, Tools for Model Engineering, Forge and bellows, tinning tools, &c.—FIRE BRIGADE, Pontypool.

Wanted, good 3in. to 4in. second-hand back-geared lathe, compound slide-rest, saw, chucks, drills, cheap. Full specification, cheap.—FIRE BRIGADE, Pontypool.

Agents Wanted.—Morgan's celebrated Improved Scale-Preventing Compound. Nothing better or cheaper.—W. H. MORGAN, Engineer, Gloucester.

Wanted, a good second-hand Lathe, about 3ft. 6in. centre to centre.—SHADLERS and COLEMAN, Ironmongers, Southhampton.

Wanted, Reid's work on "Clocks."—J. C. LEE, 26, Sheaf-street, Heeley, near Sheffield.

Agents Wanted to introduce our Oil Paintings, Copying, etc.; one stamp.—P. MITCHELL and Co., Artists, Sydenham.

Wanted, Wholesale Price-list of all kinds Woodworking machinery.—ELLIOTT and Co., Marlow, Bucks.

Wanted, Wholesale Price-lists of Soda Water Machinery.—ELLIOTT and Co., Marlow, Bucks.

Wanted, Proctor's "Other Worlds than Ours," cheap and in good condition.—X., 19, Long-street, Devizes.

Wanted, 2ft Locomotive Inside Cylinders in damaged condition. Will give Six Guineas.—ARTHUR HAUGHTON, 26, Park-road, Liverpool.

Addresses.

"Grateful's" address for "Tom B.'s" kindness is X. Y., High-street, Romford, Essex.

Wanted, addresses of all that have had dealings with "Sunlight."—Coton Lodge, Gnosall, near Stafford.

"Sunlight's" present address urgently wanted, as he has left Bath.—Coton Lodge, Gnosall, near Stafford.

Wanted, the address of Makers of Machines for stamping leather edging for book-case shelf fronts and leather-covered buttons.—J. H. P.

"Joiner"—Address to W. RATCLIFFE, 16, Barbara-street, Barnsbury, will oblige.

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All the Parts and Materials, with full instructions, are furnished in the AMATEUR BICYCLE AND TRICYCLE CABINETS.

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RUBBER STAMP MAKING.—The "EXCELSIOR" APPARATUS (Registered) is cheap and effective. With this Machine *any* person can make stamps at once without previous experience. Send for particulars, press opinions, and testimonials, and see what others say.—GEO. W. SMITH and CO., 44, Springfield-place, Leeds. Beware of worthless apparatus.

WANTED, A GOOD GENERAL MECHANIC, one used to Portable Engine and Thrashing-machine work preferred.—Apply to J. BALDWIN, Wadhurst.

AN ENGINEER desires a PARTNERSHIP in small works. Riverside preferred. Good connection in launch engines, also several specialities introduced. Good opportunity for a firm to enter this new and lucrative trade.—H. R., 62, Harcombe-road, Stoke Newington, London.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, JULY 7, 1882.

FIRE RISKS OF ELECTRIC LIGHTING.

IN our last volume we gave one or two papers on the precautions to be taken to avoid risks from fire in connection with electric lighting; and the suggestions of Prof. H. Morton have now been supplemented by an authoritative—so far as anything of the kind can be authoritative—opinion of the Council of the Society of Telegraph Engineers and of Electricians. The engineer of one of the fire insurance companies has already issued a pamphlet on the subject, in which the risks are clearly pointed out, as well as a method of avoiding them; but, naturally, the engineer has erred on the safe side, and the rules and regulations drawn up by a committee of the society above-named will probably be regarded by the public, and perhaps ultimately by the insurance companies, as a better working guide than the rather narrow rules suggested by an official of one of the companies. Those who are familiar with electrical phenomena do not need to be told that there are fire risks in connection with electric lighting, but they are not inclined to admit that the risks are any greater than they are in the case of gas lighting; and, certainly, the electricians, remembering the cost of copper rods, will object to being compelled to use them 50 per cent. heavier than they need be. The principal fire risk in connection with an installation of the electric light is an accidental heating of the "leads;" for although there is some little danger in the case of sparks falling from the carbons in the arc lamps, the experience gained during the exhibition at the Crystal Palace shows that simple precautions will effectually avoid any serious risk of fire from that source. The rules and regulations recommended by the Council of the Society of Telegraph Engineers and Electricians are based on a report made to them by a committee numbering amongst its members Profs. W. G. Adams, G. C. Foster, D. E. Hughes, and Sir Wm. Thomson; Dr. Hopkinson and Dr. De la Rue; and such well-known practical men as Sir C. Bright, W. H. Preece, C. E. Spagnoletti, A. Stroh, and E. Graves. The recommendations of such a body can be received with confidence; and, if proper attention is paid to them, there will not be many accidents either from fire or from the effects of the current upon the human body. The chief dangers, the council point out, arise mainly from ignorance and inexperience on the part of those who supply and fit up the requisite plant; and we may add that, until a trained staff of workmen can be raised, it is necessary for the electrician to critically examine every part of the circuit. The defects against which the electrical engineer has to guard are leakage, undue resistance in the conducting wires, and bad joints; they are, so to speak, internal and invisible, and even the sense of smell does not avail us as a detective as it does in the case of gas. Nevertheless, by careful testing the condition of an electric circuit can be ascertained with certainty and with great delicacy, and it is not surprising that these rules should strongly advise the frequent testing of the wires, especially as the skill needed is easily acquired with a little practice. The committee's report was evidently dead against the use of "earth" in any part of an electric lighting circuit, for the "rules" state that the chief enemies to be guarded against are the presence of moisture and the use of "earth," for moisture leads to loss of current and to the destruction of the conductor by electrolytic corrosion, and the "injudicious" use of "earth" as a part of the circuit tends to magnify every other source of difficulty and danger. From the use of the term injudicious it would appear that under some conditions the council consider it allowable to use "earth"; but those who are fitting up an electric lighting installation for themselves would do well to employ complete metallic circuits—in other words, lead and return wires, for the employment of gas and water-pipes ought not be allowed in any circumstances. The amateur electrician in fitting up his electric lighting circuit would no doubt use insulated wire throughout, as cheaper in the long run; but where considerable distances have to be covered, bare wires are permissible with certain precautions. In the first place bare wires should always be placed so that they can be seen at once, since, if other conducting bodies happen to fall on them, there is a liability to short circuit; but where possible it will, we think, always be advisable, when bare wires are used, to arrange the circuit so that the return is a considerable distance from the lead—so far, in fact, that no one can touch both wires at once. Bare wires are suitable only for out-of-door work, and where they are attached to insulating supports they should themselves be coated with insulating material for at least 2ft. on each side of the support. Joints must be mechanically and electrically perfect, which is readily accomplished by laying the two ends side by side, and binding smaller wire round, filling up all over with solder. As to the size of wires, the gauge should be proportioned to the currents to be conveyed, but wherever there is a change of circuit from a larger to a smaller wire, the latter should be protected by a safety-fuse melting at a temperature of 150° Fahr. The Council do not recommend the expenditure of 50 per cent. more than is necessary for wires, but prefer to rely upon fuses, which, it should be borne in mind, must always be inclosed in incombustible cases. They point out, however, that if wires become perceptibly warmed by the ordinary current, they are too small for the work, and ought to be replaced by larger leads. Besides the fuses on the branch circuits, there must always be one on the main circuit, of easily fusible metal, so that if the current attains any undue magnitude, the circuit will be broken. Every switch for turning current on or off must be so constructed that, when it is moved and left, there shall be no permanent arc, and no heating, while the base or stand on which it is fitted should be of slate, stoneware, or some other incombustible substance. All wires concealed from view should have their positions indicated, and where they pass through holes, or are liable in any way to abrasion, they should be protected with some suitable material. The dynamo should be fixed in a dry place, preferably on an insulating bed. To avoid accident to the person, the council recommend that the conductors and fittings should be so arranged that no one can be exposed to the shocks of alternating currents exceeding 60 volts, and there should never be a greater difference of potential than 200 volts between any two points in the same room. If such a difference does exist between two points within a house, then, whether the source of electricity be external or internal, a switch should be provided outside, by means of which the current can be cut off. By careful attention to these rules amateur electricians may safely light up their houses—that is, as safely as they can with gas, for there is always a risk of fire with every system of artificial illumination.

REVIEWS.

Handbook of the Polariscope and its Practical Applications. From the German of H. LANDOLT, by D. C. ROBB, B.A., and V. H. VELEY, B.A. London: Macmillan and Co.

FROM what can be gathered in the translator's preface, we are indebted to Mr. Frank Faulkner, of St. Helen's, for the appearance of Landolt's work on the Polariscope in an English dress, just as we were indebted to him for an English translation of Pasteur's "Studies on Fermentation." The present work in its roughly finished manuscript was placed in the hands of Mr. D. C. Robb, who unfortunately died before he could complete the duty of editing it, and it was finished by Mr. V. H. Veley. The translation follows as closely as possible the original, a few notes being added where Mr. Robb thought they might be useful. Prof. Landolt wrote his "handbook" at the request of friends who had read a paper of his on the mode of determining specific rotation, published in *Liebig's Annalen.* Accordingly, he has endeavoured to include an account of all the recent instruments and practical applications, and the notes appended by the editor render the work in its present dress a valuable textbook for the use of those who appreciate the value of the polariscope, or, in other words, the advantage of definite knowledge over rules of thumb in certain processes of manufacture. The optical activity of organic substances affords much assistance in determining the constitutional formula to be assigned to them, and an investigation of the connection between chemical constitution and optical power is a promising field for students. For this purpose, however, it is essential that determinations of specific rotation should be made with the most rigid accuracy, and special attention has been devoted to that branch of the subject by the author. After a few pages of introduction, in which the action of the polariser and analyser is explained briefly, the section on general aspects of optical activity commences the technical portion of the work, about one-fourth of the whole book consisting of descriptions of practical applications of rotatory power, which consequently render it of considerable value to many who would not care to go beyond the requirements of their own businesses. Camphor, cane-sugar, and glucose are the only solids the direct specific rotations of which have been accurately determined up to the present time; for although numerous investigations have been published as to many other substances, the observers have, as a rule, employed solutions containing only small percentages of active substance, so that only a few points have been determined, and those not of the greatest importance. Further, the concentration of the solutions only is mentioned, i.e., the number of grammes in 100 cubic centimetres, whereas, according to Landolt, the percentage composition by weight and the density of the solutions should be noted; for, to take an example, the specific rotation of tartaric acid is given in many texts-books briefly thus $[\alpha] = + 9{\cdot}6^{\circ}$, whereas the specific rotation in solutions containing 10 to 90 per cent. varies for the yellow ray D from $3{\cdot}25^{\circ}$ to $13{\cdot}68^{\circ}$; for the green ray b, from $1{\cdot}08^{\circ}$ to $16{\cdot}40^{\circ}$; and for the blue ray e, as much as from $- 6{\cdot}51^{\circ}$ to $+ 18{\cdot}64^{\circ}$. Similarly the specific rotation of cane-sugar is given as $[\alpha] = + 73^{\circ}$ to 74°, without note that that value is for the

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transition tint, although for the neighbouring ray D the value for solutions holding 25 per cent. of sugar is only $[\alpha]_D = 66{\cdot}44°$. Landolt goes on to say that the specific rotation of an active substance in a solution of given composition is constant, and, therefore, can be employed as a distinguishing characteristic of the substance; but he says, in order that it should possess this value, it is indispensably necessary that along with the value of $[\alpha]$ should be stated: (1) The ray with which the observations were made; (2) the description of the solvents; (3) the proportion of active substance present; (4) the temperature of the solution when the angle of rotation was observed; and (5) the direction of rotation. It will thus be seen that the author treats his subject in a thorough manner; and as it is freely illustrated, and contains descriptions of the different instruments, together with determinations and rotation-constants of many substances, the book will be of great value to the chemist who takes up this branch of the study, and a guide to those who frequently have occasion to use the polariscope in laboratories attached to factories. An appendix by Mr. I. Steiner, assistant to Mr. Faulkner, contains a valuable paper "On the Estimation of Maltose and Dextrin in Malt-Worts and Beers," a subject of special interest to technical chemists and brewers.

The Law of Kosmic Order. By Robert Brown, Jun., F.S.A. London: Longmans.

The author of this little work has already in two previous publications endeavoured to show the extent and character of the non-Aryan element in Hellenic mythology, to trace the career of the Semitic sun-god from the banks of the Euphrates to the Boiôtian plain, and onward to his pillars in the far west, and also to give the history of the Lunar power up to its final appearance as the sinister supporter of the Royal arms of Great Britain. The present work follows up the theme, but is from its nature of greater interest to the larger number of readers, for Mr. Brown notices the rise of the Year-concept with its sidereal band of the zodiacal signs, and he endeavours to show how those, to us, singular emblems attained their present position by a process so natural as to be almost inevitable, and consequently how hypotheses connecting the signs with religious, philosopical, and scientific ideas, are simply baseless. Briefly, but succinctly, the author shows how the three great divisions of time were probably made in the simplest manner; his first section, on the mental standpoint of archaic man, giving the keynote, as it were, to the evolutions of the concepts space, time, and number. In about 90 pages, however, it is impossible to deal with the subject in a style suited to popular reading, and this brochure is then, we may say, simply for students—a guide to a branch of archæology the most interesting of all. The sections in which the origin of the signs of the zodiac are described will, however, attract many readers, and cannot fail to instruct them, though the more intelligent amongst them will inevitably ask for more, which perhaps in one sense will meet the object of the author.

We have also received *The Great Giant Arithmos*, by Mary Steadman Aldis (Macmillan), a "most elementary arithmetic," a book intended to be read to children (very young children, we presume) by their mothers or nurses. The lessons delivered as if they were extemporised by the teacher would be admirable; but we are afraid that if any teacher attempts to read them to her pupils she will fail in teaching.)——*An Elementary Treatise on the Construction of Roofs of Wood and Iron*, by E. Wyndham Tarn (Crosby Lockwood and Co.) is an introduction to the first principles of roof construction for the use of architectural students.——*A Practical Treatise on the Joints Made and Used by Builders*, by Wyvill J. Christy (Crosby Lockwood) is a description of the various "joints" employed by artisans—is in fact a "dictionary of joints," which will be a useful work of reference to apprentices in the respective trades.——*Elementary Decoration*, by James William Facey (Crosby Lockwood), is a useful guide to the practical part of the work; but we hope the amateur will not copy the "designs" of the author. Speaking of black paint, Mr. Facey says that the "tendency of black to attract (!) heat is as great in proportion as that of white to repel it."——*The Manual of Colours and Dye Wares*, by J. W. Slater (Crosby Lockwood), is the second and much-enlarged edition of a very useful manual for all engaged in calico-printing and dyeing.——*The Boilermaker's Ready Reckoner*, by John Courtney, revised and edited by D. K. Clark (Crosby Lockwood), is chiefly valuable for its tables—the information on templating being very meagre. The dimensions in the tables are specially useful to the boilermaker who cannot work by decimals but must have his dimensions set out, as "1¼ 1-16."——*Experimental Physiology*, by Richard Owen, M.D., F.R.S. (Longmans), is really a defence of vivisection, and an attack on the anti-vivisectionists, with the full text of the "address" delivered when the author unveiled Harvey's statue at Folkestone last August.——From Messrs. Longmans we have also, as additions to the "Sunbeam" series, J. G. Wood's *Strange Dwellings*, Hartwig's *Arctic Regions* (extract from "The Polar World"), and Trench's *Realities of Irish Life*.

ARTIFICIAL FORMS OF SILICA RESEMBLING AGATE.

We have previously given tolerably full particulars of the methods by which attempts have been made to produce artificial diamonds, and in Vols. XXX. and XXXI. will be found several notes on the manufacture of imitation gems, the distinction between the terms "artificial" and "imitation" being obvious. If by any of the processes of the laboratory, and by the aid of any of its contents, the chemist can make a clear crystal of carbon, then he has produced an artificial diamond; if he merely mixes up sundry substances and produces an imitation diamond, that is interesting from the manufacturer's point of view, but is of no value from the scientific point of view. It will be remembered that artificial diamonds were produced by Mr. J. B. Hannay, and Messrs. Frémy and Feil had a similar success with rubies. We gather from a paper contributed to the Mineralogical Society by Messrs J. I'Anson and E. A. Pankhurst, that they have been practically as successful in the artificial production of agate, chalcedony, onyx, &c., and as the experiments which have led up to these results are simple and easily performed, they may be of more than usual interest to many of our readers. Chemical students who have had any experience with the silicates know that when a solution containing an alkaline silicate is acted upon by a reagent capable of separating the silica from the base, the silica is generally thrown down in the solid form. The chemist makes a note of the reaction; the mineralogist goes further, and studies the form in which the precipitate appears. The form varies with the conditions of the experiment, and by studying these Messrs. I'Anson and Pankhurst sought to elucidate experimentally the wondrous and beautiful varieties of structure seen in natural specimens of silica. The great group of banded agates presents an infinite variety of form, but is readily separated into two types—one in which the solidification appears to have taken place in successive layers from within outwards; another in which the layers seem to have grown from without inwards. These two types may therefore be named respectively the exogenous and endogenous. With the exogenous type of agate are grouped such stalactitic forms of silica as show in transverse section a series of concentric rings or bands. Such stalactitic forms may be obtained by taking a solution of silicate of soda or potash and dropping into it any of the strong acids; but, in order to produce the branching coral-like forms, Messrs. I'Anson and Pankhurst adopt the following procedure: "A strong solution of silicate is taken, containing a certain amount of alkaline carbonate, and a strong acid (sulphuric seems to give the best results) is introduced by means of a pipette to the bottom of the vessel in which the solution is contained. Bubbles of carbonic acid gas immediately arise, carrying with them a certain amount of the stronger acid. Round the stream of ascending bubbles, silica is deposited by the decomposition of the alkaline silicate, and in a very few minutes a tube is formed reaching from the bottom to the surface of the solution." The walls of the tube increase in thickness by the deposition of silica on the outer surface, so long as the flow of acid is kept up. The carbonic acid evolved at first is essential to the commencement of the tube; but that once formed, sulphuric or other acids can be forced through it, and by the application of pressure to the surface of the fluid in the pipette, the action can be kept up for a long time, stalactites ¼in. in diameter being formed without much difficulty. The same result can be produced by passing an acid gas or any other reagent capable of separating the silica—such, e.g., as the acid salts of various metals—in fact, the experiment can be varied in many ways, the specific gravity of the fluid as compared with that of the reagent and of the precipitated silica having much influence on the form assumed. Where the specific gravities are equal the tubes may take indifferently any direction with regard to gravity. The stalactitic productions thus made are considered the analogues of all the group of banded stalactitic growths where the growth appears to have proceeded from a central cavity which has been subsequently filled in with a core. If the action is carried so far that the fluid surrounding the tube becomes saturated with the acid reagent, the whole of the fluid gelatinises by the precipitation of amorphous gelatinous silica, so that if such stalactitic forms had been produced in nature in an inclosed rock cavity containing an alkaline silicate solution, by the infiltration of an acid solution, a like result would follow. Such natural forms constantly occur, and it is probable that Messrs. I'Anson and Pankhurst have discovered the mode of their formation. They account for the endogenous type, by supposing the rock in which is the cavity containing the alkaline silicate to be permeated by an acid solution or gas. The layers of silica would then be deposited on the walls of the cavity, and as the action continued, the layers would grow inwards until the central portion would set into an amorphous mass. These forms have been produced by modifications of the process above described. By the use of acid solutions containing vegetable and earthy salts, the colouring of many natural stones has been imitated, and it seems probable that jaspers, moss-agates, &c., have been coloured naturally by chemical precipitates. The most prevalent colouring matters, for instance, are the red and yellow ferric, and the green ferrous oxides. If ferric chloride be added to alkaline silicates, a more or less flocculent, red or yellow-coloured precipitate is produced, around which will grow a filmy white deposit of silica, frequently taking the banded form seen in jaspers and allied stones. The green, mossy markings of the moss-agate and the darker colour of the onyx can be perfectly produced. The precipitated silica, however, being deposited at no great pressure or temperature, the artificial stones fall short of the natural ones in hardness and stability, crumbling up when exposed to the air, though some forms, approximating closely to common opal in appearance, but of lower specific gravity, remain with little or no alteration after once being dried. It is conceivable that, with suitable conditions of temperature and pressure, perfect artificial agates could be produced; but the resemblances are so remarkable that there can be little doubt Messrs. I'Anson and Pankhurst have solved an interesting problem. So far we have only indicated some of the reagents and salts that may be used, and it is scarcely necessary to give a list which, however long, would probably not include all—the student of chemistry will find no difficulty on that head; but he may be advised to allow the stalactitic forms to come into contact with the sides of the containing vessel while the process of growth is going on, by which means their progress can be conveniently watched. A solution of commercial alkaline silicate, especially silicate of soda, is capable of dissolving considerable quantities of pure gelatinous silica as well as various silicates produced by precipitation with sulphates of copper, iron, &c. Thus, if solutions of ferric sulphate, or chloride, or cupric sulphate are poured into an alkaline silicate, coloured precipitates are produced, which, after washing, are dissolved in alkaline silicates yielding purplish red and green solutions, which can be used for colouring the preparations above described. Further investigations will probably lead to a method of making the artificial agates, jaspers, &c., as hard and durable as the natural specimens, for very hard preparations of silica are occasionally found by the manufacturers ot silicates in the course of their operations.

THE ACHROMATIC OBJECT-GLASS.—IV.

By W. BRADBURY.

(*Continued from page* 372.)

THE following table of Tulley's curves appeared in the correspondence columns of this journal some time ago. I have endeavoured to deduce from them the refractive indices, and also the dispersive ratios. It is not possible to do this accurately, but the numbers are sufficiently near the actual values to show the properties of the glass. One kind of crown appears to have been used throughout, most probably that known as "Ratcliffe Crown," and it evidently varied very little in its optical properties; the flint glass had a specific gravity ranging from 3,192 to 3,466.

A TABLE OF CURVES EMPLOYED BY THE OPTICIAN, TULLEY.

FLINT.—Sp. gr., 3,192. Refractive index, 1·574. Ratio of refraction, 1·52.
CROWN.—Sp. gr., 2,527. Refractive index, 1·53. Dispersive ratio, or value of δ = ·725.

Focus.	Crown	7·5	Flint	10·1
30	lens	11·5	lens	20·5
Focus.	Crown	8·0	Flint	7·4
27	lens	7·5	lens	24·5
Focus.	Crown	11·5	Flint	15·25
44	lens	16·8	lens	32·50
Focus.	Crown	18·4	Flint	24·4
72	lens	26·8	lens	52·0

FLINT.—Sp. gr., 3,334. Index, 1·588.
CROWN.—As before. Ratto of refraction, 1·642. Dispersive ratio, ·71.

Focus.	Crown	8·0	Flint	11
30	lens	12·5	lens	27

FLINT.—Sp. gr., 3,354. Index, 1·592.
CROWN.—As before. Ratio of refraction, 1·656. Dispersive ratio, ·68.

Focus.	Crown	8·0	Flint	12·11
30	lens	14·3	lens	28·5
Focus.	Crown	13·6	Flint	16·3
44	lens	17·2	lens	54·0

FLINT.—Sp. gr., 3,437. Index, 1·597.
CROWN.—As before. Ratio of refraction 1·726. Dispersive ratio, ·66.

Focus.	Crown	13·6	Flint	17
44	lens	18·8	lens	67
Focus.	Crown	8·0	Flint	13·15
30	lens	17·2	lens	32·60

FLINT.—Sp. gr., 3,466. Index, 1·6.
CROWN.—As before. Ratio of refraction, 1·74. Dispersive ratio, ·65.

Focus.	Crown	14·3	Flint	18
44	lens	19·4	lens	72

An examination of this series of numbers will show, that with one exception, the same system of arrangement is followed throughout. Commencing with the crown lens, it will be seen that in a rough way, the proportion of its radii may be taken as 2 to 3; while the flint lens, having a proportion of 1 to 2 in the lightest kind, gradually rises to 1 to 4 with the heaviest glass. This is in exact agreement with theoretical deductions.

The second pair seems to be a departure from the regular method: the crown lens is nearly equi-convex, with the flattest side anterior; and this, though only a slight alteration, increases the aberration so much as to need a higher ratio in the flint curves. No other similar instance is given, so that we may conclude it was an exception to the general practice, and more difficult to arrange satisfactorily.

If we compare the above radii with those which theory assigns to be due to the specified optical properties, it would seem that nearly all have the characteristic feature which led Dollond to devise the triple object-glass—viz., the convex lens appears too strong. Such combinations, if formed of spherical curves, would be affected with positive aberration or under-corrected. But we must remember, that there is a great deal more in the method of working than in the actual curves made use of. When the artist was master of his method, it was, without doubt, a great advantage to have a combination, which always left a slight margin for final correction, of one definite kind, rather than those which, being nearly in perfect balance; when correctly wrought, were apt to leave a final error of an uncertain character, owing to uncontrollable deviations in working. But, apart from any special practice, I believe it would have been found easier to introduce the final correction, if the flint curves had had a higher ratio.

The method of computing curvatures, which is described by the writer in Rees' "Cyclopædia" as being that used by Tulley, seems to have originated in the following way:—Soon after Dollond's discovery of the method of producing achromatism, Benjamin Martin published a work entitled "New Elements of Optics." Martin seems to have possessed very considerable mechanical skill, as well as theoretic knowledge; for he was enabled to test the truth of his deductions, by experiments on optical glass. His first work was to find the actual value of the refractive index of any species of glass.

Newton's experiments had given 30 / 21, or as near as possible 3 / 2, as the value of the index of refraction, and it does not appear to have been suspected to be variable. Such a value defined the radius of curvature, as the focal length of an equi-convex lens; and in case of unequal curvature, the same quantity was twice the product of the radii divided by their sum. These distances were found to be correct by experiment. But when Martin proceeded to test several lenses, ground to the same curves but of different species of glass, he found a great discrepancy between the actual and the calculated focus, especially with the denser or flint lenses. The focus calculated by the above rule was termed the *geometrical* focus, and that given by trial, the *refracted* focus. Martin found, by measuring these distances and dividing the former by the latter, that he obtained a number which was constant for the same species of glass. Hence, when he knew this number, he could find the true or refracted focus of any lens made of this glass: or, if he knew the radii and refracted focus, he could find out the number belonging to any kind of glass.

Martin thus obtained the true measure of the refractive power; for it will be evident that his value ($2a$) is really the double of the refractive power, or, of the refractive index diminished by unity. So that the real refractive index is ($1 + a$). Martin's rule gave $R / 2a$ as the refractive focus of an equi-convex; the ordinary rule is $R / 2 (\mu - 1)$, so that the identity of the two terms is apparent. He was thus enabled to tabulate the refractive powers of various kinds of glass.

The retention of the obsolete and useless term, "geometric focus," leads to much confusion. It is scarcely necessary to add that it does not represent a focus at all, but merely indicates an imaginary point, derived from the erroneous supposition, that the refractive index was an invariable quantity.

Martin, having found a definite measure of the refractive power, next turned his attention to the subject of dispersion. Taking two pieces of crown and flint glass, he proceeded to compare them in a manner similar to his previous experiments. As he had before ground equal convexities, and compared their refractions; he now made them into equal prisms, and compared their dispersions. By measuring, as well as he could, the distance to which the red and violet extremities were separated by each prism, he found that of the flint wider than that of the crown, in the proportion of 5 to 3. He then gradually reduced the flint prism until both separated the rays alike; and when they were arranged in opposition, dispersion was practically neutralised.

By applying analogous reasoning to the action of lenses, he deduced the general laws, which must govern the formation of an achromatic compound. "The radii of the lenses must have the same proportion as the differences of the sines of incidence and refraction in red and violet rays in prisms of equal refracting angles of white and crown glass. The radii or foci (geometric) of the lenses must have the same proportion as the angles of dissipation in refraction by such prisms, and, of course, the same proportion as the lengths of the coloured spectra produced thereby.

"In all cases of a compound lens for producing vision without colours, the ratio of the radii, r and R of the concave and convex lenses must be as 5 to 3, and then the ratio of their foci (refracted) for parallel rays will be as 3 to 2 nearly."

It will have been noticed, in the table of Tulley's curves, that a number is given termed, "Ratio of refraction." This does not mean the ratio of the refractive powers of the glasses, but the ratio of the differences of the red and violet indices for each glass; or, as it may be termed more correctly, the ratio of their dispersions. Martin's law simply states that the radii, and consequently the refracting angles of the lenses, must be directly proportionate to their dispersions. It is now usual to divide the dispersion by the refractive power. The number so obtained is the *dispersive* power; because while the quantity a in Martin's rule, or the refractive power, is the measure of the effect of a substance in changing the direction of the ray, the dispersive power shows what part of the whole angular deviation is occupied by the colorific interval. Expressed in terms of the foci, which is by far the most intelligible way, Martin's rule is: the focal lengths must be directly as the dispersive powers. As a means of indicating the character of the glasses in combination, Tulley used the term "ratio of refraction"; but "ratio of dispersive powers," or the value of δ in the table, is much more complete, as it takes into account the refraction also.

Having succeeded in obtaining a general relation between the curves, which would satisfy the conditions of achromatism, Martin next engaged the more delicate problem of finding a *particular* relation which should destroy the spherical aberration. He does not seem to have met with much success, partly because his mathematical analysis was not sufficiently complete, and partly because the opportunities of comparing theory with practice were not very extensive.

PRACTICAL NOTES ON PLUMBING.—XXXVIII.*

By P. J. DAVIES, H.M.A.S.P., &c.

(*Continued from page* 346.)

Tip-up Lavatory Basins.

THIS kind of lavatory basin is shown at Fig. 224. G is the container with its trunk shown bedded into the dip-pipe of the Ʊ-trap; L is the basin. This basin swings upon two pivots at P, suitable bearings being fixed on the sides of the container; the basin has suitable stops or buffers to prevent the too sudden closing; in this case the rubber buffer is shown fixed under the spout of the cock at O, and held there by the claw. The container should be fixed below the top slab, and the hole in the slab made of sufficient size to allow the basin to swing without touching. In fixing these basins take care that the pivots are properly fastened: otherwise when the basin is jammed or bumped against the buffers, the basin will become loose and probably get broken. For another method of fixing the pivots see P P, Fig. 225. This is for screwing up to the top or slab, or it may be fixed to the false bottom, the latter method usually being adopted.

Fig. 226 illustrates a skeleton of the round container tip-up basin, as fixed over the ordinary half Ʊ-trap. When such basins are fixed over these traps, take great care to well ventilate the outlet of the trap, *but not* as shown at R; for reasons, see *Building News*, page 753, December 9th, 1881.

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* From the *Building News*. All rights reserved.

Fig. 227 illustrates the basin properly fitted up, and a little tilted to show the stop S, so that it is not always necessary to have the stops on the cocks.

FIG. 224.

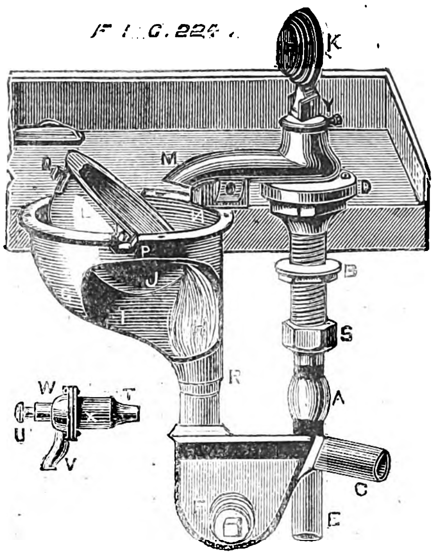


FIG. 225.

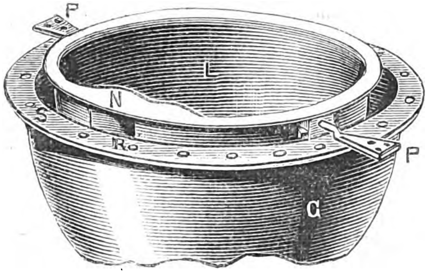


FIG. 226.

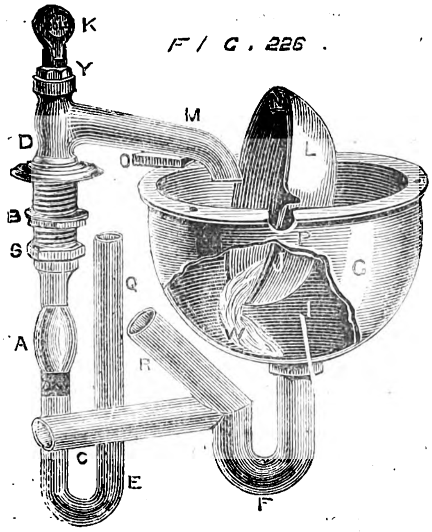
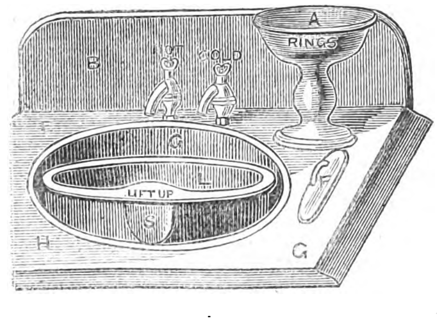


FIG. 227.



(*To be continued.*)

FOURNIER'S ELECTRIC BATTERY.

AN electric battery possessing some novel features has been recently patented in this country by M. Geo. Fournier, of Paris. The principal novelty is the use of a paste, or compound of lead oxide and glycerine, which is moulded into any suitable form for use as a battery-plate, either in primary or secondary batteries. The patentee claims the use of any other metallic oxides capable of forming with glycerine a solid compound insoluble in water. In forming the plates, the lead oxide and glycerine are mixed in such proportions as to form a thick paste, sufficiently fluid to be run into moulds. In about twenty-four hours after being thus "cast," the mixture sets into a solid mass which is insoluble in water. This compound is exceedingly reducible, so much so that when immersed in dilute sulphuric acid together and in circuit with metallic zinc, it becomes reduced to the metallic state as fast as the zinc is attacked. It is, therefore, says the patentee, eminently suited for use in galvanic batteries, as it will prevent galvanic polarisation, and it may either wholly replace carbon or be applied in layers upon carbon or other conductor of electricity. Being an excellent depolarising agent, it enables one to obtain a constant single-fluid battery.

As above mentioned, the compound becomes completely reduced and, therefore, in the present example we have metallic lead as the product of the reduction, which, being in a complete state of division will be very readily reoxidised for use again as a depolarising agent, or even become peroxidised, and may therefore be employed with advantage in the construction of secondary batteries, which may be prepared by the direct peroxidation of plates composed of a compound of lead oxide and glycerine without the intermediate reduction of the lead to the metallic state.

The oxide of lead is the oxide best suited to form the plastic mass with glycerine, but other matters still better adapted to oppose polarisation of the electrode, such as the peroxides of lead, manganese, &c., may be added. These, although not capable alone of combining with glycerine, are nevertheless susceptible of being agglomerated (when mixed in suitable proportions) with lead oxide and glycerine, and form therewith a solid mass. The addition of peroxides confers greater depolarising properties, as the compound then contains, weight for weight, a higher proportion of oxygen; besides which the peroxides being better conductors of electricity than the oxides, the internal resistance of the battery is notably reduced and its power correspondingly increased. This quality of conductibility consequently enables the portions of the mixture not already peroxidised to be more easily peroxidised by the passage of the electric current, and permits of the production of plates of any desired thickness wholly composed of lead peroxide, and very suitable for use either in primary or secondary batteries.

Let us consider, first, the action of a primary battery, in which a plate composed of glycerine, lead oxide, and lead peroxide, agglomerated as above mentioned, and plunged in a dilute solution of sulphuric acid contained in a cell, forms the negative plate or element, and a copper plate, for example, of suitable thickness forms the positive plate or element. When the circuit is closed, the sulphuric acid attacks the copper plate forming sulphate of copper, and disengaging hydrogen which passes to the plate composed of glycerine, lead oxide, and peroxide; that plate would soon be covered and polarised were the hydrogen not in contact with a matter capable of very readily oxidising it. No polarisation will therefore take place, and the battery will act with uniform constancy so long as the acid acts on the copper plate, and there remains in the compound plate any oxygen to oxidise the hydrogen thereby disengaged.

A battery thus composed is, so to speak, of indefinite duration, as it may be readily reconstituted or reconverted into its primitive elements by the passage of an electric current. Suppose that the whole of the sulphuric acid has combined with the copper and formed sulphate of copper, and the hydrogen thereby disengaged has combined with the whole of the oxygen of the compound plate of lead oxide, lead peroxide, and glycerine, there will remain in the battery only the plate of copper partially attacked, sulphate of copper, and the plate of reduced lead. If now an electric current be passed through the battery in the proper way, the sulphate of copper will be decomposed, copper will be deposited on the copper plate, the oxygen of the decomposed sulphate of copper will combine with the reduced lead plate and reoxidise it, the sulphuric acid will be set free again, and the battery will then be reconstituted and ready for further action.

In the case of secondary batteries the compound plate of oxide, peroxide, and glycerine is immersed in a dilute sulphuric acid solution, in presence either of a sheet of lead, or, better still, a plate composed of lead oxide, metallic lead in powder, and glycerine. A current passed through this battery under proper conditions will decompose the water, the oxygen combining with the plate of oxide, peroxide, and glycerine, completely peroxidising it, the hydrogen passing to the other plate. Thus we have the elements of a Planté accumulator, with the difference that the substances employed are in a condition more favourable for oxidation and reduction than sheet lead.

ON THE ACTION OF THE MICROPHONE.*

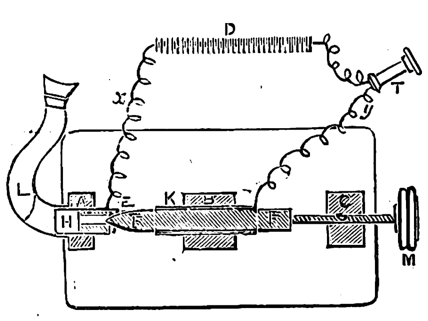
By Prof. James Blyth, M.A., F.R.S.E.

IN the microphone transmitter, as usually employed in circuit with a battery and a Bell telephone, we have essentially two pieces of carbon resting lightly against each other through which the current passes. That the instrument may work effectively, two things are requisite: first, that the carbons be always in contact or at least sufficiently near for the current to pass between them, and, secondly, that they may be not pressed together so tightly as to prevent any motion of the one relatively to the other. This state of things is sufficiently well described by the term "loose contact," first used, I believe, by Professor Stokes. To understand the action of the microphone we have to find out what effects are taking place at the loose contact when the instrument is acted upon by sonorous waves. These are twofold: first, the effect produced by the sound waves (that is, the variations of density due to the condensations and rarefactions of the air), which pass directly through the air when they arrive at the loose contact, and, secondly, the effect produced by tremors set up in the entire instrument, wooden supports and carbons together, by the sound waves which strike against it and are thereby stopped.

For distinction we may call the first of these the air effect and the second the tremor effect. In my experiments I have endeavoured to arrange the instrument so as to isolate these effects, and, as far as possible, examine each of them separately. To isolate the air effect it is obviously necessary either to fix the carbons rigidly in their supports so as to avoid any motion of the one relatively to the other, or to use a strong current and place them just clear of contact with each other.

The following experiment illustrates how this may be done.

A, B, and C are three blocks of brass firmly fixed to a heavy wooden soleplate. To the top of A is soldered a piece of brass tube, H, about 2in. long and $\frac{5}{8}$in. bore. To the top of B is soldered a piece of similar tube, K, about 4in. long. Through C passes a fine screw S worked by a milled head, M. A piece of carbon-rod, E, is fixed firmly into H and has a hole $\frac{1}{4}$in. in diameter drilled through its centre. A long piece of carbon, F, pointed at one end, passes tightly through the tube K and can be moved backwards and forwards by the screw S. A piece of indiarubber tube, L, is passed over the left end of the tube H, and to this is attached a mouthpiece, M. By means of the wires x and y soldered



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* A paper read before the Royal Society of Edinburgh.

to the carbon rods, they are put in circuit with the battery (twenty Grove's cells) and the telephone T, which must either have a small resistance or be placed in a separate circuit from that containing the battery so as to be acted upon inductively.

When the carbon F is screwed tightly into the hollow of E the circuit is completely closed and no sound uttered into M is heard at T¹. But when F is drawn gradually back until small electric arcs are seen to pass between F and E, every sound uttered into M is loudly and distinctly reproduced in the telephone T. Here we have clearly only the air effect acting, and that solely upon the small electric arcs passing the carbons.

I have found it, as yet, somewhat difficult to get the sounds to last for any length of time, in consequence of the arc distance soon getting too great for the current to pass and requiring re-adjustment. When the arc begins and ends a sharp click is heard in the telephone; but in the interval during which the arc lasts the sounds are distinct.

As far as the tremor effect is concerned, it is obvious that the microphone action must depend, either (1) upon the variation of resistance due to variation of pressure, or (2) to variation in the extent of surface contact due to the elastic yielding of the carbons under pressure.

To test the first of these causes, I made about two years ago some experiments on the effect of pressure upon the specific resistance of carbon. for this purpose I took a short length of carbon rod, and soldered wires to it at a short distance from each end. By means of these wires the resistance of the carbon rod was balanced in the Wheatstone bridge. Pressure was then applied by means of a lever to the carbon in a longitudinal direction. No appreciable variation in the resistance was observed even under considerable pressure; and it only became manifest when the pressure was sufficient to bend or crush the carbon. I have recently repeated these experiments with the greatest care, and found the same results. I observed also that similar experiments, with the same result, have quite lately been made by Professor Silvanus Thompson. Hence we can hardly, I think, believe that variation of specific resistance due to pressure can have the slightest effect in producing the microphone action.

To test the second cause above mentioned, that is, the variation of resistance due to variation in the extent of surface contact due to elastic yielding under pressure, I experimented as follows: In the apparatus already described, I replaced the tubular carbon by a finely-pointed piece, so as to have two fine points exactly opposite each other. The resistance of the points was balanced in the bridge in the usual way. Pressure was then applied by a known number of turns or parts of a turn of the fine screw, and the change of resistance noted. The screw was then brought back to former position, and the pressure relieved so as to allow the elasticity of the carbon to act and restore the points to their first condition. It is obvious that if the change of resistance were due merely to elastic yielding it should now be the same as before. This I found not to be the case. From the gritty nature of the carbon the points of contact I found were perpetually changing, and hence the variation of resistance produced in this way obeyed no regular law. From this irregularity it is impossible, I think, to conclude that this cause could explain the transmission of musical sounds for less articulate speech.

As far as my experiments go, the following appears to be something like the true explanation of the microphone action. What I have termed the air and the tremor effects take place simultaneously. The tremor effect produces a jolting of the carbons sufficient to allow momentary minute electric arcs to take place between the points which are just clear of contact with each other. Simultaneously with this the air effect comes in, and, on account of the variations of density due to the condensations and rarefactions of the air, acts upon the minute electric arcs so as to vary their resistance. The tremor effect explains merely production of the musical pitch of the sounds heard in the telephone, whereas it is to the air effect that we must look for the transmission of the quality of the sounds uttered into the microphone transmitter. The microphone is thus so far a delicate make and break analogous to the old Reiss transmitter, with the important addition, however, of minute momentary gaps filled with a material which is sensitive to the minute harmonic variations of the atmospheric density which constitute sonorous vibrations.

THE SALTNESS OF THE SEA.

DURING a recent voyage to Campbell Island, in the South Pacific, M. Bouquet de la Grye, took occasion to make careful observations on the saltness of the sea. Referring to his paper in the *Annales de Chimie et de Physique*, for details of method, we propose to give here his principal results.

In the Mediterranean, an inclosed sea, with strong evaporation, the saltness reaches as high as 22 grammes of chlorine per litre of water. In the port of Marseilles the water of the surface has only 20·75gr., but in the open water one finds 21·71gr. There is also progressive increase from west to east.

Near the Coast of Egypt, the influence of the the Nile was observed before that of the land was recognised. The fall was sudden, about 0·80gr., while the densimeter and thermometer showed no variation. Before arriving at Port Said, the chlorination went down to 19·45gr., a certain proof of currents bearing the Nile water eastward.

The analysis of water of the Suez Canal, at 23 different points, led to the following conclusions: The fresh water of the Nile has an influence on the saltness of surface-water, which is felt beyond Lake Timsah. The recovery of chlorine begins about the second station; there is a very slow increase at first, as far as the entrance of El Kantara, then a rapid increase as the Bitter Lakes are approached. At the latter, one finds 37·20gr., and 37·47gr.

Continuing the examination, it appears that the Red Sea diminishes in saltness from North to South; at first the saltness is slightly over that of the Mediterranean; but it soon falls below it. This is explained by the influence of the Southwest monsoon, which is accompanied with torrential rains.

When the voyagers were entering the Indian Archipelago, all the rivers were overflowing—the water was troubled by the mud flowing down—and the chlorination, always under 20gr., descended to 17·42gr., opposite Batavia. This was the smallest figure reached during the voyage.

The waters of Java and of New Guinea also gave low figures as far as the Torres Straits. There a complete change was encountered. The rainy season was five months distant; the coast was sandy and dry, and the water-courses were low; thus, notwithstanding nearness of land, which was skirted twelve days, the author found only one chlorination under 20gr.; this was off Keppel Bay, where the river Fitzroy enters the sea.

From Sydney to Campbell Island the same saltness: the wind was then blowing from the north, the weather was mild, but the spring was little advanced, and the ice of the Polar circle had not commenced to melt. Four months later, at the time of quitting Campbell Island, there was already a change; the water was less salt, and in some places off the New Zealand coast, figures under 20gr. were met with.

In traversing the Pacific Ocean, an extra saline zone is found under the southern tropic; then a zone of comparatively fresh water, the equatorial zone. To the north there is, again, an extra elevation of chlorine under the northern tropic, and beyond a strong diminution; this arises from the polar current descending along the Coast of America.

Coming to the last part of the voyage across the Atlantic, the tables show that the neighbourhood of the American coast gave waters very fresh and icy, which are suddenly replaced by hot and very salt waters, when the Gulf Stream is entered; then as the route of steam-packets goes along the great bank of Newfoundland, one passes from the current to find anew the fresh and cold waters; these being succeeded by the average water, in which navigation continues to European seas.

"*En résumé*, we have found in the Pacific the law indicated by Gay-Lussac and by Humboldt, and verified by MM. Roux and Savy in the Atlantic. It may be enunciated thus: *Under the two tropics the saltness is greater than under the equator, and beyond the tropics.*

"In indicating," the author proceeds, "that the saltness usually diminishes as coasts are approached, a fact is stated which is the consequence of the rivers bringing to the sea a large tribute of fresh water, and in some circumstances great advantage might be derived from this knowledge, especially in navigating along the coast of Africa or America. How far out would not the waters of the Amazon be revealed by the sole test of chlorination, where the thermometer and the densimeter indicated nothing? The approach of icebergs in cold seas would likewise be indicated by change in the saltness.

"As regards navigation, then, chlorometry may yield very useful direct results; but, better still, the investigation of currents cannot, it seems to me, be properly carried on without it.

"Maps giving every three months the chlorination of the sea would lead to a more exact notion of currents, and would make known new currents. But the question may further be looked at with reference to the slope producing currents. One may investigate the form taken by the surface of the ocean according to the saltness and temperature of all its component parts. Approaching one side of this new question, should we continue to denote as the mean level in a port the level obtained as the mean of a certain number of heights taken at all seasons? Evidently not, because there is neither equilibrium of height nor comparison possible between waters estimated differently, and having densities variable according to this saltness and their temperature. We may not bring into the same average the fresh waters which in spring spread over our coasts, and the salt waters of other seasons. In summer, a tidal wave whose force is represented by a weight, and not by a height, will lead to figures different from those of winter. And let it not be thought that the corrections belonging to different chlorinations are insignificant. When a new level is now sought in surveying operations, its value might be given to nearly a millimetre; when the stability of a coast is to be measured, it is still this approximation that is had in view. Indeed, for a difference of 15°, we have, with mean saltness, 0·004m. difference per metre in height If the tide be 5m., the correction due to temperature gives differences of 0·02m.; this is the entire value of one of the latter waves considered.

"As to the correction due to difference of saltness, it is much greater. At Honfleur, at Havre, and especially at Saint Nazaire, the chlorination of the sea may make the density pass from 1·028 to 1·012; for 5m. of tide the correction is 0·08m. It is these differences that render so little comparable the means of heights of the tide obtained for long periods. At Brest, where the maregraph acts at the mouth of the Penfeld, the annual means are discordant.

"We add, that when we have to do with the level of equilibrium, it is necessary to further make a correction which is as the low water, for this latter level remains the same for a great stretch of sea, while the border of the coast, through local circumstances, narrow passages hindering the play of tides, &c., presents various surelevations; but this correction does not apply either to seas without tides, nor to points projecting into the ocean.

"Where the level of equilibrium, then, has to be investigated, one must take account of the density at low-water mark of the place, and there is occasion henceforth to complete the indications of maregraphs, by adding for each day the temperature of the sea and the weight of the chlorine."

As regards the general question of levelling of seas, it is pointed out that the sea is not everywhere a level surface in the geometrical sense. In all seas there is equilibrium of weight, and there are merely tendencies to equilibrium of level.

M. Bouquet de la Grye has sought to apply these principles to the level of the Atlantic, and taking as zero the plane which passes through the Cape Verde Islands, we find, under the tropic of Cancer a depression of two metres, and near the United States a considerable surelevation, in some cases exceeding four metres. Thus, we have a difference of level of six metres between two points of the same ocean.

THE RELATION OF APERTURE AND POWER IN THE MICROSCOPE.[*]

By Professor E. Abbe, Hon. F.R.M.S.

I.—General Considerations as to Wide and Narrow Apertures.

(*Continued from p. 375.*)

WHENEVER the depth of the object under observation is not very restricted, and it is essential that the depth dimension shall be within the reach of direct observation, low and moderate powers cannot be overstepped, and no greater aperture should therefore be used than is required for the effectiveness of these powers—an excess in such a case is a real damage. High powers and correspondingly wide apertures are restricted to those observations which do not require any perceptible depth of vision, i.e. to two different cases (1) when the objects are quite flat or exceedingly thin; (2) when preparations of greater depth are sufficiently transparent to admit of an *indirect* recognition of their solid structure by means of successive optical sections through *successive* focussing of different planes. For the latter method of observation the loss of penetration with increasing power and aperture is no drawback, but rather an advantage, because it enhances the distinct separation of the sectional images at successive foci. A disregard of these natural restrictions in the use of wide apertures is obviously the origin of the opinion that aperture *per se* is antagonistic to good definition. It is quite true that there are many even very delicate objects which are much better seen under a given amplification with a system of very moderate than with one of very wide aperture, the former giving a clear view of the whole structure, the latter showing perhaps some distinct points, but as a whole veiled in haze. Provided, of course, that we have well-corrected objectives, the fault here is not on the part of the lens, but on the side of the object, which requires for proper recognition a greater range of depth than is reconcilable with a wide aperture. The theoretical suggestion which has been brought forward in support of the notion that different parts of the clear area of an objective produce *dissimilar* images, and that *therefore* the resultant image must show increasing confusion with increasing aperture, cannot apply to the delineation of a plane object. In a well-corrected objective the partial pictures received through the various parts of the aperture-area are always strictly similar so far as one plane of the object is concerned. The confusion suggested is nothing else but confusion of the images of *different depths*—lack of penetration, but not lack of "definition" in any reasonable sense of that term. Provided the objectives are properly corrected and the objects are fit for the delineation of an image, undisturbed by interfering confused images from other planes, the "defining power" of an objective is always greater with greater aperture for every kind of objects, inasmuch as under all circumstances the wider aperture admits of the utilisation of higher amplifications than can be obtained without perceptible loss of sharpness (with the same objects) by lower apertures.

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[*] From the *Journal* of the Royal Microscopical [illegible]

There is therefore no drawback in principle to the use of a large aperture when the objects are suitable. But the considerations above lead to the conclusion:—

> *Wide apertures (together with high powers) for those preparations only which do not require perceptible depth of vision—i.e., for exceedingly flat or thin objects, and for transparent objects which can be studied by optical sections. Moderate and low apertures when a wide range of penetration cannot be dispensed with.*

4. There is still another point of view, and one of special practical importance, which shows the positive damage connected with the use of *unnecessarily* wide apertures. The increase of aperture is prejudicial to the ease and convenience of microscopical work in two essential respects.

1stly, It necessitates a progressive reduction of the working distance of the objective. Owing to the rapid increase of the anterior aberration with increasing obliquity of the marginal rays (particularly in the case of dry lenses), perfect correction of a system cannot be obtained unless the layer of low refraction between the object and the front lens (i.e., the working distance) is reduced to a certain fraction of the focal length of the system, which fraction is necessarily diminished in a rapid proportion as the aperture becomes greater and greater. Whilst there is no objection to retaining as working distance 7-10ths of the focal length for an aperture of 30°, if the aperture is 60° not more than 3-10ths can be allowed, and with an aperture of 116° really good correction is not reconcilable with a working distance exceeding 1-10th of the focal length. It is, therefore, an obvious disadvantage to use aperture angles of 60° and 110°, when the power which is required or available can be obtained with 30° and 60° respectively.

2ndly, Increase of aperture is inseparable from a rapid increase of sensibility of the objectives for slight deviations from the conditions of perfect correction. The state of correction of an objective depends on the thickness of the refracting film between the radiant and the front lens, represented by the cover-glass and that portion of the preparation which is above the actual focus. This is a variable element independent of the objective itself. In order to avoid large aberrations which must result from the change of that element, its variations must either be confined to narrow limits or must be compensated for by a corresponding change in the objective. Now there is a great difference in regard to this requirement between the objectives of low and of wide aperture, in particular with the dry system. An objective of a few degrees is almost insensible, it may be focussed to the bottom of a trough of water without any loss of performance. With 30° differences in the cover-glasses within the usual limits are still inappreciable, and an object may be seen at the depth of a drop hanging on the under surface of a cover-glass. With 60° a deviation of the cover-glass from its standard thickness by not more than 0·1mm., or a corresponding increase of the depth of the preparation above the actual focus, will introduce perceptible aberrations and a visible loss of definition if not compensated for. With an aperture exceeding 100° in a dry lens, the same result will arise from a change of thickness of 0·02mm. only. To preserve always the best correction in such a system would necessitate a change of the correction-collar for almost every change of focus in the inspection of successive layers, unless the preparation is exceedingly thin.

The reduction of this sensibility in somewhat large apertures is one of the great practical advantages of the immersion-method. The extreme increase of that sensibility which is met with when the aperture of *dry* lenses approaches the maximal value of *a* for air (1 N.A.), is in my opinion a strong objection to the construction of such lenses with greater apertures than 0·80-0·85. Not only in this case must the working distance be reduced to an intolerably small amount in order to obtain proper correction, but the preservation of that correction in the practical use of the systems is almost impossible, notwithstanding the correction-collar, whilst at all events the very slight benefit of optical performance is not worth speaking of in comparison to the large increase obtained with the immersion-method under so much more favourable conditions. I need scarcely point out here that the claim of a *special* insensibility of certain lenses in regard to differences of the cover-glass (as has been sometimes made) is, to say the least, either great thoughtlessness or simple self-delusion, just as are similar claims of *special* penetration in favour of certain objectives. The aberrations in question, as well as the dissipation-circles from difference of focus, originate *outside* the microscope. The particular construction of the objective cannot possibly therefore influence their amount in a cone of rays of given aperture, and the degree in which both become *visible* in the ultimate image of the microscope must be strictly determined by the same elements which determine the visibility of any real object of given dimensions at the same plane of focus. There is no room left, therefore, for special properties of different constructions. It is, however, true that an *apparent* insensibility, as well as an apparent depth of focus, is sometimes found—viz., in *badly* corrected objectives. When a system has no distinct focus at all, it is quite evident that the dissipation-circles arising from different thicknesses of the cover-glass, and from the difference of focus of different levels, may become much greater before the deterioration of the indistinct image becomes visible. Well-corrected objectives *must* be sensitive in both respects in strict accordance with their aperture so far as one and the same system of construction (dry or immersion) is in question.

So far as the necessity of obtaining a certain amount of amplification in an efficacious manner *requires* a certain aperture, the above-mentioned restrictions and difficulties in the proper managemen of the objective cannot be avoided. But all restrictions in regard to the objects, and all the trouble taken in the adjustment of the objectives, is quite for nothing when the same result can be obtained with a lower aperture. If for the sake of convenience the precautions required in the use of wide-angled lenses should be disregarded in working with the lower powers of wide apertures, the performance of such lenses is always *worse* than that of much narrower apertures under the same amplification. The best wide-angled system, if not carefully adjusted when in use, is not better than a *bad* low-angled lens, for the tolerably sharp image, which could be still obtained through the central part of the aperture alone (even under the imperfect state of correction) is disturbed by the coarse dissipation of light from the ineffective marginal parts of the aperture.

The amateur who likes the microscope for his amusement may not much object to some extra trouble connected with the use of wide-angled low-power lenses, which he admires as brilliant specimens of optical art. For those, however, who *work* with the microscope, the econmy of labour to which they are obliged will be expressed by the rule:—

> *Never use wider apertures than are necessary for the effectiveness of the power, because excess of aperture is always waste of time and labour.*

5. A few remarks about another point of practical interest. By those who plead in favour of large apertures *in all cases*, it has been sometimes suggested as a rational plan for reconciling opposite demands, to have all objectives constructed with relatively wide angles, and to reduce them by stops or diaphragms when smaller angles are desired. The greater penetration and insensibility of the low apertures may of course be attained thereby; but nevertheless this device is only a makeshift, and the result is inferior to that obtained by objectives *originally* arranged for a lower aperture. It is not merely that the stops cannot increase the working distance (which will always remain at the point corresponding to the full aperture of the lens), but that the low-angled lens which is made out of a *good* wide-angled one by means of a stop, is in optical respects a relatively *bad* objective—not nearly as well corrected as the same power would be if carefully adjusted for the lower angle. The reason will be readily understood from the following consideration.

The best correction of an objective of given aperture depends on the proper *distribution* of a certain amount of residuary aberration, which cannot be eliminated with our present means. The greater the aperture the more aberration must be intentionally left *at the central part of the system* in order to prevent an obnoxious accumulation in the marginal zone. It is obvious, therefore, that with an aperture-angle of say 90° the inmost cone of 45° cannot be so well corrected as it might be if the marginal zone could be left out of account. The effect is by no means inconsiderable, particularly in regard to the colour corrections. Owing to the chromatic differences of the spherical aberration the central portion of a somewhat wide aperture must always, even in a well-arranged objective, be perceptibly under-corrected chromatically, and in using this central part alone (the compensating influence of the over-corrected marginal zone being done away with), we have the performance of an inferior lens. In point of fact, no intelligent optician would ever make an objective of 30° aperture on the same formula as one of 60°, or one of 60° on the same formula as another of 100°, though this could be done by merely reducing the clear diameter of the lenses.

There cannot, therefore, be a reconciliation between the pleasure of exhibiting mere optical accomplishment and the interests of the working microscopist. Bad lenses will certainly not meet the demand for low and medium powers affording the utmost possible economy of time and labour in scientific work. This can be done only by systems in which all advantages attendant upon the lower aperture are fully realised by constructions specially aiming at the *best* which can be obtained under the actual conditions of the case.

The *progressive increase of aperture in the higher powers*, formerly within the capabilities of the dry system, and at a later period by the development of the immersion method, is without any reasonable doubt, the most important feature of the *modern advance of microscopical optics*. It has rendered possible the successful extention of microscopical research to minuter and minuter objects, which otherwise would have been impossible by the ineffectiveness of all increase of amplification beyond certain low figures. The appreciation of that progress and the recognition of its true basis has led to a tendency to increase more and more the aperture of *every* kind of objectives. The fact has been disregarded that it is an entirely different thing whether the object is to promote the performance of the Microscope *in the whole* at the limits of its power, or to promote its performance for aims beyond these limits. The opinion has thus arisen that what is a benefit for one kind of lenses must also be a benefit for every other kind. Objectives of low and medium powers (1-inch to ¼-inch) of 15° to 60° are proclaimed at this time by many microscopists as old-fashioned and worthless thing; 45° to 100°, or even 60° to 140°, are wanted for the same powers. Now as from a purely technical point of view, it *is* an accomplishment when the delineating power of an objective cannot be exhauxted even with the deepest eyepieces, opticians (notwithstanding the total bootlessness of such a super-abundance) of coure take pleasure in making such "superior" lenses, and the natural consequence is that the lower apertures required for useful scientific research are likely to be esteemed as second-rate work, no longer worthy of high technical art.

This opinion is a fatal mistake, and its practical effect, if not counteracted, will be a decided retrogradation of microscopical optics. Nobody, of course, can have the least objection to the construction of lenses of any description whatever for the personal pleasure of this or that microscopist. Strong opposition should, however, be made against all tendencies of captivating microscopical optics in favour of such predilections, at the cost of the general usefulness of the instrument.

Scientific work with the microscope will always require not only high-power objectives of the widest attainable apertures, but also carefully finished lower powers of small and very moderate apertures.

ON PLANT-DRYING AND SOME PHENOMENA OF VEGETABLE DEATH.*

By Leo. H. Grindon.

We are now in the heart of the season when it is useful to give a little time to the preservation of plants for the Herbarium. Collections of dried specimens of course are not to be regarded as anything more than means to an end. It is not accumulating a vast quantity of vegetable mummies that makes a botanist, however elaborately they may be arranged, however pretty their epitaphs. Botany is the study of plants as they live and grow, their manner and customs, their curious ways and changes, noting these carefully, and then, in order that the memory may be assisted at times when living examples are unfavourable, drying one or two good examples in the best possible manner, sorting and labelling them, so that the whole constitute a kind of dictionary. This is the true and essential idea of an Herbarium or Hortus Siccus, the only one that is to be approved, the only one that carries with it the ideas of common sense and of really practical results for good to the collector. When the work of our hands can be supplemented with gifts from friends, and particularly from friends residing in foreign countries, so much the better. But it must never be forgotten that no can ever claim exact knowledge of a plant who has merely seen it dead.

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* From the *Field Naturalist*.

The very ancient adage, that if a thing be worth doing at all it is worth doing well, applies to the preservation of plants for the Herbarium as much as to any great and important work or business. Specimens that are no better than fragments of brown stick, or that seem effigies of plants cut out of thin brown-paper, the flowers shrivelled and shrunk so as to be no longer intelligible, the leaves crumpled and doubled up, everything confused and mashed together, such as one may see sometimes in collections, are altogether undeserving of the name. Nothing that is not dried in the best manner possible, — its colours and configuration preserved as perfectly as the nature of the plant will admit—ought ever to be allowed a permanent place in the Herbarium. The bad may be tolerated awhile, in default of better, but the further a specimen is from vivid and pleasing resemblance to the living thing, the speedier should be the endeavour to supersede it. Specimens from abroad that cannot be superseded of course we do not speak of. It is of plants within reach that none but admirable representatives of their best features while alive should be considered worthy of a place. Plants dry very variously. Some require not a moment's trouble, others demand patience. Now and then the case is hopeless, and we are constrained to fall back upon the pencil, and prefer drawings, coloured ones if possible. Grasses and their allies, most kind of ferns, plants that resemble heather, "everlastings," the mature leaves of shrubs and trees, call for only the minimum. Those which try the patience, and can be managed only after considerable experience with easy ones, are such as may be illustrated by citation of the hyacinth. To secure the best results, obtain first half a dozen pieces of stout millboard, cut to about eighteen inches by twelve. Then gather together a hundred old newspapers, and fold them neat and square to about the dimensions of the millboards. Four or five yards of common white cotton wadding, a score of sheets of tissue paper, and as many of blotting paper, all cut to the same size, complete the apparatus. One of the boards serve for the foundation; on this lay a newspaper, then a piece of wadding, and upon this place the specimen intended to be dried. The cotton being soft and retentive, every portion can be laid in a a proper and natural way, including the petals of the flowers. A newspaper above, two or three if the specimens have thick stems, and so on, till all shall be deposited in the way of the first. If the specimens are sticky, or hairy, or of a kind that the wadding seems likely to adhere to, then, before depositing them on it, introduce a half sheet of the tissue-paper. A heavy weight must be put on the top of all, sufficient to embed the specimens in the wadding; then leave the whole to rest for twenty-four hours. All the papers must then be changed, dry ones being put in their place; and if the plant seems to throw off a very considerable amount of moisture, such as will render the wadding quite damp, change the wadding also. A second and even a third change is desirable, at the end of two or three days or a week, and when this is made introduce the blotting paper, pressing again till everything is perfectly flat, and the specimens are absolutely dry.

Such is the simple process by which the writer of these lines has succeeded in the art of preserving the colours and forms, not only of robust and tractable plants, but of the most delicate, and very many of the obdurate. Every petal, every leaflet, retains the form it had in life, and nine specimens out of ten keep their colours excellently. To ensure the keeping of *colour*, it is well, if time can be spared, to change the blotting paper many times, and to dry it thoroughly before the fire, but this need not be done till after the third day from the beginning.

Most curious are the phenomena now to be witnessed. If those pertaining to the history of life are full of interest, those which accompany death almost equally arrest attention. The grand conspicuous phenomena of autumn we do not here so much refer to as to those observable during the preparation of Herbarium specimens. In autumn, as well known, the leaves fall in consequence of the development of a peculiar layer of cellular tissue at the point of junction of the petiole to the stem of the plant; while the colours come of the leaf being "super-oxygenated." But no one has yet uttered so much as a hint as to why some super-oxygenate into yellow, others into crimson, others into brown; one here and there, the ash, for example, declining to super-oxygenate at all, and simply dropping to the ground. Leaves and leaflets when drying between papers, are often cast off, probably in consequence of derangement in the onward flow of the sap. This happens very markedly in fir-trees, ericas, the wistaria, and various species of cissus and ampelopsis. Peduncles and petals also leave go, as in berberies, flax, the Boussingaultia and many solanums. The entire inflorescence on that beautiful grass, the Zizania aquatica, falls to bits so completely that a skeleton only remains. Crimson flowers very often change to a fine violet-purple, as in the case of the erica cinerea, the Lagerstrœmia, cyclamens, and the hairy willow herb. The cowslip, on the other hand, changes from yellow to green; and the vanda from white, variously and exquisitely mottled, to irrepressible black. Not unfrequently the entire plant changes to black, and will not be hindered, as happens with the aucuba, the lathræa, and the monotropa, in the two last of which, being parasites, we might perhaps expect it; but the aucuba — well, why here? Many plants, while drying, after death give out an agreeable perfume. New-made hay supplies a familiar illustration. We have other examples in sweet melilot and the woodruff. Sometimes the petals shrivel and contract in a very singular manner, quite different from the usual, as seen in agrimony and the Bauera; or they go into glassy films, as in the eucharis. Anemones, poplars, droseras, hellebores, stain the paper, the dye often not coming out for many months, and even years. Mercury is content to assume a beautiful indigo blue colour, which, it if said, can be extracted.

These are but a few of the curious changes that could be mentioned. They are given with a view to showing the beginner that he must never be astonished at what may occur. In the case of change of one pleasant colour to another, there is nothing really to regret. The only thing to lament over when one's specimens are of colours they need not be, is that we have ourselves been unskilful or neglectful.

SCIENTIFIC SOCIETIES.

ROYAL MICROSCOPICAL SOCIETY.

THE last meeting of the session of the above Society was held on the 14th ult., at King's College, Strand, the President (Prof. P. Martin Duncan, F.R.S.) in the chair.

The President called attention to the donation of a complete set of the *Geological Magazine*, and Mr. Stewart to the "Studies in Microscopical Science," edited by Mr. A. C. Cole, the illustrations of which he considered were very good, and the letterpress appeared to be equally so. The novel feature was that a microscopical preparation accompanied each part.

Mr. Crisp exhibited a ¼in. objective by Tolles, with a very tapering front, and stated that it was claimed on Mr. Tolles' behalf that he was the first to make such fronts about ten years ago.

Mr. Ingpen said that he had one of Andrew Ross's ½in. objectives with a triplet front dated 1848, which was similarly tapered.

Mr. Beck said that he had made them in the same way for the last fifteen years.

The President, referring to J. L. de Lanessan's "Traité de Zoologie-Protozaires" 8vo., Paris, 1882, pp. vii. and 336, and 281 figs.), said that it treated of *Amœbæ* on a somewhat grand scale, particularly as regarded the larger kinds, and he would suggest to some of the Fellows that they should search for these species as being of great interest. He obtained one from the Hampstead ponds which he found full of minute refractile points.

Mr. Stewart said he had examined some large *Amœbæ*, a short time ago, which came from Mr. Ingpen's aquarium, and were crowded with refractile points. They were distinctly crystalline in character, and had a vesicular nucleus.

Mr. Hartog said that he used to find the nuclei in the large *Amœbæ* with a very distinct network, although one which he found had a hollow nucleus.

The President inquired if Mr. Hartog had ever been able to iodise or get any colour out of *Amœbæ*?

Mr. Hartog said he had stained them with picro-carmine, but had not done so with iodine.

Dr. Ralph, the President of the Victoria (Australia) Microscopical Society, responding to a welcome from the President and the meeting, said he should like to take that opportunity of bringing before the Fellows of the Society the examination of the leaves of various kinds of plants by means of the action of prussic acid and ammonia. The process was a very simple one, it being only necessary to place the section under the microscope, and then introduce the compound. He had only had time as yet to examine a few kinds of leaves in this way, but the vine had hitherto given the most marked instances of the chemical action to which he referred. A longitudinal section as thin as possible being made of the leaf and placed under the microscope, the fluid should be added, and would be found to penetrate the structure, chiefly acting on the ducts, which were within reach of the bark. In a few moments, the most extraordinary colours made their appearance, such as claret, amber, port-wine colour, and others having all the appearance of a coloured injection of the tissue, only that in about a quarter of an hour it all disappeared. Other leaves which he had tried behaved much in the same way, though they did not all respond to the reagent in an equal degree. It was only in the brittle, sappy stems that it was possible to get the least results. He had lately tried what he believed was the panix, but he found the results were uncertain. Sometimes it failed, and sometimes it did not. The question of interest, however, was whether they could extend their observations to other plants. In consequence of these observations, he had been able to treat sections of the human subject with prussic acid with marked effects. Whenever he got in the plasma amorphous particles distinctly blue in colour, he also found the formation of amyloid bodies in the blood. These bodies were very well defined, and under favourable circumstances in polarised light, the black cross could be seen. The production of amyloid forms by chemical means, not only under the action of hydrocyanic acid, but by chloral, formic acid, or solution of copper in ammonia, was a point of considerable interest. If a portion of either of these reagents were added to fresh blood, and examined carefully under the microscope, they would, in all probability, find these starch-like bodies developed in the field. It was not easy to show the process in a room to a number of persons; but if any one present was interested in these subjects, he should be very glad to demonstrate what he had been describing.

Mr. H. Stewart inquired whether these bodies were supposed to be formed by the reagent, or were they supposed to be really present before, but only to be made visible by the reaction?

Dr. Ralph said that under favourable circumstances they might see a globule which they would be disposed to say was oil; when the reagent was added it would increase in size from about the 1-3000in. to about the 1-1000in.; later it would suddenly become opaque, and then it would colour in such a way that any one looking at it would say at once that it was starch. So far as he had carried out the observations, it seemed as if these starch-grains really did develop, and he thought it might be an instance of the commencement of the process of amyloid deposit.

Dr. Morris, of Sydney, was introduced to the meeting by the President, and detailed some experiments which he had made in mounting diatoms in phosphorus in such a way as not to be inflammable. As he had only just arrived from Sydney, he had not had time to write anything on the subject. He had seen some of the specimens which had been mounted in England, and was under the impression that the solution was too strong. He proposed, therefore, to reduce it to such a strength that if a piece of white blotting-paper was put into it, it would not blaze up. By such a solution, all difficulty as to using the medium was done away with, the only necessary precaution being to have a basin of water near at hand to dip the fingers into.

Mr. Stephenson said that if they used a weak solution, they would get a proportionately lower refractive index, whereas the principal object in mounting in phosphorus was to get as great a difference as possible between the refractive index of the medium and that of the object, for on this difference alone did the increase of visibility depend.

Mr. Crisp said that if phosphorus was used diluted to a refractive index of 1·8, the visibility of the diatom would be proportionately reduced, and as there was no virtue in phosphorus, except for its high refractive index, it would be better not to use it at all in such a condition, but to take some non-inflammable substance which had the lower refractive index.

Dr. Morris said he had tried some *Navicula*, and that with an oil-immersion lens the object mounted in phosphorus was resolved in the most perfect manner—far superior to anything that could be seen with balsam.

Mr. Crisp said that it must be borne in mind that the danger incidental to the use of phosphorus was not confined to the process of mounting. A case recently occurred, in which an object-glass, brought down too hard broke the cover-glass, and the observer, having wiped off the exuding phosphorus with his handkerchief, put it into his pocket and set himself on fire.

Mr. Ingpen said he had brought for trial some of Steinheil's eyepieces, which he thought would be of interest, on account of the speciality of their construction, and of much value for microscopical purposes when it was necessary, or, at any rate desired, to use deep eyepieces for increasing magnifying power. It was well-known that with higher objectives than 1in. the deeper Huyghenian eyepieces failed to give good definition; but these gave a remarkably sharp image. It might, of course, be a matter of opinion as to the value of increase of power by means of eyepieces; but there could be no doubt as to the superiority of this combination over the ordinary form. The field of view was rather small, not exceeding 40°. The combination consisted of three lenses cemented together, the two outer ones being of flint-glass and the middle one of crown-glass, the stops being grooves ground in the edges and filled in with black after the manner of a Coddington lens.

Mr. Crisp explained the new method devised by Dr. Ehrlich, the assistant of Dr. Koch, for preparing the bacteria of tuberculosis, which constituted a considerable improvement upon the original process. It produces a more intense colour in the bacteria, so that they appear larger, and can be recognised with a lower power, even, it is said, of 250 diameters. The substance he makes use of, instead of methyl-blue and caustic potash, is *phenylamine*.

Prof. Abbe's process of increasing the consistency of pure cedar oil, so as to render it less fluid and therefore more convenient for use as a homogeneous-immersion fluid, was explained by Mr. Crisp. The oil is spread out in thin layers, and exposed to the action of the air and light for a long time, until it becomes of the consistency of castor-oil.

Mr. W. F. Petterd's letter was read accompanying a collection of diatoms from Tasmania.

M. A. Cates' letter, reiterating his claim to the discovery of a method of staining the nucleus of *living* infusoria, was read by Mr. Crisp, who said that the author of the interpolation by which such a claim was described as "erroneous," now agreed that he was mistaken in the view he had expressed, not having in fact sufficiently noticed that the claim related essentially to the nucleus of the *living* animals.

Mr. Crisp called attention to a process devised by E. Korschelt, of Freiburg, for preserving infusoria and *Amœbæ* by the use principally of osmic acid and chromic acid, no method having hitherto been found for the latter organisms. Dr. A. Gruber had also succeeded in preserving Heliozoa by the method, in excellent condition.

Mr. R. Miller's description of his caoutchouc cement for making and sealing cells was read, in which he stated that he did not claim to have discovered any new material, but to have accidentally hit upon a new method of combination.. The material so obtained was singularly easy to work, and reliable in its results. It was used not only for making the cells but for sealing them afterwards.

Dr. Van Heurck's letter was read describing favourably his further experiences with the Swan lamps and Faure-Reynier accumulators.

Prof. Abbe's note was read with reference to the description of his camera lucida, inserted in the *Journal*, that the benefit of the arrangement consisted simply in the ease with which it may be used. In other respects it did not possess any advantage over those forms which fulfil the condition that the image is seen without reflection or other loss of light.

Mr. Ahrens exhibited and explained the construction of his new erecting binocular microscope. In general outline it presented much the same form as that of Mr. Stephenson's, the tubes being inclined, whilst the stage was horizontal. The erection of the image was, however, obtained by introducing a Nachet-erector prism over the objective, another prism similar to the Wenham being used above to divide the pencils.

Dr. Millar said that whilst he could speak with great praise of the advantages of the erecting binocular as an instrument to work with, leaving nothing to be desired for comfort and convenience, he thought the one now before them did not appear to give an entirely satisfactory stereoscopic effect.

Mr. Michael said there was no doubt that a binocular microscope, with a flat stage and an erecting arrangement, was an immense help to those who worked at living objects. In drawing from living insects he had found it of the greatest practical service.

Prof. Liversidge's communication on the "silver-fish" of Sydney was read, in which he defended the accuracy of the observations of Hooke recorded in his "Micrographia" (1665) as against the strictures of Mr. W. Blades in his "Enemies of Books" (3rd ed., 1881). Specimens of the insects were sent, and labels and sheets of paper destroyed by them exhibited.

Mr. Hartog said there was no doubt as to the animal being *Lepisma Saccharina*, the same that was often found in this country. It was mentioned by Emerson Tennant as being thought by some to prey upon books, but the author thought that it rather preyed upon the insects which were found in the books, a view which he (Mr. Hartog) thought was an error.

Mr. Thoms' letter on "Saccharomyces" was read, in which he mentioned that he had devoted all his spare time for ten years in tracking these organisms, and now made all his bread without any yeast, so called.

Mr. Bennett, to whom the letter was addressed, made some remarks upon the subject.

Prof. Abbe's paper "On the Relation of Aperture to Power," Part II., was laid before the meeting by Mr. Crisp, who said that as it was a very long communication, he had prepared a résumé of it, which presented the leading points in a condensed form suitable for being read to the meeting. This he was proceeding to do, when

Mr. Beck, interposing, said he thought that as the paper was an important one, and required a good deal of consideration, a résumé of it would be of very little use to them. He would suggest, therefore, that the paper should be printed, and that when it had been before them *in extenso*, an evening should be specially devoted to its consideration and discussion.

The Chairman (Mr. Glaisher, in the absence of the President), on the contrary, thought that it would be very useful to have an abstract of the paper read.

Mr. J. Mayall, jun., also thought it very desirable that the Society should be in possession of Professor Abbe's views, without having to wait until the next issue of the *Journal*. The meeting having indorsed this view, Mr. Crisp read a *résumé* of the paper.

The Chairman said that the paper was obviously one of very considerable importance, and he had great pleasure in proposing that the warm thanks of the Society should be presented to Professor Abbe for it.

Mr. Stephenson seconded the suggestion, and said that, having had the advantage of reading the paper in M.S., he believed it would be found to contain a most exhaustive discussion of the subject.

Mr. Crisp said that it was the first attempt that had been made to establish a definite relation between aperture and power, and it could not fail to prevent the perpetration in future of such absurdities as had been issued in the way of low-power objectives, with very large aperture.

The Chairman said that the report of the Committee appointed to consider the question of standard gauges for eyepieces and substages had been adopted by the council. The gauges recommended for eyepieces were 1·35in. and 0·92in., and for substages 1·5in.

Mr. Crisp said that it should be mentioned that there had been some difference of opinion, both on the part of the Committee and Council, as to whether there should not be a third intermediate gauge; also, that in selecting the sizes mentioned by the Chairman, regard had been had to the sizes which were at present in most frequent use, so as not to disturb existing arrangements more than could be helped.

The following papers were taken as read: "Plant Crystals," by Dr. Aser Poli, of Rome, "Note on the Rev. G. L. Mills' Paper on Diatoms in Peruvian Guano," by Mr. F. Kitton.

The meeting then adjourned for the vacation, until October 11th.

USEFUL AND SCIENTIFIC NOTES.

A Blind Man's Vision.—M. J. Plateau, who for the last forty years has been totally blind, has just published a little paper on the sensations which he experiences in his eyes. He states that he has constantly in his eyes the sensations of light; his field of vision is divided into spaces, of which some are very clear, and others sombre or almost black. These spaces are not precisely limited, but run into each other at their borders; but what is remarkable is that their general tint alternates between gray and reddish. For example, if it be grey M. Plateau perceives now, in a few hours it will be red; then a few hours later, the grey again, and so on. The reddish tint is that obtained by mixing pale rose-colour, or rather flesh-colour, with a certain quantity of black. The relative arrangement of these different spaces is always the same, but the intensity of their tints varies. The central space shows itself sometimes very clear, sometimes very sombre; above and below, as far as the limits of the visual field, there is sometimes clearness, sometimes obscurity. It is the same with the space to the left: there is generally a vertical, almost black band, and the space to the right of that, as far as its limit, is almost always clear and ruddy. These appearances seem to M. Plateau to fill the whole extent of his ordinary visual field. He believes the distance at which they are is small. These same appearance follow all the movements of the eyes, as if they resulted from a modification of the retinas. It appears to M. Plateau that the two eyes do not participate in the same manner in the tints in question; but he is absolutely incapable of distinguishing what belongs to the one from what belongs to the other. He has not been able to establish any coincidence between the changes of the general tint and the work of digestion.

VALUE of exports per head of the population in the Australian Colonies:—New South Wales, £21 11s. 2½d.; Victoria, £18 15s. 3d.; South Australia, £21 1s. 7½d.; Queensland, £15 10s. 8¼d.; Tasmania, £13 6s. 1¾d.; Western Australia, £17 4s. 0½d.; New Zealand, £13 7s. 10½d. General average, £18 5s. 6¼d.

SCIENTIFIC NEWS.

THE Dun Echt Circular, No. 53, contains a *Science Observer* telegram, announcing that Mr. S. C. Chandler, jun., finds the period of the variable star D. M. + 1° 3408 to be only 0·83 day. A minimum occurred on July 1, 12h. 57·6m. G.M.T. On reference to p. 324, XXXIV., a note from Dun Echt Circular, No. 41, will be found, in which the period is given as 5·24 days.

Prof. Schmidt saw comet Wells at Athens on June 10. He gives the position as 3h. 59·7m. Athens M.T., R.A. 5h. 0m. 40s., N. Dec. 23° 19 4′. The distance of the comet from the nearest limb of the sun was 2·8°.

The comet seen during the eclipse observations has not been again observed. It was carefully looked for in Egypt during the week after the eclipse, both before and after sunset, but was not detected.

The flint disc for the great telescope of the Lick Observatory proved to be, like the crown, a most successful casting. The trustees of the Observatory have ordered a meridian circle with 6in. aperture from Messrs. Repsold, of Hamburg There will be two divided circles, each having four reading microscopes; the axis of revolution will be a telescope with collimators east and west. The object-glasses for the instrument, and the collimators will be made by Alvan Clark and Sons.

It is stated that the Crystal Palace Company are endeavouring to organise an exhibition, during the autumn and winter, of gas and electric-lighting appliances. The direct competition of the rivals would be very attractive, especially if the relative costs of the systems were given by a jury of experts.

Prof. Houston, of Philadelphia, thinks that underground wires for electric lighting are perfectly feasible, and much safer than overhead wires. The municipal authorities of Chicago have determined that the wires shall be placed underground.

The report of the Streets Committee of the City of London on the tenders for the electric lighting of certain districts has been issued with a map. The figures given in the tenders are remarkable; but it is scarcely fair to take the cost of the plant, putting it down, and removing it into account, when comparing the estimates with the present gas-bills. To take No. 1 district, the gas-bill is about £551; the cost of the electric light for twelve months (that is, the charge for the actual working) varies from £498 to £1,620; but the total cost varies from £2,190 to £5,750. Adding 10 per cent. of the actual outlay for plant to the lowest working figures the bill would be £837 as against £551 for gas. In view of these and other facts, the Streets Committee think it unadvisable to proceed further at present.

The Smithsonian Report for 1880 contains a "Synopsis of the Writings of Sir W. Herschel," prepared by E. S. Holden and C. S. Hastings. The "general appendix" in this volume has very few of the usual scientific papers, but there is a "record" of recent scientific progress, in which the subjects are each treated by well-known students: *e.g.*, Prof. Holden writes the record of astronomy. It is intended to make this record a special feature of the report, but it will not exclude the monographs which have heretofore formed so valuable a part of the annual volumes.

Mr. Stretton's little book on "Railway Accidents" is evidently a success. A second issue of the third edition is announced, with additional pages and diagrams. We trust the author's object of tracing and preventing avoidable accidents may be in some measure secured, and that he may reap the reward of his long and persistent efforts on behalf of railway employés and the travelling public.

The expeditions intended to make a series of observations in the Arctic regions—the circumpolar expeditions, as they are called—are nearly all en route, and by August 1 will commence their work, which will be continued for thirteen months. The results will be discussed at an international conference.

A project by Prof. Wellner, of Brünn, for utilising the motions of the sea, was recently noticed in our columns; part of it consisted in letting the compressed air enter the lower divisions of an immersed wheel, of water-wheel-shape. Prof. Wellner has patented (in Austria) steam-wheels working in the same way —a new type of steam-engine. The mechanical work depends on the lifting power of the specifically lighter steam in the heavier liquid. The steam may be generated immediately below or brought from elsewhere. The escape-pipe at the upper part of the case may either let the steam into the open air or into a condenser. These machines may be connected with ordinary ones, and then afford a means of utilising the waste steam.

Magic photographs, in which the image is developed by tobacco-smoke, have been lately supplied in various tobacco-shops on the Continent. A cigarette mouthpiece is provided, and with it are some white photographic papers about the size of a postage-stamp. One of the latter is placed over a lateral orifice in the mouthpiece, and a sliding piece drawn over it. After smoking, one finds the image on the paper. *La Nature* explains the process. A small photograph, prepared on chloride of silver paper, as usual, but without intensifying, is put in a solution of bichloride of mercury, where it pales and disappears. The bichloride of mercury changes the photograph partly into white chloride of silver, and partly into protochloride of mercury, also white, making the image invisible. The image may be brought back by action of hypochlorite of soda, or of ammoniacal vapours. Tobacco-smoke, as containing the latter, does very well. The principle of magic photographs was indicated by Herschel in 1840.

It was announced that an exhibition of electricity was to be held at Vienna this year, and another at Munich. Considering the disadvantage of these being at the same time, the Vienna Committee have resolved to delay till August—October, 1883. In Bavaria, the railway authorities have offered the Exhibition Committee trains for trial of systems of lighting, and the telegraph authorities lines for trial of long-distance telephoning; the longest of the latter is Munich to Dresden, 550 kilometres (say 343 miles.) Telephonic experiments have been lately made with success, by day, on the line between Paris and Dijon, a distance of 314 kilometres (196 miles). It is curious to read that three telegraphic stations have been recently opened in Palestine, at Nazareth, Tiberias, and Safiè. In Arabia, the material is getting ready for construction of the system of telegraph-lines of Hedjaz. Part is destined for the first lines from Djedda to Mecca, and from Mecca to Yambo and to Medina; the rest for connection of the lines projected for Hedjaz with the existing lines in Yemen.

New experiments have been made by M. Richet with a view to ascertaining the *minimum fatal dose* of the principal alkaline chlorides (of lithium, sodium, potassium, rubidium, and cæsium) on animals. The animals selected were small guineapigs, and the substances were injected under the skin. M. Richet finds no relation between the atomic weight of the alkali metals and their physiological activity.

Glove-leather is usually coloured by manual labour with brushes. This process, besides being slow, has the disadvantage that ugly edges are produced on the flesh side, and the colouring, in spite of great care, is never quite uniformly distributed. Herr Kristen, of Brünn, has sought to remedy this by a (patented) process, in which uniform colouring is effected with the aid of centrifugal force, the skin being fixed on a horizontal disc, the colouring poured on it at the middle and the disc rotated. Thus an equal distribution of the matter is obtained. The liquid in excess flies over the edge, and is caught in a funnel, which guides it to a reservoir, whence a pump bringsit again to the disc. In about 10 to 15 minutes a skin is finished. Only one man is required for five of the machines, which are placed near one another, and driven by the same shaft. In twelve hours 150 skins can easily be coloured by this method, and in a very satisfactory way.

In Berlin an exhibition of machines and raw products of soap, perfumery, wax and candle manufacture was opened on 4th June.

A method of lighting miners' lamps by electricity formed the subject of a recent paper by M. Hubert, to a scientific society in Hainaut. The body of the lamp is traversed by two tin tubes, holding two other concentric wooden tubes, which serve to insulate copper wires passing through (tightly) to a small piece of platinum wire near the wick. The explosive gas cannot enter along with the current. On applying the two series to the electrodes of a battery, the platinum glows and the wick is lit. The battery is a bichromate; two zinc plates and four carbon plates being immersed in a mixture of bichromate of potash and water, acidulated one-tenth of its weight with sulphuric acid. To avoid sparks, two plates of carbon and of zinc are held out of the acid by two springs. After applying the lamp to the electrode to light it, the springs, on being released from pressure, raise the plates from the liquid, and, on removing the lamp, no spark can pass, since the circuit is ruptured within the battery.

The idea, expressed a short time ago, that red-beet was destined to rival the vine in production of wine, appeared open to serious doubt. M. Lefort, a member of the French Academy of Medicine, has recently furnished technical reasons for rejecting it. The spirit produced in the vinification of the must of beet contains, in addition to vinic alcohol, some aldehyde, which is the chief cause of the depreciation of beet-spirits; also propylic, butylic, and amylic alcohol, substances that are poisonous even in small doses, as the experiments of MM. Dujardin-Beaumetz and Audigé have proved. There is further to be cited an alkaloid called *betaïne*, which is always met with in the beet, in a proportion of 1 to 5 per cent., according to the roots, and whose physiological properties are unknown. In fine, the pretended beet-wine is simply a pale red liquid, containing 4 to 5 per cent. of alcohol, easy to keep, but of a very disagreeable flavour by reason of the odorant principle of the beet. This manufacture, M. Lefort holds, cannot have a great future.

The manufacture of alcohol from potatoes by means of hydrochloric acid is carried on entirely in Germany (according to *Le Genie Civil*) as follows: The potatoes are introduced into apparatus in which they are treated with steam at high pressure; then saccharification is effected with hydrochloric acid, and the excess of acid is neutralised with carbonate of soda. The cooled mass is submitted to fermentation in vats, then distilled. When saturation has been reached, the residues may, without inconvenience, be employed as food for cattle.

One day recently, the Hotel de Ville at Arras was struck by lightning and set on fire, though the belfry has a lightning conductor over 12 metres long, which was repaired last year by a local electrician. The part struck (above the mayor's rooms) appears to have been within the cone of protection according to received ideas. A specialist, M. Jarriant, has suggested three possible causes of the phenomenon: (1) Solution of continuity in the metallic circuit; (2) insufficient section of the conductor; (3) a bad condition of earth-connection. On May 31st, lightning struck the earth covering the powder-magazine of the Fort Werder, near Strasbourg. The ground-sill of the magazine, a stone more than a yard thick, was shivered to pieces. It is remarkable that none of the new forts raised by the Germans about Strasbourg have been furnished with lightning-rods—an inexcusable imprudence (says *L'Electricité*), because many examples prove that lightning has a real affinity for powder.

The first electric railway in Holland has been opened. It runs along the North Sea, from the sea-baths of Zandvoort (a place connected by rail with Harlem) to the park of Kostverloren, the length being two kilometres (1¼ miles). The line is constructed by Siemens and Halske, of Berlin.

An interesting report on the results of experiments in Russia, with moving targets for artillery fire, appears in the *Revue d'Artillerie* for June. Such targets give good results, it is stated, when they have the form of a drum or a two-wheeled vehicle, with two long cables attached (the length of cable being not over 2,500 metres, and the traction being by horses). The targets are moved either across or along the line of fire. Temporary supports, with guide-rollers for the cables, are planted on the ground.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

ζ HERCULIS.—ξ BOÖTIS.

[20235.]—IN letter 20212 (Vol. XXXV., No. 901, p. 377), "F.R.A.S." refers to the distance separating the components of ζ Herculis at the present time. I again carefully measured this star on the evening of Friday, June 30th, with the following results:—P = 106·2°; D = 1·2″; Ep. 1882·49. This is the mean result of 4 measures, and I believe may be relied on, say, within 3° of the position angle, and about 0·1″ of the distance.

I shall be happy to measure the second companion of ξ Boötis for Mr. H. Sadler (letter 20179, Vol. XXXV., No. 900, p. 349) on the first opportunity.

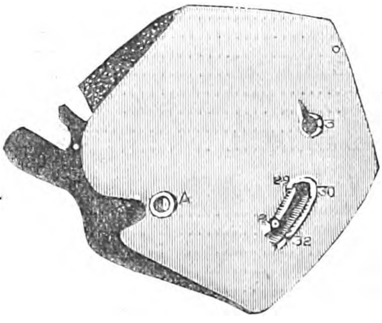
Jevon J. Muschamp Perry.

St. Paul's Vicarage Observatory, Alnwick.

PTOLEMÆUS.

[20236.]—IN Tab. LXXII., Fig. 51, Schröter has delineated four deep pits, two of them being nearly as large as the crater, Ptolemæus A. From "Celestial Objects," and also from Neison's "Moon," it appears that these curious objects have not been seen since Schröter's time, though Mädler observed the floor for four years, and saw 11 small craterlets upon it. In the *Astronomical Register* for February, p. 45, however, I gave a brief account of some observations of one of these large pits, the northern one (η of Schröter); and last night I was favoured wish a few short, but very interesting, glimpses through gaps in the clouds, with the following result:—

1882, June 23, 9h. 20m. to 9h. 30m., 2·75in. achrom., p. 102. Moon's age, 8·1 days. Definition fair, but a little fluttery. The two principal pits appeared very conspicuous, and nearly as large as the crater A. They were nearly, but not quite, filled with shadow, the eastern side being bright, with perhaps a trace of a very low wall. The southern one had a short extension of the shadow south, and on its east side was a bright spot, No. 3, which last, sometimes appearing as a crater, has been seen to vary considerably in brightness. The northern pit was still more interesting. On its east and west edges were two minute spots, Nos. 29 and 30, both of which are really small crater cones. From spot 29 a ridge ran N.W. to the pretty large craterlet 2, which, under a higher illumination, appears as a bright streak *t*. This ridge was pretty lofty, and quite conspicuous. Another ridge ran from spot 30 to 32, forming a light streak *v*, at full moon; this was also very plain. The space included by these two ridges, which are perhaps shown too far apart in the sketch, was nearly filled with shadow, and very dark elsewhere. There was only just time to draw the outline, and insert these features in the accompanying sketch, before clouds completely obscured the moon; but much other small detail was visible on the floor.



It is remarkable that such very large and prominent features as these should have escaped attention for so long, and should not always be visible soon after sunrise. Thus, on May 27, 1882, at 8h. 30m., moon's age 8·4 days, not a trace of either of these great depressions, or of the ridges, could be seen, though the floor was carefully examined with a 5¼in. Calver, and power of 275. Nor has the slightest vestige ever been observed at sunset.

I am anxious to obtain every possible information with regard to these wonderful objects during the next few months, and should, therefore, be very glad of any assistance. The inclosed sketch will serve to point out roughly the positions, &c., of these objects; but if anyone who thinks of looking them up will write me a line, I shall be happy to give the positions of certain measured and other spots and objects in the neighbourhood, which will serve to fix their positions exactly, and other information which might be of use.

A. Stanley Williams.

1, Medina-terrace, West Brighton, June 24.

CATALOGUE OF SUSPECTED VARIABLE STARS.—I.

Andromeda, Aquarius, Aquila, Argo.

[20237.]—We have collected from various sources a catalogue of all the stars suspected of variation, the number of which has now reached to between four and five hundred. The variation of so many of them may be watched with an opera-glass, that we think, perhaps, by publication of them, some of your readers may be induced to undertake observations of them. We shall give them in order of the constellations, arranged alphabetically. The places are only given roughly, but will be sufficient to identify the star on the star-map. We are aware that the catalogue is very incomplete, but trust that such as it is it may be acceptable to your readers:—

		h. m.	° ′		
	ANDROMEDA.				
1.	π Androm.	0 30	+ 33 4	—	Herschel.
2.	η ,,	50	+ 22 47	—	Schmidt.
3.	56 ,,	1 49	+ 36 40	—	Cornish.
4.	ι ,,	23 32	+ 42 36	—	Gore.
5.	B. A. C. 8245	23 36	+ 44 20	7	Franks.
	AQUARIUS.				
6.	4 Aquarii	20 44	— 6 10	—	Herschel.
7.	5 ,,	45	— 5 58	5·8	Gould.
8.	7 ,,	50	— 10 11	5·9	Gould.
9.	18 ,,	21 16	— 13 30	—	Herschel.
10.	B 596	40	— 2 46	6 — 8	Birmingham.
11.	28	54	— 0 5	4·8	Herschel.
12.	32	57	— 1 36	4·5	Herschel.
13.	39	22 5	— 14 18	6·1 — 6·6	Gould.
14.	Anon	22	— 10 39	7·8 — 0	Rümker.
15.	Anon	29	— 8 16	9 — 0	Hind.
16.	66	35	— 7 44	5	Franks.
17.	69	40	— 14 19	4·6	Herschel.
18.	B 625	52	— 25 48	Var. Spectrum.	Secchi.
19.	φ	23 6	— 6 51	4½ — 5·0	Espin.
20.	303 B	23 10	— 12 25	7 —	Schmidt.
21.	22743 A.O.	11	— 19 36	6 — 9	Schulhof.
22.	ψ³	12	— 10 16	—	Schmidt.
23.	100	24	— 22 10	5·1	Herschel.
24.	LL 46090	25	— 11 48	—	Schmidt.
26.	104	34	— 18 37	4·8	Herschel.
27.	ω²	35	— 15 21	4·4	Herschel.
28.	107	40	— 19 21	Var. Col.	P. Smyth.
	AQUILA.				
29.	B 447 Aquilæ	18 26	— 5 11	Var. Col.	Birmingham.
30.	B 464	43	— 8 2	7½ — 9½	Birmingham.
31.	B 483	57	— 5 52	7½ — 0	Knott.
32.	24	19 11	+ 0 5	5·2	Herschel.
33.	B 498	21	+ 1 56	7·8 — 8½	Birmingham.
34.	36	22	— 3 5	6	Franks.
35.	LL 36863 (?)	23	+ 2 38	6·3 — 7·2	Gould.
36.	μ	27	+ 7 7	4·4 — 5·3	Gould.
37.	ι	30	— 1 33	4·6	Gould.
38.	46			5·4	Herschel.
39.	B 510	38	+ 4 40	7·0 — 0	Birmingham.
	ARGO.				
40.	LL 14088 Argon.	7 8	— 22 27	6 — 9	Gould.
41.	Anon.	7 10	— 23 6	—	Birmingham.
42.	Anon.	55	— 12 13	8½ —	Pickering.
43.	14	58	— 19 19	5·0 —	Herschel.
44.	L 3344	8 24	— 26 25	6 — 8	Gould.
45.	κ	9 2	— 25 21	4·9 — ?	Gould.
46.	L 3833	21	— 28 14	6·5 —	Gould.
47.	R	10 4	— 37 7	6⅓ — 8	Gould.
48.	α	21	— 30 25	4·4	Gould.

T. E. Espin.
W. H. Gage.
T. Read.

(*To be continued.*)

CARBON CONNECTIONS.

[20238.]—The plan suggested by "Beetle Crusher" of drilling a vertical hole in the carbon and filling it with lead, I used to find defective, until I improved upon it as follows: Place a small piece of platinum foil, tinned on the upper surface into the drilled hole, and pour in the solder or lead around some removable object; then, when cool, fill the hole.

I found the surface of the lead soon oxidised otherwise, and filling by degrees prevented shrinkage.

D. H.

SECONDARY BATTERIES—SUGGESTED IMPROVEMENTS.

[20239.]—These batteries are likely to become so important in the future, for the purpose of storage of power, that any suggestions which may be productive of improvement, are, I think, worthy of consideration and experiment.

In the first place, it is advisable to consider what are the principles which give rise to the action of this battery, and also to show in what manner it differs from the ordinary sort. In this we employ the same metal on each side, and thus we are enabled to use one conducting fluid instead of two, which is free from some inconveniences which arise from the use of two fluids. Next, we must choose a metal which is capable of three degrees of oxidation, and further, this metal and its oxides should be able, or nearly so, to resist combining with the fluid which we are using. Now, in the oxides of lead, and in dilute sulphuric acid, we have the necessary conditions. Let us now observe what takes place when in use. Having the plates on both sides covered with the *intermediate* oxide of lead; upon applying the "dynamo," the plates are polarised, causing one to have a greater affinity for oxygen, and the other a less. By this means the intermediate oxide on one plate takes another molecule of oxygen, which the other plate loses. Upon disconnecting our dynamo, there is energy in the side having the lower oxide, to drag (as it were) the superfluous oxygen from the other plate; but this cannot take place until a passage is made for the electricity—as it were, a back door to find its way to the opposite side, and in by another back door; for, the immediate space being occupied, no room is left for the passage of the electricity till another way is afforded; and thus, by completing the circuit, we can intermediately employ the electricity for work, or any purpose we require.

But it is a mistake, I think, to use so large a quantity of metal to conduct the electricity provided by only a thin coating of oxide. As the possible store of energy must depend upon the quantity of oxide present, it is evident that there is a great disproportion between the large quantity of metal employed for conducting, and the small quantity of oxide furnishing the electricity.

To improve upon this, I propose that a number of flat, porous jars be provided, fitting into a suitable case. Into the middle of each of these should be put a thin plate of lead, and filled up with the oxide of lead; and then that the acid liquid be poured over all so as to fill every vacancy. Now, notwithstanding the extra space occupied by the porous jars, it is plain that by this method a much larger quantity of oxide is stored in the same space, and the construction of the battery is rendered much more simple.

Every alternate plate is to be connected to one conducting wire, and the other alternate plates with the other conducting wire, and by this method we may get a large *surface* of plate connected with a large *quantity* of the oxide; and hence a much larger storing capacity.

But we are not confined to lead as our metallic conductor, nor to its oxide as our oxygen carrier, for there are a variety of substances which will be found suitable to fulfil the required conditions.

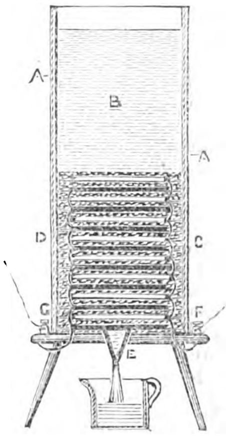
And it is a fortunate circumstance for our first cost of battery, that in iron—the cheapest of metals—we have, as I think, the most suitable metal which could be found to answer the purpose, for we have the three oxides—namely, the protoxide, the intermediate black oxide commonly called the magnetic oxide, and the sesquioxide, and it so happens that this intermediate oxide is a combination of the other two. But, moreover, all these oxides are insoluble in phosphoric acid, or nearly so; and hence we have a successful method of forming a cheap secondary battery by employing the oxides of iron and dilute phosphoric acid; and possibly the cheap salt phosphate of soda might be found to answer in the place of phosphoric acid. Now, adopting the plan of porous cells described, and using thin iron plates, all the cells may be packed with the magnetic oxide and the liquid supplied; and then all would be ready for the application of the dynamo to store up energy. Or, instead of this oxide, we might supply every alternate cell with the protoxide of iron, and the other alternate cells with the sesquioxide of iron, and then the liquid being added, the battery would at once be ready for doing work. But in the latter method the weight of each of the oxides should be proportioned, so as to form the magnetic oxide, and nothing over, making all capable of being effective. By this plan of battery it will be evident that every surface of the cells will have opposite to it another surface, having opposite polarity; the extreme ends of course excepted.

I hope some of our readers, who may have handy all the materials and accessories required, will try the experiment, and report the result to the English Mechanic, or point out any inconsistency in the chemical and electrical reasonings which I have put forward, and thus help us on the road to success, which, as we know, is often the results of our mistakes.

J. H. Huxley.

IMPROVED BICHROMATE BATTERY.

[20240.]—The following is the description of an improved bichromate battery which I have designed, with a view to producing constancy, compactness, and cheapness. It consists, as is shown in the annexed sketch, of a containing vessel of a construction which I will now describe. Take about 15in. of glazed earthenware drain-pipe, say, 5in. outside diameter, and fit one end of it with a water-tight stopper, having a 1½in. hole in the centre. This may be of wood, turned to fit, and afterwards made water-tight by pouring some melted pitch round the edge. The 1½in. hole should have a small conical nozzle fixed in, as shown, with a very small orifice at the base, capable of letting



out about one pint per minute of any liquid that is placed in the vessel. The plates of the battery are carbon and amalgamated zinc. To fill the battery, first place a small piece of round wire gauze over the conical nozzle inside the battery, then lightly lay a thin layer of pine sawdust about ¼in. thick; this being done, place a plate of carbon on it, having a guttapercha covered wire attached to it, then cover with another thin layer of sawdust. On this lay a plate of zinc, also having a guttapercha wire attached to it. Then another layer of sawdust, and so on, until the requisite number of plates are deposited in the battery jar. The wires should all be brought up to the top of the vessel over the mouth to two binding-screws; the carbon wires to one, and the zinc wires to the other. In the sketch this arrangement is shown differently, thus making the meaning clearer to the readers of this article. The vessel should be placed on a stool, having a round tube in the centre, through which place the nozzle, and any suitable vessel should be placed under it, in order to catch any liquid flowing from the battery. To charge the battery, saturate bichromate of potash to the proportion of 2oz. to one pint of water, and fill the jar with it to about 1in. of the top; then add 1oz. of concentrated sulphuric acid to every pint of the solution, and add more acid as the work of the battery is being carried on.

The action of the battery is as follows:—The solution filters down to the bottom through the sawdust, and out of the nozzle into the vessel beneath; that being full it is quickly removed and another substituted, the contents of the first being poured back into the battery-jar. To stop the action of the battery, let all the liquid run out without replacing it. The object of this battery is to produce a circulation of the solution, thus preventing gas congregating round the different poles and stopping its action. The shape of the battery plates is immaterial so long as they are of good stuff. The wires from them should be carefully examined, to see there is no inlet to the acid, and all holes or parts exposed should be painted over with sealing-wax varnish. The explanation of the sketch is as follows:—A, is the containing vessel; B, the battery solution; C, the wires on this side are connected to the zinc plates, shown white; D, the wires on this side are connected to the carbon plates, shown black; E, is the nozzle; F and G are the binding-screws placed on the stool for the sake of compactness.

Beetle Crushers.

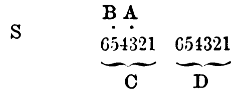
TO "ORDERIC VITAL," MR. BELL, AND MR. BRASHEAR.

[20211.]—IN answer to "Orderic Vital" (20138), I have purposely tried again a round hole of about the same area as the triangular hole—*i.e.*, giving about the same amount of light, and I can perceive no difference in the shadings from the same speculum. "O. V." will easily perceive that since a round hole is not a point, the shutter must touch some part of it first, and this is but true of a triangular hole. When we have only small holes to deal with, and not mathematical points, it is little matter what shape the hole is, so that it has some pretension to arranging its light symmetrically round its centre. "Prismatique," who, like myself, looks at the subject from a practical point of view, is correct when he says (20188) "my judgment leads me to suppose the shape of the point is not so important in zone testing as it is in testing from the centre of curvature with an eyepiece. The extreme smallness of the hole, I should say, is what is required in the shadow test, as there is no magnification of the objective itself in the usual sense." I use a round hole in my experiments upon flexure; but, in the measurement of the foci of the zones, it is the point where the rays from opposite sides of the zones cross we want to ascertain, and if the hole, whatever its shape (in reason), is practically a point to the unaided eye, this is all we want; beyond this our unaided vision cannot go. It is different where we magnify the hole with an eyepiece. In answer to "O. V.'s" last paragraph, I am happy to say that Mr. Calver has very generously lent me a beautiful short focus, 12in. speculum, as being, on account of its short focus, a very good test for the rule. I can safely say it is one of the very best I ever saw, most regular in its curve, and good up to the very edge; its curve he considered exactly right, as proved by actual observation. I most carefully tested it over and over again, and it answered most admirably to the rule of dividing the square of the semi-diameter of the middle of the zones by double the focus for parallel rays. This, with the results of "O. V.'s" trouble and labour, has quite confirmed me in the belief that the rule is correct as far as we want it, and it is pleasing to thus see theory and practice agreeing: this should always be the case, and of course will be where they are both right. I should like further to say that Mr. Calver's kindness has led him to offer me the use of some other specula if I require them.

In answer to Mr. Brashear (10156, p. 328), I can say that I am glad that our American cousins are taking an interest in our subject; by the way, I have some real American cousins, a county over there being, I am told, named after one of them, "Wassell County," so I hope a friendly feeling will ever exist between us, and that our columns may ever be the medium of a national exchange of thought, and that if our American cousins improve (as they generally do) on us, they will let us have the benefit of their improvements through our columns at an early date. No doubt the measuring of the zone's foci, as a test for the parabola, has occurred to many; but no one seems to have reduced it to practice with anything like success or certainty, and then made it known. This is what I have aimed at, and so far have succeeded; and the more I examine the subject in the light of all the correspondence that is now going on, the more I am convinced of its importance and thoroughly practical and reliable character. Now, as to the diffraction-rings Mr. Brashear refers to, I find no practical inconvenience from them; they do not extend one-tenth over the area of the zone, so we have nine-tenths of the area of the zone to judge from, and this is enough; in fact, I cannot understand how any difficulty in the testing can have arisen from this cause, except Mr. B. attempted to use too narrow zones: but I have before been careful to explain that every speculum ought to be divided into six zones, thus I divide a 12in. into 1in. wide zones, a 6in. into ½in. wide zones, and so on for all sizes; with these zones the diffraction-rings do not interfere with the shadings. The suggestion of "O. V." and Mr. Brashear to take the "exact focus of the central zone and the outside zone, then if the amount of longitudinal aberration is correct, and the curve is regular from centre to edge, no diaphragms need be used." Now, the practical objection to this plan is the difficulty of taking the exact focus of the very centre rays on account of their small angle; and then here is the advantage of taking all the foci of the zones: we extend our measurements over a large area and a large number of measurements, and we can see if the proportion is regular. Thus, if we find Nos. 1, 2, 3, and 4 zones shorting regularly, and then find No. 5 zone not so short as it should be, as compared with No. 1 and the others, then we may suspect that we have made some mistake, or that there is a mound about where No. 5 zone comes; we examine the whole aperture without stops, and do not see a mound; we shall re-measure, and find out how we have made the mistake. Thus, the outer zones become a check on any mistake of our measurement of the centre zones; but such a mistake could only occur to an amateur of little or no experience, or by an accidental shifting of the measuring apparatus. Now, by testing 2-100ths on each side of the supposed centre zone focus (as I have explained before), and, seeing if the shadings are alike, we can get even the centre zone focus to the 1-200th inch, and this is near enough for anything. But, as I have already explained, whatever mistake we make in the measurement of the zones, the actual error on a celestial object is only ¼ of this mistake. This is very fortunate.

A correspondent of mine has worked out the formula given in letter 20183, and he says, "I have worked it out for your supposed 6in. mirror. Your value (*i.e.*, by the rule I use) is ·063, and by it (the formula) ·0621, which looks as if you were somewhere about the mark." In other words, the rule seems to be an approximation to the 1000th inch, which is near enough.

Now, as to Dr. Hastings' letter, which "O. V." and Mr. Brashear have kindly got for us (see 20184, p. 357). First, he says, "Thus we see that the mathematical optician is right" (2nd col., 20 lines from bottom). From this I understand that the rule "O. V.," from mathematical reasoning, and I from practical experiments, believe to be correct, is correct in Dr. H.'s opinion; therefore a speculum that does not conform to it is not perfect as to its correction for aberration. But now follows the difficulty in Dr. H.'s mind as to the practical carrying out of this form of testing. He says, "But it should not be overlooked that by no purely experimental method can one find the point C." My answer is: We do not depend on finding the point C exactly, or at all, for, practically, whether we test from the point C or a little before or a little behind it, there is no perceptible difference in the ratio of the zones' foci as given by the rule, so that we need not trouble ourselves about the point C to an inch or two, and surely any amateur can put the edge of the shutter opposite the hole in the chimney to an inch or two; for the shutter being an inch from the point C makes no difference in the ratio. I am quite sure, for I have tested hundreds (perhaps thousands) of times without ever being careful to an inch in having the shutter-edge opposite the hole, and I have never detected any difference in the ratio of the zones' foci, whenever I have put the shutter-edge within these limits, and I am sure I should have detected any difference had there been any perceptible. Therefore, as we do not depend on finding the point C to commence measuring from, the deduction of "O. V." has no application to this mode of testing. He says, "Unless the place of the radiant point can be unerringly decided upon, this method of paraboisation is totally useless, for a very slight change in position may give either double or quadruple aberration" (3rd column, 17th line from top). Now I will go down the cellar (literally), and put all this to the test of fact on a 12in. speculum, and let all our amateurs know the result when I come back.—Well, I have come up from the cellar, and can now reassure our amateur friends that they need not be afraid that this beautifully simple way of testing by the zones' foci has suffered under the most severe testing, which I will now describe by the aid of a diagram, which will help to show our kind mathematical friends what is the question we have asked them to help us to decide. Let S be the speculum and A the radiant point, i.e., the hole in the chimney; now let 1, 2, 3, 4, 5, 6 C represent the respective foci of the zones No. 1, 2, 3, 4, 5, 6, into which our speculum is divided; now the foci 1, 2, 3, 4, 5 C, have each a certain distance from 6 C, which the rule gives us. I find the most convenient way of measuring this is to set the index to the distance obtained by the rule for the focus of the zone No. 1; we then, by the adjusting-screw set the edge of the shutter to the focus of zone No. 1; therefore, O on the scale ought to be the focus of the centre of the speculum for the radiant point, if the speculum is parabolical.



Now, this is the way we find the point where the focus of the centre of the speculum is, and where we have to start from for our measurements; We have now only to find the foci of No. 2, 3, 4, and 5 zones by the measuring screw, and we see at once if they correspond with the calculated distances, and, consequently, have the proper ratio among themselves. If they have, then our speculum is perfect as to the correction for aberration. Now, if by moving A to B, so as to throw the zones' foci to D, the ratio between the foci of the zones is perceptibly altered; then we must be very careful to have the shutter exactly opposite the hole—i.e., at the same distance from the speculum. Now, "O. V." and Dr. Hastings seem to think that a very minute deviation from equality in distance from the speculum between the radiant point A and the shutter, will make all the difference between the rule where double the focus is the divisor, and the rule where four times the focus is the divisor. If this be so, then this test is almost useless and unreliable. Well, now I will tell them the facts of the case, as I have just proved down the cellar. I took a 12in. speculum whose figure and ratio of zones' foci I was well acquainted with. I set the testing apparatus so that the shutter should be exactly the same distance from the speculum as the hole. I carefully measured the zones' foci, and found them to be exactly the same as when I had many times before measured them, with the shutter at a more convenient distance from the speculum—i.e., about opposite the middle of the chimney, say about 1in. from the hole further from the speculum (for I have never been particular to ½in., and I shall be less particular in the future, for an inch or two makes no perceptible difference). I have no doubt a slight difference is made in the ratio, by thus moving the shutter and radiant point an inch or so; but it is, perhaps, only 1,000,000in., which I do not think we need attempt to measure. But I thought I would put the test to a severer test, as to its utility, and reliability, and certainty, so I put the shutter 3in. from the hole further back. I measured the foci of the zones, and found no perceptible difference in their ratio, and this is the point in dispute as affecting the reliability of the test. This experiment made me rejoice for the amateur's sake, for I could now tell him if he only put the shutter within 3in. of the hole, he could use the rule with confidence, as being practically perfect, and need not spend twelve months of his time in studying the mere shadow test, and then be only able to guess somewhere near the parabola. But to make certainty doubly certain, I thought I would put the shutter double 3in. away, so I put it by guess, as I felt confidence in the rule holding good at that distance. I measured the zones' foci, and found no perceptible difference in their ratio. I measured the distance between the shutter and hole, and found it to be 7in. So, now all I can say to the amateur is that, if he cannot adjust his shutter to within a few inches of the radiant point (the hole), he has no business to attempt speculum making; it will not suit his capacity. What I should advise every amateur is to put the shutter about opposite to the middle of the chimney, or a little further away for convenience sake, and he need not fear the results being practically altered from the exact truth. I thus have, at the earnest request of "O. V.," looked into this subject, and feel that he and Dr. Hastings have not exactly comprehended what we practical amateurs asked of them to decide for us by mathematics; they have been to a great deal of trouble to oblige us, and I am thankful to have their help; they have proved the rule to hold good when the shutter is exactly at the same distance from the speculum as the radiant point. I have proved experimentally that the rule holds good to all practical ends when the shutter, for convenience sake, is a few inches further from the speculum than the radiant point; therefore, we need not be anxious where we place the shutter within reason. I will try to show this in another way: suppose we have a 12in. parabolical speculum of very short focus—i.e., where the aberration is a great deal, say, ·195, which was the case with one speculum I had to test. Now it is evident that to obliterate this aberration, which it has at double its focus (i.e., the so-called centre of curvature), we must remove the radiant point to such a distance that the rays will be practically parallel, which will, according to our supposition of having a parabolical speculum, cause the rays from all the zones to meet in a point; say this distance is 5,000 yards. Now, it takes the moving of the radiant point 5,000 yards to obliterate ·195 of aberration. How little, then, must the movement of the radiant point or shutter a few inches alter the aberration if 5,000 yards are required to obliterate the aberration of about 2-10in. The same reasoning applies whether we move the shutter or the radiant point, for they are related to one another.

I am much obliged to "O. V.," Mr. Brashear, and Dr. Hastings, and all others who have, I think, with much trouble, proved the rule. The thanks of all amateurs are due to them for their contributions. To Mr. Calver, also, our thanks are due by lending me so perfect a speculum to test the rule by. I may add that every speculum of his I have examined has its edge good. He has certainly mastered this difficulty, and need not make his specula ½in. larger than ordered, with the understanding that the edge is bad, and must be stopped off.

Again, it does not do to depend on the "rolling back" of the edge to make up for the under-correction of the other part of the speculum, and thus work to a rule that undercorrects; a "rolling back" edge is worse than useless with a high power and a small object (a star); it is confusing to the image. A speculum to be good must be good to the edge and regular in its curve from edge to centre. A speculum to be perfect must have all this, and its zones' foci corresponding to the ratio given by the rule—divide the square of the semi-diameter by double the focal length of the speculum for parallel rays. **H. A. Wassell.**

Addenbrook Villa, Love-lane, Stourbridge.

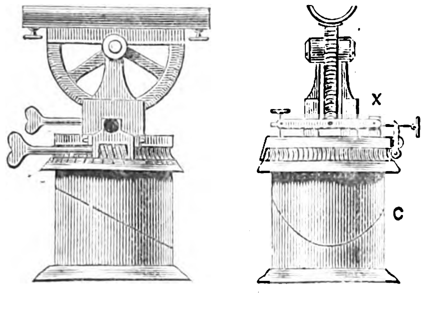
ABERRATION OF A MIRROR—COMBINATION ALTAZIMUTH AND EQUATOREAL — CROWN GLASS ACHROMATISM — TRANSIT OF VENUS: A SUGGESTION.

[20242.]—THE formula for computing specular aberration, obtained by "W. H. G.," is in agreement with my result. I do not see the necessity for using a large and small p in the equation. Is it a misprint? The final result is better expressed in the form of two fractions than by one. We then have.—

$$m = \frac{y^2}{p} + \frac{y^4}{2p^3} = \frac{y^2}{2f} + \frac{y^4}{16f^3}.$$

The first quantity is the same formula as used by Mr. Wassell—viz., the square of the semi-aperture divided by twice the focus, and, consequently four times the focal error. The second term is the square of the first divided by $4f$, and is therefore too small to be of any practical use. Hence the central parabolic aberration is shown quite near enough by the first term.

Mr. Grubb's mounting, described by "More Light," is identical in principle with "Smeaton's Block"; but we should not be justified in concluding that because he has made a stand of this kind he claims to be the inventor of the principle. When looking over "Rees' Cyclopædia," I was struck with the usefulness and simplicity of "Smeaton's Block," and made a rough sketch of it. I send a reproduction, so that in case Mr. Godfrey has not also done the same, it may be used. The stand is certainly superior in stability and compactness to the one figured by "More Light." Scarcely any description is needed. The short cylindrical block C is split in the manner of "More Light's" diagram; and the upper half may be swung round on the lower till the vertical axis is brought into the position of the polar axis. This upper half carried the divided circle and tangent-wheel, upon which rests the foundation-plate of the vertical circle standards. The horizontal tangent-screw is clamped by a set-screw pressing against the block X. This block also forms the fulcrum of a frame carrying the vertical tangent-screw. This screw is clamped by a set-screw pressing on the foundation-plate.



Smeaton's principle may be applied to the ordinary altazimuth-stand at very little cost; and, considering the usefulness of the combination, it is a wonder that it is not more commonly used.

As one of those who has read, with considerable interest, Mr. Penny's original theories, I regret to see the sentence with which he concludes his second paper. I presume the "other plan mentioned in No. 1," refers to his method of uniting coloured rays by two lenses of the same material. An *object-glass* producing achromatism (so called) by parallelism of the coloured rays is, I think, almost useless in comparison with the ordinary form. The perfection of an o.g. depends on the precision with which all the rays are united. If Mr. Penny thinks the action of crown and flint can be successfully imitated by *one* kind of glass only, why does he not give a combination by which the truth of the theory may be tested?

May I be allowed to offer a suggestion, which, at this period, may not be considered inappropriate? As months roll on, the time for the transit of Venus will arrive; and in the beginning of next year we hope to read full details from those who dwell where it will be well seen. Would "our" able and courteous "F.R.A.S." object to write one or two articles describing the different methods of obtaining the solar parallax, what parts of the area of visibility are specially adapted for each, and any other matters incidental to the coming Transit. Such information, in the lucid style inseparable from "F.R.A.S.," would enable anyone to read published accounts intelligently.

June 26. **Orderic Vital.**

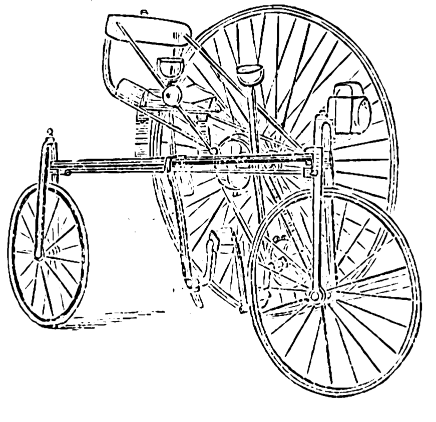
EDGING FLATS.

[20243.]—As the subject of edging flats has frequently been started in our journal, perhaps I may be allowed to describe my own method which, though perhaps not new, is original so far as I am concerned. I first turn in the lathe a piece of wood, 6in. or 8in. long, and 1¼in., or whatever the minor axis is desired; cut this at an angle of 45°; about the middle, fix a suitable piece of glass with pitch or other cement between the two parts of wood, then grind glass down to wood all round; this gives the outline of glass accurately, also angles at ends as well as preserving edge from nippling. I grind on an ordinary grindstone.

Cotswold.

COVENTRY TRICYCLE, WITH WESTROPP SEAT.

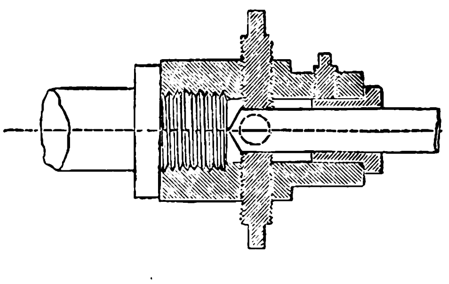
[20244.]—I INCLOSE photo. of Coventry rotary, with seat "*à la* Westropp." It will explain itself; but one thing must be borne in mind—viz., that it is *essential* to keep the webbing strained, so that *full* power may be obtained over the treadles; therefore, I have a ratchet on the right-hand side of the seat to tighten it up when stretched.



Cheltenham, June 30th. **M. Jeffrey.**

SIMPLE DRILL CHUCK.

[20245.]—I FORWARD drawing of a simple drill-chuck in which drills can be regulated to a nicety by the four set-screws at the back. The drawing shows the shank of drill and thimble parallel; but it is better to taper the shank, or cone the inside of thimble to allow freedom of action. Where the drills are the same diameter, the thimble may be dispensed with. Perhaps one or more of your correspondents would help me, through your columns, to true the rim of a tricycle, which is every way (not the circle) through an upset, bent sideways.

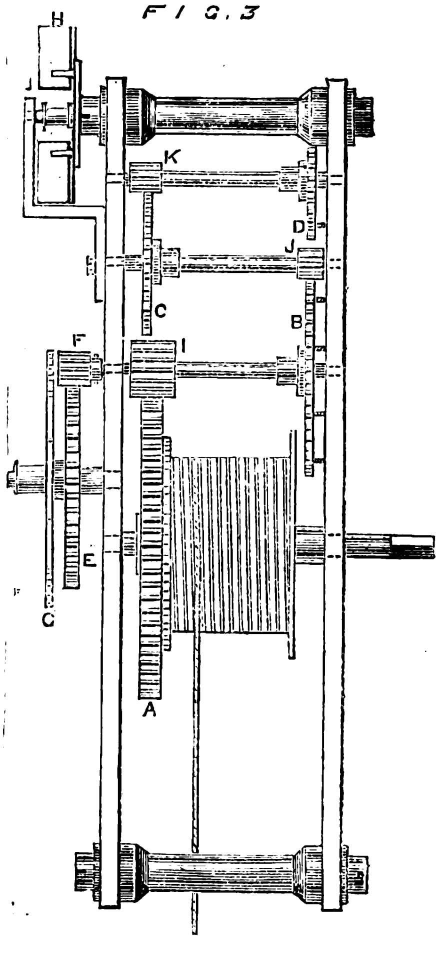


C. Townley.

CHIME-CLOCK MAKING.—III.

[20246.]—THE barrels being finished, the main wheels may now be fitted on. They should fit the arbor well, but not too tight to prevent them turning freely. They are secured in their place by a key; the way shown in Fig. 3 is the usual one. A square-bottomed groove, the thickness of the key, is turned in the arbor, one side of it being flush with the main wheel. The key Fig. 4 is then fitted to it, and secured by a screw tapped into the wheel. The second plan is to fit a brass collet over the arbor, press it close up to the wheel and drill a pin-hole right through collet and arbor, and fit a pin in tightly. The clicks and springs for winding must now be made, and fitted to the wheels. Having completed this, the barrels are ready to be placed in the frames. Drill out the barrel holes a trifle smaller than the pivots, and carefully broach them out to fit. In broaching out pivot-holes, it is necessary to insure a good bearing hole that the two holes should be parallel with one another. The broach should therefore be tested by placing a square on the clock frame, when it will be seen whether it is square or not, and a little side-pressure applied while turning the broach in the hole will bring it right. In all good work the pivots are fitted tightly by the

FIG. 3



cutting broach, and afterwards freed by a round broach, which burnishes the hole, and insures it being perfectly round. The round broach should be kept well polished, and a little oil used with it. I have omitted to mention that the going-barrel must have the going or maintaining power ratchet fitted between the barrel ratchet and the main wheel. It should have about 160 or 180 teeth, and the teeth must be turned the opposite way to those in the barrel ratchet. See Fig. 1.

Fig. 3 will show the arrangement of the hour-striking train, and I will, in my future papers, give drawings of the going and chiming train; but for this week we will confine ourselves to Fig. 3. The barrel and its wheel have already been described. The pinion 1 has twelve leaves, and is driven by the main wheel A of 144. Its back pivot projects through the frame to carry the brass pinion F, which drives the locking-plate E. The pin wheel B of 80 is attached to the arbor by a brass collet soldered on, to which the wheel is riveted. Eight pins are put round the web of the wheel at equal distances from each other to lift the hour-hammer. The pin wheel drives the pinion J with 10 leaves, upon whose arbor the pallet locking-wheel C of 72 teeth is fixed. It will thus be seen that the wheel C makes one revolution for every blow of the hammer. The pinion K, with 8 leaves, is driven by C, and the warning-wheel D is attached to its arbor. The warning-wheel, in its turn, drives the fly pinion, the front pivot of which runs in the frame as usual; but the back pivot is run in the cock L to allow of a longer fly being used than could be got in any other way.

Having thus briefly explained this train, we come to the pinions. These are made out of ordinary pinion wire. They are sized from the wheels by the sector. Having obtained the wire the correct size, we will commence with the first pinion of twelve; cut off a piece of wire long enough to make the pinion; turn or file off the leaves, except just where the head of pinion is wanted; set the pinion perfectly true, and turn the arbor true; the pivots should also be turned down a little larger than they will be when finished. Face up the sides of the pinion perfectly flat, and smooth them up with a fine file. The leaves of the pinion next require smoothing up with a rounding-off file, and the bottoms of the spaces squared out. You need do no more than just clean the drawplate marks out. Next smear the pinion head over with common soap, to prevent scaling; heat it in a clear fire to a bright red, and plunge it in clear water that has just had the chill taken off it; harden head arbor and pivots; do not make it too hot and get head arbor and pivots evenly heated before you harden; temper by flaring over a gas-flame. The correct temper is known by the oil on the pinion taking fire, and remaining alight after being withdrawn from the flame. Blow the oil flame out, and allow the pinion to cool: a smooth file should now just cut it. The pinion will now probably be considerably out of truth. To set it true, mark the high side with a piece of chalk; lay it on a smooth stake, and pene the side opposite to the chalk-mark with a light peneing hammer; use the hammer gently, giving the pinion a few light blows, and then trying it in the lathe again. If still out of truth, continue the peneing until the pinion runs true. To polish the head, cut a piece of soft wood to fit the spaces, and use flour-emery mixed into a paste with oil to polish with.

W. Baldwin.

110, Richmond-road, Dalston.

THE TURKISH OR HOT-AIR AND VAPOUR BATH, AND THE SCIENTIFIC PRINCIPLES ON WHICH IT SHOULD BE CONSTRUCTED.

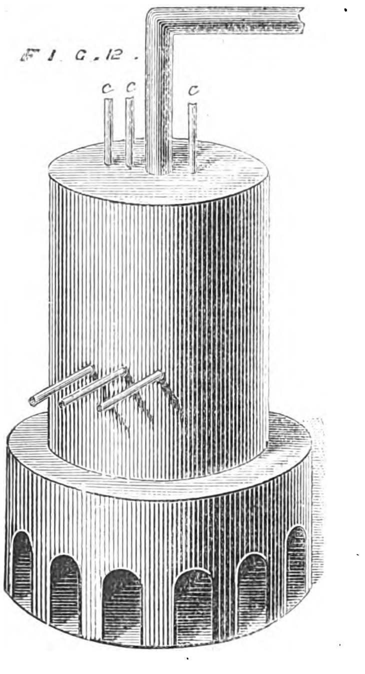
(*Continued from p.* 379.)

[20247.]—HAVING now satisfied myself that I had mastered the principles of the hot-air bath, I decided on converting a recess at the side of the chimney, and the portion of the room adjoining, into a chamber for either hot air or vapour.

I extended it into the room by a wooden partition, which had a small window fitted to its door to give light (a reference to Fig. 3 will make this plain). My bathroom was thus 7ft. 3in. long, 4ft. 6in. across, and 10ft. high. The furnace was at the corner near the door, marked F; in the opposite corner was a shower-bath S, and there was room to place a sitz-bath when wanted. There was a small table, with basin and other conveniences for washing, and a comfortable cane-chair that I brought home with me from Bombay; it pulled out, and made into a comfortable couch, and it was a luxury to sit in it. I used this chamber as my daily washing-room; but it was of an evening always ready to receive a bather; and the children soon got to enjoy and look for their vapour-bath. I had an iron gas-pipe passed across the table, with two T-pieces and nipples, so that by an indiarubber tube I could have a light if I used it after dark; or light a small gas-stove, and get warm water readily for shower or sitz-bath; a tap, leading from the large cistern of water on the roof, supplying cold water ad libitum, as a pipe from it led into the dressing-room in that corner.

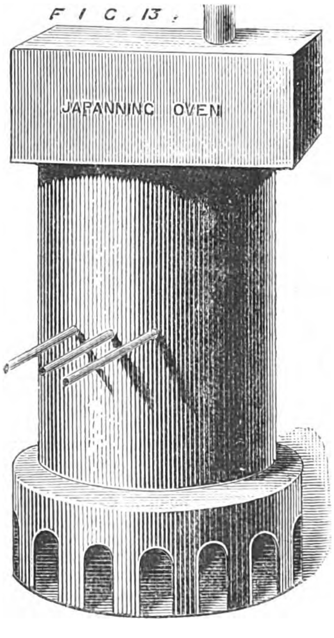
To show the arrangement complete, I give an elevation of it in Fig. 12. I found it to answer well, and used it while I remained in England. The alteration I made in the burners of the gas-stove obliged me to raise the chambers, and add another one on which the two upper ones stood, and inside which was placed the gas-stove. This cylinder was about 9in. high, and at its base it was cut into a number of arches, through which the air in the apartment was drawn into the outer chamber and thence discharged through the stove-pipe into the chimney. By this arrangement the lowest, and consequently the coolest, stratum of air was constantly removed, and thus the temperature could be made equable, and as high or low as the bather chose. By use of a damper in the stove-pipe, which was of considerable length, as it first passed up to the ceiling, and by an elbow along the upper corner of the wall, through the wall, which was the side of the recess into the chimney, the draught could be regulated, its great length gave it great power. It might very well be called the foul-air extractor.

FIG. 12.



I utilised this for many purposes besides bathing. A very slight flame gave me a dry air for drying chemical precipitates; by placing a large tin canister with a hole in its cover, and its bottom to fit the stove-pipe, I made a drying-closet, which answered fairly for chemical purposes. It was also admirable for drying any small article varnished. It was a japanning closet, as illustrated in Fig. 13.

FIG. 13.



The bath-room and apparatus I have described answered well; and as the stove was easily moved from under the arched cylinder, I could give a vapour-bath by simply placing a saucepan over a three-legged support, under which was placed the gas-stove. The air from its combustion mixed with the steam, and soon added to the heat of the bath-room.

To create a ventilating current, I placed a simple single flame Bunsen burner in the hot-air apparatus, and it caused sufficient draught through the outer chamber and the stove-pipe to thoroughly ventilate it. Cold air to any extent came in through the inner chamber, according as the connection with the air outside was open or closed.

For most purposes the apparatus was very effective. After a while, it caused the seams of the wooden partition to open. I fell back on my floor-cloth. An old one, which was becoming shabby, was used to line the whole of the woodwork. As, after a vapour-bath, it remained moist, I prohibited vapour-baths till the lining was as dry as a bone. I then gave it a coating of linseed oil, prepared in the same way as sailors do to make oilskin coats for themselves, and with this I painted it over very carefully, laying it on evenly, and allowing no drip. Three coats of this were followed by a coat of white zinc paint, which, when thoroughly dried, received a final coating of coachmaker's varnish—which, after a vapour-bath, could be rubbed over by a sponge, and the condensed moisture removed.

The whole arrangement did not cost £5, and was quite as good and efficient as the expensive contrivances which a professed gas engineer or a builder would have charged from £30 to almost any amount, according to details and finish.

I will now briefly recapitulate the essentials.

1. You must have a perfectly air-tight apartment of moderate size, not a small box not much bigger than a coffin.

2. You must have an efficient heating apparatus under your own control, so arranged that the heated air comes from outside, and is, therefore, pure.

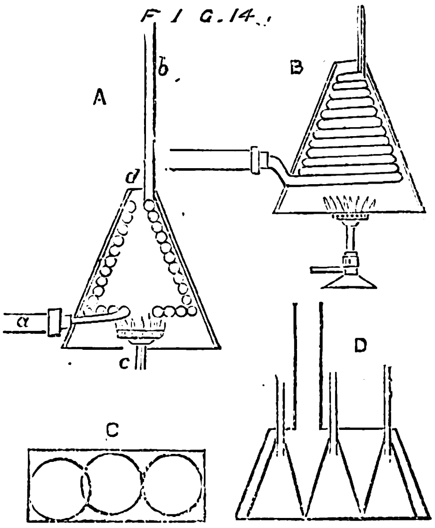
3. You must have an escape for the impure air and products of combustion; and not merely an escape; you must have it in your power to create a draught to carry it off.

4. You must have the means of lowering the temperature, so that you need not leave your bath in a sweat. If you do so you will catch cold

5. The room adjoining your bath proper should be comfortably furnished, and free from draughts, and you should be able to regulate its temperature.

Circumstances obliged me to go abroad to a place where gas was not procurable, so I left my apparatus at home with a relation who was good enough to give it house room. My landlord made me take out the tubes from the walls and remove all the things I had added, and place the room in the state it was in when I entered the house. A bricklayer and plasterer soon did this, and I myself repaired the paper and paint. A year or eighteen months after this my friend got into bad health, and wrote to ask what he was to do with the apparatus. I desired him to do what he liked with it, as it was not worth paying rent for, and if left in damp might deteriorate. He had visiting him a friend, the captain of a large ship trading to America, who had a look at the apparatus and took in its use at once, and said, "If you will give it to me I'll take it to my brother in America. I think it will just suit him; he is just the fellow to appreciate a dodge like that. So to America it went about the year 1870, and was found useful.

FIG. 14.



My friend, his friend, and brother have gone the way of all flesh, but what has become of my apparatus I know not. It was a rough and ready adaptation of odds and ends, picked up chiefly at an old iron store for a scientific purpose. Its actual cost was but little, but it involved a good deal of labour, but that no enthusiastic amateur mechanic grudges.

If its resuscitation proves of use to the fair Isabelle Stuart I shall be pleased.

Should I make another vapour-bath, I would do it as follows:—I would get some ½in. wrought-iron gas-pipe made into a cone, 6in. at base, and 8in. high, as shown in Fig. 14; A, section; B, elevation. This cone I would inclose in a conical iron box, with a hole top and bottom; three of these cones I would arrange as in 14 C; each should be connected with an inch gas-pipe, leading to the outside of the house. The lower four coils, as may be seen by the sectional drawing, are placed on the same level. These I propose heating with a rose gas-burner of Griffin's pattern; the fresh air goes in at *a*, the heated pure air passes out at *b*; the impure air passes through the flame at *c*, and escapes with the products of combustion at *d*. In this instance I would make the outer chamber an angular box, to contain the three coils, and would use one, two, or three as I found advisable; each hole for the gas-burner should have a sliding cover, to be slipped on when its burner was not in use. Of course, a simple arrangement of this sort might be made—in which case no rectangular case would be required—the pipe *b* would have to be led out on one side, and the cone should terminate in a small stove-pipe. The reason for inclosing the three in a case is to make one stove-pipe sufficient. It strikes me that this would be a very simple form of hot-air bath. Of course, the other arrangements as to the room would remain the same.

Although this is specially a paper of the vapour and hot-air bath put together as a reply to "Delta," 46899, and Isabelle Stuart, 47050, I have had the matter on my mind for some time, and on looking through some old papers, I came on my sketches and memoranda of my early attempts. At times it has run through my mind that I might add to my limited income by developing these ideas into an apparatus which I might patent; but I abandoned that idea, as I felt that the forms of apparatus which could be constructed were countless, and that *scientific principles could not be patented*—that they were the property of all educated minds that could understand and appreciate them; and, moreover, any attempt to do so by the amateur would be a failure, as if there were a demand for such apparatus the practical mechanic could soon devise modifications which might be better or cheaper, or of more elegant form, and drive the amateur patentee out of the market. Patents, when they guarantee to a real inventor a reward for his ingenuity and payment for his labours, are an incitement to invention and an aid to progress; but when they are prostituted to lock up the application of scientific principles, which I hold are the property of all that can apply them, they are a pest and a bar to progress. I, therefore, offer my ideas on these points to the public through your columns, and shall be pleased if they prove useful to any. **Gereb Adml.**

INDICATIVE SYMBOLS.

[20248.]—THERE is a great want of a short mode of expressing certain words or phrases containing a compounded meaning, which are constantly-recurring when writing on many subjects. Chemical science has already, since the time of Berzelius, adopted symbols, such as H, O, C, N, &c., to represent hydrogen, oxygen, carbon, nitrogen, &c.; but the science of mechanics, even now, is almost unprovided with such a short way of expressing ideas. We are constantly writing of yards, feet, inches, pounds, tons, or, just as often, of metres, litres, kilogrammes, grammes, which are French measures. Again, we write of square yards, or feet, or inches, of cubic yards, &c., foot-pounds, foot-tons, square metres, cubic metres, metre-kilogrammes, &c. What I propose to establish is, by common consent and usage, to employ a Roman capital (and small), the initial letter of the measure or idea signified, whenever it may have to be written.

Thus let Y always mean yard, F foot, I inch, P pound, T ton; also let Y^2 represent square yards, Y^3 cubic yards, F^2 square feet, F^3 cubic feet. In like manner, let M, L, G be always written to express metres, litres, and grammes respectively. To the English measures there are subordinates in common use, the ounce and grain, which would be represented by o and g. In the French system there are several commonly used, multiples and sub-multiples of the M, L, G. These would be represented by m, c, x, signifying 1000. 100, 10 times M, L or G respectively, and by $\bar{m}$, $\bar{c}$, $\bar{x}$, signifying 1-1,000, 1-100, 1-10 parts of M, L, or G respectively. Thus m M is 1,000 metres (kilometre), c L 100 litres (hectolitres), x G 10 grammes (decagrammes), $\bar{c}$ M is 1-100 metre (centimetre) $\bar{x}$ L 1-10 litre (decilitre), &c.; the bar above the letter indicating the fractional character. Also Fp Ft would be written for foot-pounds, foot-tons, and Mk for metre kilogrammes, &c. As the French often use kilometre, kilolitre, and kilogramme, it may be useful to write Km, Kl, Kg, which are equivalent to mM, mL, mG.

When writing on electric subjects, Eu would mean units of electricity, Fu units of electromotive force, Ru units of resistance, Qu units of quantity; O would stand for ohm, and V for volt. Thus we obtain a series of symbols, Y, F. I (or i) P, T, Y^2, Y^3, F^2, F^3, M, L, G, O, g, M^2, M^3. and their multiples or submultiples m, c, x. $\bar{m}$, $\bar{c}$, $\bar{x}$. Eu, Fu, Ru, Qu, which, if commonly used, would considerably shorten long phrases or words now necessary.

There is another mode of employing Roman capitals which, in calculations, has saved me the writing of many figures or ciphers, and which I recommend for general use on account of the convenience. It is, wherever decimals occur containing many ciphers, or when it is desirable to write in a line without fractions, to employ Roman numerals to represent the decimal ciphers; also when integers are combined with many ciphers, thereby becoming thousands, millions, &c., to adopt the same plan. When the numerals are written plain they mean so many integral ciphers added; when they are written with the bar over them, they mean so many decimal places. Thus:—

200.000 would be written 2V

$\frac{1}{200,000}$,, ,, $2\overline{\mathrm{V}}$, or $\frac{2}{\mathrm{V}}$

·0001573 ,, ,, $4573\overline{\mathrm{VII}}$, or $\frac{4573}{\mathrm{VII}}$

11·721 could be written $11721\overline{\mathrm{III}}$, or

$\frac{11721}{\mathrm{III}}$ if required

95,000,000,000 could be written 95IX.

$$\frac{\cdot007 \times \cdot0143 \times \cdot000081}{\cdot0000063} = \frac{7\overline{\mathrm{III}} . 143\overline{\mathrm{IV}} . 81\overline{\mathrm{VI}}}{63\overline{\mathrm{VII}}} \text{ or}$$

$$\frac{7 . 143 . 81\overline{\mathrm{VI}}}{63} \text{ or } \frac{7 . 143 . 81}{63\mathrm{VI}}$$

In the last illustration the numerals below the bar being deducted from those above, show the number of ciphers (integral) to be placed below, instead of dealing with so many decimals separately; if they be barred above the bar of the fraction, they become integral below it, and *vice versâ*. Again, employing the numerals in electric diction, we can write, instead of a volt being 100,000,000 units of electromotive force, 1 volt = Fu VIII., 1 megavolt = Fu XIV., 1 microvolt = Fu II. In like manner, 1 ohm = Ru VIII., 1 megohm = Ru XIV., 1 microhm = Ru II.; a method which certainly avoids the writing of very many ciphers. The multiple *mega*, and submultiple *micro*, may be also applied conveniently thus: 1 megavolt = mmV., 1 microvolt = $\bar{m}\bar{m}$V., 1 megohm = mmO, 1 microhm = $\bar{m}\bar{m}$O. I think the above proposals deserve consideration among scientific writers; they cannot be called confusing.

I cannot recommend the use of the Greek numerals, though they are precise. They are very little known, or employed, except in algebra or astronomy. The first nine would suffice for the purpose herein suggested, adding a tenth to represent 6, which is absent in Greek numerals, but may be signified by ξ, which is truly 60. Then the Greek letters—

α	β	γ	δ	ε	(ξ)	ζ	η	θ	ι
1	2	3	4	5	(6)	7	8	9	10

would represent ciphers respectively, integral if plain, decimal if barred above; if they were barred below, as in Greek, they would represent 1,000 times more. But it is very doubtful whether, supposing that 200,000 were written 2ε, it would convey the idea so clearly as 2V., the Roman characters being so well known and accepted. So also ·0000495, written $495\bar{\xi}$, instead of $495\overline{\mathrm{VII}}$., would not be clearly apprehended for want of familiarity. If, electively, they came into use for the purpose herein suggested, they would serve as well as, or better, than the Roman letters.

M. Jonson.

WEATHER FORECASTS.

[20249.]—IN your issue of June 30th "A Fellow of the Royal Astronomical Society" says, on p. 377, letter 20212, "That no one living can foretell the weather in these islands 48 hours in advance, and no vaticination of meteorological change for that, or any longer period, is worth the ink it is written with."

Now, for the last two years Captain Newton has published his monthly weather forecasts in the *Newcastle Chronicle*, 90 per cent. of which have proved to be absolutely correct. He affirms that he has discovered the causes which regulate the winds and weather; that they are as invariable as those which regulate the tides, and that with proper appliances at his disposal he can correctly forecast the weather, the world over, for years in advance.

Indeed, in the North of England, "Captain Newton's Monthly Weather Forecasts" are acknowledged by all who read them, to be of the most accurate and reliable nature, and he only needs proper appliances to make a book on forecasts as dependable as a nautical almanack.

J. Mitchell.

126, Westgate, Newcastle-on-Tyne.

MELLAGEN — ALUMINIUM — LEWIS'S INCANDESCENT GAS-LIGHT—SMALL DYNAMO-MACHINES—FREE OIL.

[20250.]—MELLAGEN (query 47136, page 339), is undoubtedly a product of the action of the nascent oxygen evolved in the electrolysis on the carbon forming the anode. It certainly is not connected with atmospheric carbonic acid.

I think "Zelia Naien" almost deserved the snub he received from Mr. Grey (page 361), but as I am much interested in hopeful methods of producing aluminium (query 47143, page 339), I shall be glad if the querist will communicate with me. The majority of those who have endeavoured to produce aluminium economically have lacked the chemical knowledge which would have told them how difficult a problem it was.

I am much interested by Mr. Sprague's description of Lewis's Incandescent Gas-light (page 343), and think it may become very important. I am afraid the novelty of it is not very great, for I saw an almost identical arrangement fully twelve years since. It was patented by a Mr. Hogg, who had an office in Birmingham, and consisted of a Herepath's blowpipe, surmounted with a cylinder of fine platinum wire gauze. The current of air was obtained by employing a small fan, and it was the necessity for having some such arrangement which prevented me at the time from adapting the light to my lantern. The induced air-current of Lewis's arrangement appears to be the novel feature. I am doubtful whether the gas will be found to be very completely burned.

I am one of the many of your readers who would like to possess a hand dynamo-machine, but have neither the time nor mechanical skill to construct for themselves. Why doesn't some apparatus-maker take advantage of Mr. Tolman's or similar instructions, and supply this desideratum at a moderate cost?

"Free Oil" (query 47222, page 364) can be determined in a mixture of oil, rosin, and soap by an application of the following principles. Agitate the stuff with hot water, separate the aqueous liquid, which contains the soap, and weigh the residual oil and rosin. To this mixture add alcohol and a few drops of a solution of phenolphtaleïn, and then drop in caustic soda gradually, with constant agitation, till the production of a permanent pink tint shows the rosin-acids are neutralised; separate the oil from the aqueous liquid, and weigh it. If it be merely required to ascertain the amount of free oil, the preliminary treatment with water may be omitted, and the sample at once shaken with alcohol caustic soda till neutralisation occurs. Rosin oil is distinct from rosin, and will not be separated by the above process; but may be accurately determined by saponifying the sample and agitating the aqueous solution of the resultant soap with ether, which dissolves out the rosin oil. The querist will find full details of all these methods in the 2nd volume of my "Commercial Organic Analysis."

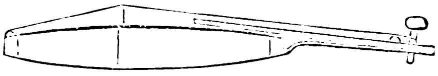
Sheffield, June 30th. **Alfred H. Allen.**

SIMPLE AND CHEAP FIRE DETECTOR.

[20251.]—THE simple and cheap fire detector, described by R. S. Baxter (letter 20143. No. 898), is certainly a very clever device; but he may be interested to know that thermometers can now be bought at a very little extra cost, with a platinum wire fused into the bulb, and another one, which can be drawn up and down to any degree, let into the top. **Seaweed.**

THE BERLINER VIOLIN.

[20252.]—WHILE the correspondence about this invention was carried on in "ours," I intended to describe its results when applied to an ordinary violin. But maintaining, as I have said before, that the violin is acoustically perfect and therefore cannot be improved (excepting the material), I did not think it expedient to interfere. Now, as Mr. Berliner has sent a violin to you, Mr. Editor, for the express purpose of being criticised, and on my application same was handed to me, I have now no reason to withhold my opinion respecting this invention. But, before I point out its results, I must make certain assertions on which my opinions are founded. Wood of a certain quantity and form, if struck or bowed, produces one natural tone only; and to make it of such a size and form as to respond to the vibrations of several octaves would be inconvenient, and would, besides that, be too stiff for the power we have at command. We are, therefore, obliged to use its gravity as tension on a small quantity of wood built up in a form to resist that tension and no more; so that, as "Fiddler" calls it, "action and reaction" can take place. The tension of the strings on an ordinary violin press against the breast with a power of 75, and their deflection is equal to 21½ pounds. Now in the Berliner violin, the tension or pressure on the body or breast is only that which is produced by the deflection of the strings while their tension is on the finger-board; hence, it must be deficient in quantity or intensity of tone. This was proved by a friend of mine, who put a light mute on the bridge of his violin, when by that means, he produced a similar quality of tone to that produced by the Berliner without a mute. He, however, improved it a bit by putting his chin-block or chin-rest in it. Here I crave permission to state, that this gentleman, Mr. James Anderson, of 14, Margaret-street, Cavendish-square, is the inventor of the chin-rest, and as it is now largely used, I thought it proper to give him his due by mentioning the fact. The tension or pressure on the breast of the Berliner violin, is equal all over, which is certainly against acoustical principles. In the ordinary violin, there is an important modification of the tension or pressure on the breast; while the treble portion has to bear the tension as well as the deflection of the strings, in order to enable it to respond to the high notes. The bass portion is supported by the bass bar, which bears a portion of the tension and deflection of the strings, and by that means leaves the breast comparatively slack to respond to the lower notes. On the Berliner violin there is no pull on the back, hence the soundpost is only a support for the breast to prevent it from flapping about. In the ordinary violin each deflection of the string straightens the back of the body a little, and by that means forces the breast up with the soundpost, while at the same time the bridge forces the breast down, so that at each deflection of the strings a wave is formed between the foot of the bridge and the soundpost. The diagram shows this sufficiently; but if any doubt should exist a few strips of wood ½in. wide, ⅛in. thick, glued together with a string on will prove this conclusively. Of course, in the Berliner violin the vibrations of the string will be transmitted to the body from the finger-board on which they are strung; but this is a round-the-corner way and cannot be much. There is also a tension (rarefying) on the breast between the bridge and the neck while that portion below the bridge is without it. I think that this invention put on any violin under any condition must lower its value, whatever that value may be.



J. H. Schucht.

SMALL DYNAMO-MACHINES.

[20253.]—Referring to Mr. Lancaster's reply to query No. 47111, page 360, in which he says that small dynamo-machines are a failure, we beg to state that, although a certain amount of difficulty is involved in designing a small and efficient machine, such a machine has been, and is being made to give satisfaction.

We have, for some time past, advertised in your columns the parts necessary for the construction of a small dynamo-machine, which we also supply fitted up, and which, driven by one man from a flywheel, gives sufficient current to illuminate three or four Swan's ten candle incandescent-lamps, and with two men, or equal power, about double the number.

Mr. Lancaster would not, perhaps, "mislead a single reader of ours" intentionally; but his decided opinion tends to deter amateurs from attempting to construct a small machine, and should not, therefore, we think, be passed without comment. **Patrick and Son.**

15a, White Lion-street, Chelsea, S.W., July 3rd.

THE BARTON ACCIDENT AND THE VACUUM BRAKE.

[20254.]—Upon the 15th of May, a collision occurred at Barton station on the Manchester, Sheffield, and Lincolnshire Railway, between the 8.40 a.m. mixed train from New Holland and the buffer-stops 50 yards beyond the proper stopping place at the platform at Barton.

The train consisted of a tank-engine, fitted with a hand-brake, a van, three carriages, luggage-van, and thirteen waggons (or five more than the regulation load). The front van and all the passenger vehicles were fitted with Smith's vacuum brake.

The driver stated that this brake was in good order when the train started, that he stopped at Barrow Haven, using the vacuum, which worked all right; but that when he tried to apply it approaching Barton, "it did not seem to take any effect on the train; the moment he stopped *blowing*, the indicator on the vacuum dial went back as if the vacuum-pipe was disconnected."

After the train had over-run the platform 50 yards, it came into collision with the buffer-stops.

The driver at once examined his train, and found one vacuum-pipe disconnected between the first and second carriages.

Major Marindin reports that he is inclined to believe the statement of the driver, and the more so because he does not advance it as an excuse, being quite aware that, according to the rules, he had no right to depend upon his vacuum brake for stopping at a terminal station, and stating, as he does, that when he first tried it he had no idea that he would be unable to stop by means of his hand-brake as usual.

Major Marindin also remarks that "If the driver's statement be correct, this case furnishes a strong argument in favour of the automatic action of brakes, for the driver would not have been able to run after the brake-pipe had become disconnected, depending upon a useless machine to stop the train in a case of emergency."

Numerous cases have been referred to in the English Mechanic in which Smith's vacuum brake has failed to act, or been inefficient; and the present instance again shows that it is far safer to have no continuous brake at all rather than one which fails at any unexpected moment, and leads a driver into a trap.

July 1. **Clement E. Stretton.**

THE POSTAL PHOTOGRAPHICAL SOCIETY.

[20255.]—We regret that, owing to the small support received from the readers of the English Mechanic, the committee have been compelled to alter the name of the society started as the E. M. Photographic Society, to the above, and to throw it open to all those who take an interest in photography, whether readers of the English Mechanic or not.

The society is now started, and all those wishing to join should send in their names as soon as possible to the hon. sec., H. H. Cunningham, 7, Fig-tree-court, Temple, or to the undersigned, of either of whom further particulars may be obtained.

G. Allison, North Staffordshire Infirmary,
Harkhill, Stoke-on-Trent.
F. Cowley, 106, Western-road, Brighton.

STONEHENGE AND SUN-WORSHIP.

[20256.]—I have now completed my examination of the Clun 10ft. boulder, and find by testing with the compass (as directed by "F.R.A.S."), and by observation of sunset on and about the longest day, it lies exactly in line with the centre of the stone circle before described, and the point of latest sunrise (Dec. 21). It has evidently stood upright—about 4ft. of it being planted in the ground—for a very long time, and, we may judge, served a similar purpose to the Friar's Heel at Stonehenge. I do not agree with Mr. Stooke that the expression "sun-worship" should not have entered into the question. These stone circles are of immense antiquity, and must date back to a time long before astronomy as a science was thought of. From the polished flint arrow-heads, flint cores, and fragments picked up on these hills, I should judge the Clun circle to be of Neolithic age. In all countries, and all ages, we find the first instinct of man has been to bow before a superior Being; and I think it is undoubted that, the whole world over, the most general object worshipped has been the sun—the most visible emblem of that Being. From the worship would spring the observation of the sun, and thence that of the other celestial bodies. And so I can imagine has slowly developed astronomy as we have it.

Neo.

COLOUR—PHILOSOPHER'S WHITE, &c.

[20257.]—Since writing to the English Mechanic last year on the above subject, I have had the matter constantly on my mind, and upon reading Sir John Lubbock's address to the British Association last autumn, in which he mentioned certain "discoveries" in mixing colour, I decided that it was my duty to endeavour to correct some of these errors.

It may be asked, if artists are so unanimous upon this subject and differ so entirely from the scientist theory, why do they not take the matter up as a body? To this I would reply, that an artist is in a very singular position: his work, to be done properly, is very slow, and requires great concentration of thought. He must, or should, do all his work himself, and has at the same time to maintain a position of equality with people who can get unlimited assistance and whose personal work is often simply to supervise. So that an artist, to hold his own against such odds, must devote all his time and energies to minding his own business, and, indeed, he is generally more or less exhausted when his day's work is over, and is not in a fit state to sit down and write upon a by-subject, to stem a current, in which he knows he will have to meet a compact though small opposition, whose members unite to defend a false position, in which many of them hold a kind of vested interest.

I think this accounts for our having allowed the "philosopher's white" theory to exist so long.

In this letter I intend to confine my remarks to two of the alleged discoveries,—viz., that "blue and yellow combine to make white," by Helmholtz; and that "red and green combine to make yellow," by Clerk-Maxwell.

The results of mixing colours are as exact and invariable as the multiplication table, and to an artist these statements are as fallacious as "discovering" that twice two make nought, or twice three make fifteen; and these two results serve to prove the impurity of the colours used, or, in other words, they show that the discoverers are not good judges of blue, red, and yellow.

Having decided, at the sacrifice of valuable time, to try and refute these heresies, I wrote to Sir John Lubbock, and in his reply he stated that he had "tried several pieces of red and green glass, and they always made yellow" (in a more recent letter he explained that he did not superimpose the glasses, but combined the reflected and transmitted colours; but this does not alter the case at all from my point of view, as I contend that any given colours, on being combined, invariably show the same result, quite irrespective of the manner in which the colours are produced). On reading this I decided to follow up the matter.

On going to purchase some coloured glass, I was not at all surprised to find that the best specimens I was able to obtain were very impure. So much so that a novice, or enthusiast, might have considered that they carried out, or proved, the alleged discoveries; but they simply proved to me, that where the artists and scientists really differ, is in what they accept as pure blue, red, and yellow.

Now, for a red glass, I had to put up with what they called "ruby," which is really a strong orange-red—that is to say, it contains nearly as much yellow as red. For a blue I obtained a purple-blue, which contained, roughly, about 30 per cent. of red to 70 per cent. of blue.

The yellow was still more impure, being what an artist would call a weak orange-brown; that is to say, it contained all three colours—red, blue, and yellow; and then the bluest green I could get was nearly all yellow, say, about 80 per cent. yellow to 20 per cent. blue.

As these glasses do, when superimposed, give more or less the results, called discoveries, I conclude they would be accepted as tolerably pure by the discoverers.

Now, as to Clerk-Maxwell's discovery. There is nothing new, to an artist, in the fact that if an orange-red and a yellow-green glass are superimposed, the resulting colour will be more or less yellow, as the equivalents of red, blue, and yellow neutralise one another, to form a degree of blackness, leaving the surplus yellow visible, or, in other words, if you superimpose any combination of coloured glasses, containing amongst them the three primitive colours, whichever colour is in excess will be visible, and might be called the result of the mixture. But it would be just as reasonable to "discover" that blue and orange make red, for this will be the result if the commercial sample of blue glass and a reddish-orange glass are superimposed.

Then, again, on superimposing the commercial blue and yellow glasses, really blue-purple and orange-brown, the red, blue, and yellow contained in them nearly neutralise one another; but the blue and yellow being stronger than the red, the result is a nearly neutral olive-green, which may be called black or white, according to the circumstances under which it is seen. For instance, if you superimpose these two glasses in front of a lantern, with all else in darkness, the result may be called white; but if they are held up against the sky or any white surface, they would be called black or dark green by comparison.

The scientist's method of examining colours in the dark is the cause of so many errors having been made. The only way to obtain a fair judgment of the purity of any colour is by comparison.

Having obtained these impure coloured glasses, I determined to make some purer samples; and although I have not been able to get them all of equal purity to the colours on an artist's palette, still they are far purer than the commercial samples of stained glass, and quite pure enough for their purpose.

If any of our readers should take sufficient interest in the matter, I will undertake to show them that any so-called red and green that combine to make yellow contain the excess of yellow (which is plainly visible to the properly-cultivated eye) to start with, it being probably contained in both the so-called red and the green. This I would show in the following way:—First let us examine the commercial "ruby-red." Seen by itself, it may be called red; but upon comparing it with a comparatively pure red, it appears so strong an orange, that we wonder how it could ever have been mistaken for a red. Then, to our best red we add glasses of a strong yellow colour, one at a time, until we match the "ruby," and find it takes six or eight yellows and one red to make a good match. This may appear exaggerated; but I shall be only too happy to show it to those who may express a desire to that effect.

Upon examining the commercial blue beside a purer sample, it appears a strong purple, and we find it is matched by superimposing blue and red glass, of which the latter is rather the paler. The commercial yellow is matched by superimposing blue, red, and yellow glasses of suitable strength; and to match the commercial green we have to use several of our strongest yellows to one blue.

We now see that our whole difference of opinion resolves itself into what we accept as pure blue, red, and yellow; and I have no doubt we shall find we differ, not as to the results of mixing certain hues, but only as to the names with which we designate them to start with, and that will, I think, be easily settled by comparing several samples of each colour (when we have fairly pure colours amongst them for comparison), for a colour which looks comparatively pure by itself may be readily detected as a compound colour when compared to a purer specimen. Every artist knows that the effect of a colour depends greatly upon its surroundings.

As a simple illustration of our inability to form a true estimate of the hue of a single isolated colour, I would mention a circumstance with which I was very much impressed.

When in Kew Gardens recently with some other artists, we noticed a green glass conservatory. Upon going inside, one of our party remarked that the roof was clear glass, and not green at all; and another said the ends and sides were not green either; we must have been mistaken in thinking so before we entered. But upon opening the door to go out, we were struck with the pink appearance of things outside, and then upon examining the glass with the door open, we were surprised to find that the whole of the glass was of a deep green colour, although we had all agreed that it was colourless (philosopher's white, in fact), until the open door gave us the opportunity of comparison with the colours outside.

It was observable while the door was closed, that some few portions of the glass being of a much deeper green than the rest, did have a faint green tint, compared to the rest of the glass, which appeared colourless.

I should be glad if amongst our readers some of those who imagine they can judge of the purity of an isolated colour, will take the trouble to visit the Tropical Conservatory for Ferns at Kew, and let us have the advantage of their experience.

S. Calton.

WILDBAD AND ITS CURES IN THE BLACK FOREST.—III.

(*Continued from page 380.*)

[20258.]—If we turn to the ancient records, Gessner, in 1745, declares that if he were to enumerate all the maladies cured at Wildbad, he must take the office of a charlatan. All these records agree that frequently early symptoms are aggravated, and to be regarded as heralds of benefit, if not cure. Old ailments, perhaps long forgotten, are apt to reappear; even old scars and wounds begin to tingle. Even after leaving Wildbad, so long as two or three months may elapse before the full benefit is perceived. The circulation may become excited, lassitude and a powerful inclination to sleep, pains in the head, slight giddiness, and oppression of the breath, may declare the subtle effects of these apparently simple waters. But after a few baths, these symptoms commonly disappear; but if they do not, intermission is advisable. Excessive action of the kidneys, with deposits, redness of the skin, with irritation, are highly favourable signs of approaching benefit. A crisis may be unpleasant, but it is the very result which guarantees a curative process installed in the system.

Dr. Schweckle relates (1844): The heir of a noble and rich family (aged 20), afflicted with an intensely scrofulous constitution, was attacked with a severe affection of the spinal cord, the lower half of his body being completely paralysed. Rejection of food from the stomach; exhaustion, almost fatal: convulsions. He bore pretty well the first bath. He lived on chicken-broth and champagne. He took 26 baths, and quitted Wildbad despairing of a cure. Some months afterwards he regained his vigour, so that he could walk a league. But a cure is not always so rapid.

An Englishman made two visits without benefit; after the third, he was left at home by his father. On his return, he met his paralysed son coming forwards to welcome him home.

Among the maladies referred to by these old writers are especially rheumatisms, stiff-joints, indurations of the joints, maladies of the stomach, cramps, and neuralgia. Dr. Granville relates a case of severe indigestion, which had tormented its victim for thirty years. "*Regardez moi,*" said he, "I was sent to the place to die. *Je suis le meilleur éloge des Bains de Wildbad.* Three seasons have sufficed to work this miracle." Cases are related of loud breathing and incessant cough, with acute pain, being thoroughly relieved. The perfumes of the pine forests probably assist in giving relief.

The literature of Wildbad teems with cases of this kind. Dr. Renz gives, in his latest book, a list of distinguished visitors from 1496 to the year 1874. He also favours us with a catalogue of the various books published on Wildbad for the same period. Of these, the Pastor Deucer* is still much respected as a veracious historian. He states succinctly, "The use of the baths at Wildbad stops the progress of the gout; in this respect they are superior to the other baths of Germany. They cure the stone, as is proved by numerous examples." (This excellent man, persecuted for his Protestant faith, fled from Mayence with his wife and ten children, and escaped into the Black Forest. But Wildbad could not long afford him an asylum. His first account of Wildbad was published in 1617.)

Experiments have been tried on a large scale on the effects of drinking the Wildbad waters without bathing. Swellings of the legs from dropsical affections have been cured here in this manner:—

M—— (of 56 years) suffered a long time with abdominal disorder, bitter taste, loss of appetite, eructations, and indigestion, joined with weight, pressure, and swelling, especially towards the heart, together with lassitude, noises in the ears, giddiness, and headaches. His person had become emaciated; his countenance, and especially the region of the eyes, pinched and tinted yellow. He began with a few glasses, and then took 8 or 12 per day. In the course of four weeks, all these symptoms entirely disappeared; he became light-hearted, with an air of robust health, and took long walks daily. He continued well. Besides these complaints, the drinking of the Wildbad water is a fine remedy against cardialgia and chronic sicknesses, and spasms of the stomach. I shall quote one more case on the authority of Dr. Heim:—

"A young officer suffered for nine months from sickness, which occurred some days 20 or 30 times a day. He could drink very little of the water at first, but the fifth day he nearly lost the affection, which now only returned when he was less guarded in his food. Gradually increasing the dose, however, he was totally cured. *Chronic Catarrhs*, as they are called abroad, mean excessive action of the mucous membrane – whether bronchial, vesical, or intestinal—receive particular benefit by drinking these waters; so much so, that the Wildbad people commonly use no other remedy. 'I will declare with reason,' says Heim, 'that Wildbad operates entirely as a specific for abolishing this bad state of the mucous membrane.'"

Here in this hotel, the Belle Vue, no odour of the cuisine is allowed to float inwards. The *chef* and his assistants are entirely divided from us by a large court. A lift for the invalid baths, also within call; wines of the highest quality, and rooms above at the lowest price, attract a swarm of grateful guests; carriages are necessarily dear, from the shortness of the season and the steepness of the roads.

Excursions innumerable invite the pedestrian or the traveller who can afford tours among the ravines of the Black Forest. Everlasting permutations of mountain scenery, crowned with the black pines of the forest, *greet* the eye. This forest is a wilderness of bright and dark green beauty and towering grandeur. Withal, the ever-grateful pine odours assuage the distress of the bronchial and asthmatic. Wildbad, too, is the only spa which enjoys perfection of beauty combined with a rapid river, abounding in trout, even in front of its best hotel. Yesterday, in the heart of the town, I saw a large trout landed after its desperate struggles: four-pounders are not unfrequent. Fishing is here a most agreeable pastime, obtainable at a moderate charge at the very doors.

As for the town, after much travel, I have never been so regaled with fresh air. For sweet water and perfect cleanliness, the place would gain the prize against all Continental competitors. Out of much evil sometimes comes much good. The town is now *tiled*, and supplied with hydrants 150ft. above, so that the natural force of the water is adequate to any conflagration. Besides which, the drinking water is perfectly sweet, pure, and fresh. No modern *sanitary* arrangement appears to be neglected. This is saying a great deal for a foreign resort.

Something there must be due, no doubt, to bathing in water such as Nature made, unsophisticated by artificial heat. Dr. Granville thought Wildbad infinitely superior to those of Gastein for this very reason. A singular proverb alludes not obscurely to this—"Juste comme Wildbad." At this moment the springs are the same temperature as they have been for centuries. Even earthquakes do not seem to have influenced the sources of the water.

G. W. Royston-Pigott, M.D., F.R.S.

THE EXPANSION OF IRON IN THEORY AND PRACTICE.

[20259.]—The point raised by Sir Edmund Beckett (letter 20206) is an interesting and important one, though I am inclined to question whether the fact he cites can be regarded as throwing any doubt upon the truth of the received coefficients of expansion. Rails do expand, very perceptibly, and so do iron bridges, although in the latter case it is not so apparent, for, where there is any considerable length of span, the expansion, instead of causing the supported ends to move forward, merely permits the whole structure to *bend*, as in the case of a dry cord stretched tightly between two points and then caused to expand by moistening. I am not acquained with the iron dome at Vienna, and so cannot suggest in what direction expansion would make itself evident; but the mere fact of the pillars upon which it rests showing no movement is hardly a sufficient foundation for the statement that the material of the structure does not suffer expansion or contraction at all.

There are other aspects of this question, such as the effect of unequal temperature in different sides of the same structure, as may be caused by the direct incidence of the sun's rays upon one part, while the rest is in shadow; but I must defer discussion of them until a future time.

J. A. Westwood Oliver.

Belle Vue, Springburn, Glasgow, June 27.

USEFUL AND SCIENTIFIC NOTES.

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A New Hygrometer.—In a recent note to the Paris Academy, M. Crova has described an instrument for measuring the moisture of the air not subject to the uncertainty characterising the indications of previous instruments when the air is agitated. The observer looks through a tube towards a source of light. This tube is of nickel-plated brass, highly polished within, closed at the further end with ground glass and at the nearer with a lens. The ground glass plate appears as a luminous disc, and the polished interior, by its reflected light, has the aspect of a bright annular space round the disc. The air, whose moisture is to be ascertained, passes slowly along the tube, entering and leaving by tubulures at the ends connected with a suction arrangement. To cool the tube, it is surrounded by a metallic sleeve filled with sulphide of carbon, through which an air current is passed. A thermometer is inserted in this liquid. When the temperature of the air under examination reaches saturation, dew is deposited, appearing like dark brown spots, which contrast strongly with the bright disc when seen directly. A gradual rise of temperature makes these disappear, and thus, by repeated appearances and disappearances, the dew-point may be estimated with an approximation of one-tenth of a degree.

A New Imitation Ivory.—One of the disadvantages of celluloid is the fact that it burns very readily when a flame is applied, but a new compound, said to be fireproof, and suitable as a substitute for ivory, is thus made:—A solution is prepared of 200 parts of casein in 50 parts of ammonia and 400 of water, or 150 parts of albumen in 400 of water. To the solution the following are added: Quicklime, 240 parts; acetate of alumina, 150 parts; alum, 50 parts; sulphate of lime, 1,200 parts; oil, 100 parts. The oil is to be mixed in the last. When dark objects are to be made, from 75 to 100 parts of tannin are substituted for the acetate of alumina. When the mixture has been well kneaded together, and made into a smooth paste, it is passed through rollers to form plates of the desired shape. These are dried and pressed into metallic moulds previously heated, or they may be reduced to a very fine powder, which is introduced into heated moulds and submitted to strong pressure. The objects are afterwards dipped into the following bath:—Water, 100 parts; white glue, 1 part; phosphoric acid, 10 parts. Finally, they are dried, polished, and varnished with shellac.

A new arrangement of filter removing calcareous deposits from water, in which the water is passed through a succession of filters, worked in series, filled with sawdust, impregnated with magnesia, have been described. Salts of magnesia thus replace those of calcium, and, being more soluble, form no scale in boilers.

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* Joh. Deucer, "The Healthful and Useful Bath-Cure of Wildbad on the Enz." Strassburg: 1637. 8vo.

REPLIES TO QUERIES.

**** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[46424.]—**Circular-Saw (U.Q.).**—The sketch will enable you to set your saw or saws; but I should not advise you to practise upon a saw first, but get a disc of sheet iron 12in. in diameter, No. 18 or 20 gauge, a small anvil, about ½cwt. (I have set them upon a large flat iron on my lap), and a hand-hammer about 2lb. weight, with a good face. With this practise, and you will soon become proficient. Fig. 1 is a buckled-saw. Now, a buckled-saw is a bent saw, but a bend is not a buckle. For instance, your saw may be perfectly straight at A A A, and strained or buckled at B,—i.e., right at the eye, but stretched at the circumference. Now, to get that out, you must commence from the outside, A 1, and gradually proceed as marked with the pock marks, striking steady, flat, and not too hard, first upon one side, and then turn over for the other. When you have made a little progress, if the saw is very bad, make a fire with some light wood upon an open hearth or in the open air, rub your saw over with some mutton-suet or a common dip candle, and with a split stick or tongs held high enough over the heated air, keep it moving about until it acquires a brown tint; when very near cold, proceed again, until you get it right. The same applies to Fig. 2, a hand-saw that is buckled, A A. When the buckle is taken out, it will present the appearance shown by the dotted line, A B. Fig. 3 is a piece of sheet iron, with several cross buckles. Fig. 4, with a bulge. Fig. 5, a dished disc, the gores show where it wants stretching to bring it flat. Your saw should always be a little tight upon the circumference, and the hollow side next the fence. Never work a dull saw. When a circular-saw has got damaged, or the set taken off with grit or a nail, I have seen it pass through timber like A, 6, and 7, and the consequence is a buckled-saw. If a tennon saw get buckled, tap the back sharp with a light hammer, and it will sometimes right itself; if not, pinch the blade between two smooth pieces of wood and bench-screw or vice, and tap the point of back; if not right, tap the back right off, and see whether the blade is buckled; if so, straighten and insert again. You must not slave at it, or go rashly to work: a few well-directed blows, or the mere fall of the hammer, when lifted from 6in. to 12in., will work wonders; and do not forget it is the tight side of your saw wants stretching to accommodate itself to the buckle; by playing upon the buckle you only make it worse.—JACK OF ALL TRADES.

FIG. 1.

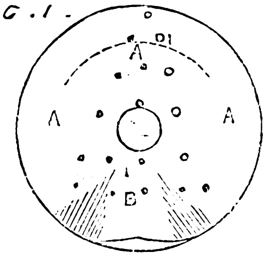


FIG. 2.

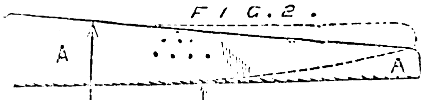


FIG. 3.

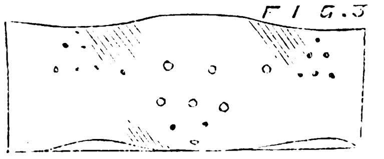


FIG. 4.

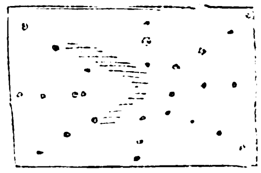


FIG. 5.

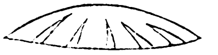


FIG. 6.

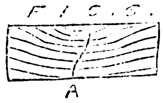
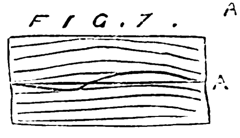


FIG. 7.



[46598.]—**Problem in Plumbing.**—One answer only was given, and that by P. Mooney, but I had exhausted all corking and plugging with no effect. Being driven to extremes, I got a piece of very thin Morocco leather, 4in. by 4in., and a piece of thin tin 4in. long ¾in. wide; this was doubled and closed on one side of the leather, a hole was made in the two opposite corners for some strings, and at 3ft. 6in. a cork tied to the end, to prevent sinking. The leather was well soaked, and measure taken, then lowered in cistern to level of pipe to boiler, the tap turned on, and a dead stop was the result; it was so easily done that I closed and opened it six times in one minute; a very thin piece of indiarubber would hermetically seal it, as the leather allows a small quantity of water to pass through it.—G. B.

[46694.]—**Brick Kiln with Down-Draught.**—I send a rough sketch which I think will aid you. Fig. 1 is the bottom with flue down the centre; the dark dots are the slabs to set the bricks on; B is where the draught goes through, S is the bottom of chimney-stack. Fig. 2 is the inner side up to the springing of the arch—A are what we call the "bags," that are built in without mortar so as to leave a little heat to go straight into the bottom, the same as with fire-holes, and a brick wide. If the bricks should be soft in the bottom, then open the joints of the "bags" a little more. Fig. 3 is the outside, showing the baulks, end, and stack. Of course, you must have a man that understands the work. When the heat gets to the bottom and a nice bright red, then stop up the holes L and put in the dampers and the heat will fly all over the kiln. You must try and keep the fires regular when burning; give the bricks plenty of drying before burning them.—BRICK-BURNER.

FIG. 1.

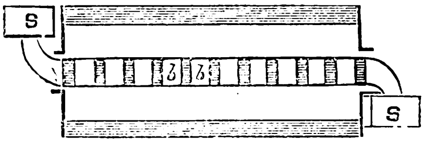
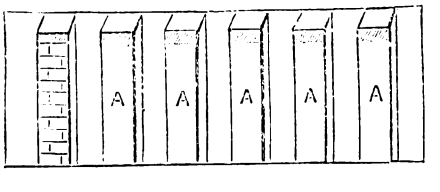
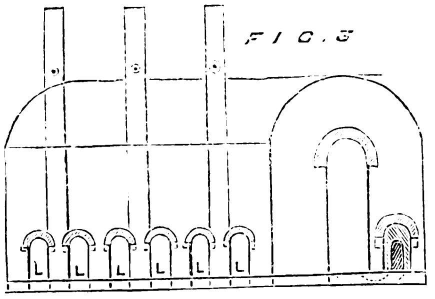


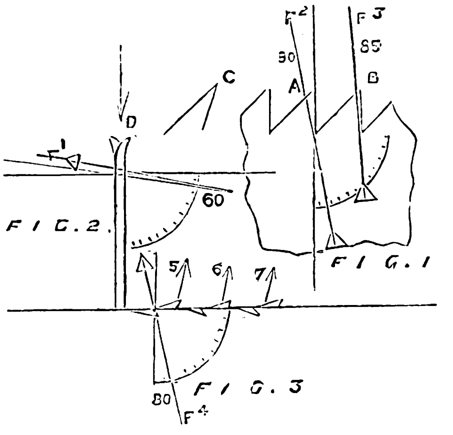
FIG. 2.





[46719.]—**Reading-Lamp.**—Withdraw the oil vessel, in the lower part of which is a valve, a piece of tin on a wire, working through a tin bridge. The cause of varying flow is usually the valve not falling true. To remedy: take out the bottom, fix the piece of tin true on wire, twirl between fingers and thumbs to test it, adjust bridge and refix bottom.—H. FIELD.

[46748.]—**Sharpening of Carpenters' Saws (U.Q.).**—Very nearly everybody who has cause to use saws think that they know how to sharpen them, but when they have done so and proceed to use them, it is a very rare circumstance that they are satisfied with the operation. You can sharpen a saw that will answer for soft timber with the grain, but come against a knot or across the grain and it is fit to jerk your arm off. And another attempt, and ten to one but what you buckle your saw if you do not break it; but as there is a happy medium that will answer for the hardest and softest wood, even to metal, that will give satisfaction, I will do my best to give diagram and instruction.



Description: Fig. 1, flat face of the saw; Fig. 2, transverse section, showing set; Fig. 3, cutting edge. Fig. 1, Fig. 2, Fig. 3, and Fig. 4, with triangles, showing the angle and path of the file, the quadrants here shown as to how the description and where the angle is taken, the greatest angle should not exceed 80° and not less than 85°. Fig. 2, showing too much rake. Fig. 3, right, A and B showing proper shape of tooth. If you sharp as at C, you will find it very difficult to start on anything, as the saw will tear the fibre, kick and dance about, obliterate your lines, sprain your wrist, buckle or break your saw. The process of sharping is shown at Fig. 3, every alternate tooth marked 5, 6, 7, the file taking the place of the tooth with the set towards you, and the top of that from you. If you follow these instructions, no matter upon what class of hand-saw for wood, you will have a saw that it is a pleasure to work with; the set is shown at D, and should be a little hollow. Never work with a dull saw, or just touch it up; do it properly, and it always pays for doing. The cause of saws running is when they are sharpened at too great an angle, and a needle point is produced. Place your saw down upon the bench, and it comes in contact with another tool, or in working comes in contact with a hard grain or knot, and one or two of your teeth get damaged, your saw will run, and if you continue to work with it it forms a curved kerf; come in contact with another knot, and you will produce a double curve, and it is with the greatest difficulty you drive it at all; perhaps sprain your wrist, buckle or break your saw, and spoil your job.—JACK OF ALL TRADES.

[46805.]—**G.E.R. Locomotives**—If Mr. Hall means the inside-cylinder four coupled tanks, 580 class, they are being built at Stratford. The six coupled goods I have been unable to obtain dimensions, &c., of; but a driver told me that cylinders were 19in. by 26in., and wheels, 5ft.—H. S. P.

[46933 and 47036.]—**Photographing in Cemeteries and Photographing Public Buildings (U.Q)**—Though addressed to Mr. Wetherfield, these queries being still unanswered, I give the following:—No doubt an order is necessary to be able to photograph the monuments in cemeteries, such places being in the nature of private property, even after the consent of the owner of such monument has been obtained. No order is necessary to photograph public buildings, except situated in any of the royal parks or gardens; for taking photographs in the latter, a license is required, such licenses being issued by Her Majesty's Commissioners of Works, &c., at 12, Whitehall-place, London.—DITTON.

[47002.]—**Black Paint for Window-Sashes.**—Any good black paint, properly laid on, will do; but all blacks should have varnish added. If vegetable black is used, grind in boiled oil, not raw linseed, and add a little oak varnish or copal. If ivory-black, grind in turpentine, and dilute with turpentine, gold size, and varnish. The gold size and varnish are required to bind the pigment. The ivory-black will need varnishing after it is dry, as it dries dull; but the vegetable black, which, by the way, should have a little driers added, will probably be glossy enough. Try it first, and if not, add a greater quantity of varnish, or varnish after it is dry.—T. P.

[47009.]—**Naval Architecture Government Science and Arts Exam.**—Thearle's "Naval Architecture" (Collins) will enable querist to answer many of the questions; but I suppose he is aware that practical knowledge, such as can be gained only in the yard, is required. In fact, an intelligent apprentice would pass the elementary stage without studying a book at all.—S. R.

[47013.]—**Steam Launch.**—I am not sure I quite understand what it is querist wishes to know, for he seems to have ascertained that he can keep a boat off any stairs if he does not get in any one's way. Practically, unless you are always on or about the spot, it is good policy to give some one a trifle to take charge of the boat, and especially so in the case of a steam-launch. Cannot you find someone with waterside premises, as a steam-launch kept knocking about near public stairs runs some risk of injury, from the fact that it "has no friends" looking on?—YACHTSMAN.

[47056.]—**Bacteria.**—In further reply to "Cygnet," the treatment of the barm-mash, as described on p. 359, is such as would produce diseased yeast in the highest degree. 185° Fahr., as a mashing heat for malt, or crushed unmalted grain, is a diastase-killing and starch-dissolving temperature that will leave the substances acted on better fitted for pigs' food than the propagation of alcoholic torulæ. In my first letter on this subject, I did not mistake the purpose of the barm referred to. Alcoholic fermentation, whether in boiled wort for beers or unboiled wort and grains for distilling, is due to the reaction of *Saccharomyces cerevisiæ* on inverted hydrocarbons. But these "disease ferments," which have their origin in the non-coagulated endosperm, are also reacting—attenuating—on the same hydrocarbons, and the product of their action is not alcohol, but various acids. Hence the majority, I believe, of the home distillers use and find more purity and profit in the yeast of ale and porter than in struggling with their thoroughly diseased yeast arising from the fermentation of unboiled worts. "Cygnet" makes two distinct mashes: the first or barm mash is for the propagation of torulæ to be sown in the second thick mash for alcoholic fermentation. My recommendation of sedimentary fermentation and yeast was for the first or barm mash. But it is quite possible, by varying his present system of mashing, for "Cyguct" to have a purer yeast. Our system of growing barm for breadmaking differs only from his in details. We use malt, wheat flour, hops, and water. We mash for two hours 3lb. malt in three gallons of water that has been boiled and cooled to 160° Fahr.; the malt grains are then strained from the liquid and pressed, and the liquor, when cooled to 110° Fahr., has incorporated with it 33lb. of thoroughly sound glutinous flour, not too finely dressed. This batter of flour and malt infusion is then scalded with six gallons of boiling water (in which 2oz. of hops may have been boiled for twenty minutes in a tin perforated vessel) in three parts of two gallons each, and stirred briskly and thoroughly between each. The heat of the whole then is 140° Fahr. or a few degrees over, and in 24 hours it has cooled to 80° Fahr., when fermentation is started with 1¼ gallon of old barm; or, we add no old barm, in which case the quantity of malt is 5lb. instead of 3lb., and one handful each of flour and cane-sugar, and the tub holding these things is kept where the temperature is constant within a few degrees of 80. With the addition of old barm the new is fit for bread-making in 24 hours; without old barm, and self-fermented (spontaneous), it is ready for use in 48 hours, if it has been stirred up three times during that time. But mark, if I scald the batter of flour and malt infusion with 8 or 9 gallons, instead of 6 gallons, of boiling water, so as to bring the heat up to 160° Fahr. to 180° Fahr. instead of 140° Fahr., then, after fermentation, the effort to make saleable bread with the barm is hopeless; the bread is low, heavy, and acid, and the barm under the microscope is seen to swarm with all the acid ferments. So much for bread-brewing. What follows relates to patented improvements in the manufacture of yeast for distilling fermentation. The full details will be found in the "E.M." for July 30, 1880:—"1lb. hops, 2oz. quassia chips, and 7 gallons of water are mashed for 20 minutes, then boiled for 10 or 15 minutes, and strained through a cloth or percolator, cooled down to 170° Fahr., and 12lb. malt stirred into the infusion; this, after mashing for 15 minutes, has the malt grains separated or pressed out, and the liquor allowed to cool down to, and is kept at, the temperature at which fermentation (spontaneous) will be excited and carried on"—not over 80° Fahr.—"That is the first or starting yeast. Fermentation will or should commence in from 18 to 20 hours, and continue from 16 to 24; when at its full height take from the toop ½ gallon and place it in a close jar, in which put also one or less oz. bi-carbonate of soda, and then hermetically seal, and keep the jar where the heat is not over 60° Fahr." See the "E.M." for the rest of the details. I prepare the ash of figs, raisins, or malt grains, by placing them in an iron tube, and the tube into a glowing furnace and keeping it there till the tube is at a white-heat, and the organic matter inside stops giving off gas and flame. As to ammonia by itself for the invigorating of yeast, I think it more harmful than useful. Torulæ, as found in worts, are no more nor less than free vegetable nuclei, mostly cereal. They are propagated by spores; but, Professor Huxley and his echoes to the contrary, that is not their origin. They are free nuclei, and the most beautiful and lasting variety are not vegetable in origin but animal in the human mouth. Looking upon yeast, then, in worts as the free components of cereals, what is required for its healthy and vigorous propagation is the mineral elements found in organised substances, without which cell structure and protoplasm, animal or vegetable, cannot be formed. These elements are found in the carbonised ash of cereals and fruits. As before explained, this ash is black, which, for my experimental purposes, is of no importance, but these mineral elements can be obtained in a colourless form, free from carbon. Their kind and proportion has been the subject of much investigation by many authorities. In different plants, seeds, or fruits, they vary in quantity; but for the practical purpose of invigorating yeast the analyses of wheat grain ash by Messrs. Lawes and Gilbert will do, and shows per cent.:—

Wheat Grain Ash.

Phosphoric acid..	49·68	Magnesia	10·70
Phosphate of iron	2·36	Lime	3·40
Potash	29·35	Chlorine......	0·13
Soda	1·12	Silica	2·47

Ash of Yeast (Mitscherlich).

Phosphoric acid	41·8
Potassa	39·8
Magnesium phosphate	16·8
Calcium	2·3

The phosphoric acid and lime may be found in lime or bone phosphates, but one form of the application of this is the subject of a patent by Professor Graham, valued at the modest sum of £20,000. The necessary equivalents of soda and chlorine will be found in common salt—W. A. THOMS.

[47071.]—**Railway Trucks.**—The waggons used for goods and mineral traffic vary upon the different lines, and some companies have as many as six different sizes for the same class of traffic. The average size will be found to be from 15ft. to 15ft. 6in. in length, outside, and from 7ft. 4in. to 7ft. 6in. in width outside.—CLEMENT E. STRETTON.

[47110.]—**Template.**—Reply 46424 will answer all "D. D. M. L." requires.—JACK OF ALL TRADES.

[47143.]—**Aluminium.**—If "Zelia Naien" will give me his address, I think I could help him out of his difficulty, as I have had considerable experience in Metallurgy. I could scarcely give him full particulars in these columns.—E. SELLON, Eccles, Lancashire.

[47159.]—**Heating Greenhouse.**—It is a mistake to have gas-stove inside. The flue-pipe should be taken into a chimney that has a good draught—one that is most in use—say, kitchen. Gas-stove being inside, it is *best* to cut off all communication, by having metal cover made to fit over it, with well-fitted door for lighting purposes, and inlet-pipe (to supply air for combustion) coming from outside. If this is not clear enough, write H. MANFIELD, London-road, Twickenham.

[47174.]—**32ft. Pedal Reeds.**—Thanks to Mr. Huxley for his hints, but I should not care to undertake to carry them out without competent aid. My past experience of meddling with reeds is, that it is a very delicate business, and best let alone by amateurs. In reply to Mr. Fryer, the instrument will be a two-manual of five rows, with independent pedal three rows, each 27 notes (32ft., 16ft., and 8ft.), my object being to avoid coupling manuals to pedals, which I have hitherto found unsatisfactory. I do not know size of reeds: should I have to get them made specially?—ARIEL.

[47175.]—**Varnish.**—I think if "Varnish" will try the following, he will find it useful and cheap: Seed-lac, 1lb.; methylated spirit, 1 gallon. I have used this for some time and have had excellent results. Seed-lac is a cheaper form of shellac, and should be placed in a jar with the spirit and occasionally shaken, and then decanted. If this is then thought too thick, more spirit may be added. If "Varnish" would like a recipe for an amber varnish to be applied to a cold plate, it will be gladly supplied by—F. H. H.

[47184.]—**Special Express Train on Midland Railway.**—In my reply, p. 362, I mentioned that T.R.H. the Prince and Princess of Wales would travel by special express from St. Pancras to Saltaire upon the 22nd of June. The train was booked to run as under:—

St. Pancras	dep.	1.30	p.m.
Kettering	arr.	3. 2	,,
,, ...	dep.	3. 5	,,
Nottingham......	arr.	4.11	,,
London-rd. Junc.	dep.	4.15	,,
Cudworth..........	arr.	5.28	,,
	dep.	5.31	,,
Saltaire............	arr.	6.15	,,

The train consisted of van No. 320; first-class carriage, 226; directors' bogie saloon, No. 1; Pullman drawing-room car, "Venus"; the new Pullman dining car, "Delmonico"; bogie saloon No. 733, and van 434, or a load equal to 11 ordinary vehicles. The train was drawn from St. Pancras to Nottingham by engine No. 1516 (driver Leadbeatter), not by 1483, as previously intended. Although an extra stop of five minutes was made at Harpenden, the train arrived at Nottingham at 4.9 p.m., or two minutes before time. The engine was changed, and No. 1511 conveyed the train thence to Saltaire, which was reached two minutes before time. It may be mentioned that the new dining car used upon this occasion will, on the 10th inst, commence to work daily, with the other new car, as under:—

	p.m.		p.m.
St. Pancras	5. 0	Liverpool	4. 5
Manchester	9.45	Manchester	4.50
Liverpool........	10.35	St. Pancras	9.35

—CLEMENT E. STRETTON, July 1st.

[47193.]—**Nitrate of Lead.**—Nitrate of lead is made by dissolving suboxide of lead in nitric acid, then it is boiled down in a lead pan and crystalised. For stannate of soda you will require two iron pans, one 2ft. deep, 18in. wide, the flange to be 6in. wide, to weigh about 5 or 6 cwt. of the best cast iron you can get. The other must be a common 10-gallon pan. You will also want a flat iron lid for the big pan, with a funnel in the centre. The following is the receipt: 5 gallons caustic soda, 40lb. common salt crushed, 27lb. nitrate of soda, 20lb. feathered tin. You must have the big pan red-hot before you start, and the caustic boiling in the small one; put the salt in first, and then the caustic will not fly; be very careful, or it will fly in your face. You will want two iron slicers or stirrers, and when it is fluxed you draw it out and dissolve in boiling water. There is another method which does not require boiling caustic; but you would have to pay for it.—SHALE.

[47196.]—**Electricity v. Gas.**—I am not so clever as Mr. Grey, and do not understand from what he intends to differentiate the tom-cat. I know if you rub one the wrong way he will prove himself electrical in more ways than one, but I do know that "Fiddler's" query deserves a more courteous answer. It is not because a thing never has been done it never can be; in the present state of science we cannot say that anything is impossible. If "Fiddler" has any theory on the subject, I would advise him not to feel "shut up," but try to work it out. At present, I suppose, there is nothing nearer to his suggestion than Doebereiner's lamp, which was invented in 1824; this forms its own gas by electricity, and burns it by means of platinum. With this to start from, I say, Go on and prosper.—ZELIA NAIEN.

[47196.]—**Electricity v. Gas.**—Why don't you try the experiment yourself? Then you will know why it is that such a method cannot be adopted. Practically, there are any number of beautiful experiments that for practical, everyday use are useless. Yours is one of them. A gentleman came to me, not long ago, with a "splendid" idea. I was to have half the profit of the commercial working of the idea. It was to revolutionise gas-making; to dispense with costly machinery. I could not mention all the great things that the invention was to do. It was to provide high towers, and above them lightning-conductors, with innumerable points. These had to "collect" the electricity in an upper stratum of air and bring it down through immense vats of water, slightly acidulated, and the vats, of course, insulated. Then two electrodes, with receivers over them, were to decompose the water. Oxygen to be stored in one series of gasometers and the hydrogen in another series. I had to cool the aspirations of my client by pointing out to him the failures that would take place, even in the beginning of the process. He went away a wiser, and, perhaps, a sadder man. Still, I never care to damp anyone's spirit; it is better to think and not succeed, than never to think at all.—W. J. LANCASTER.

[47198.]—**Wet-Bulb Thermometer.**—The idea is an old one. You should have a piece of parchment over the vessel containing the water, or have one of the small fountain ink-bottles, with a small neck. You know, of course, that the danger is with a tall supply of water, that the bulb will be too wet, and consequently, warmer than it would be if evaporation could go on only from the immediate surface of the cotton covering. The water in a long vessel is the same temperature as the outside air, and if the supply to bulb is too rapid, the wet bulb will indicate too high.—W. J. LANCASTER.

[47199.]—**Winds.**—The gusts have never yet been at all clearly explained, nor will they be for some time. Electricity has a great deal to do with sudden squalls. I have noticed sudden gusts during a thunder-shower that could be traced as due to an electrical discharge; but there is more that cannot be so definitely traced, but I think will be before long, as due to silent electrical discharges.—W. J. LANCASTER.

[47209.]—**Lever Watch.**—It is somewhat difficult to assign a correct cause for the defect exhibited by your watch. Some part or other cannot be so free as it should be. Is there perfect freedom in the action of the hair-spring? Does it touch the bar of the regulator in vibrating between the two small curb pins? Does the revolution of the balance increase or diminish when held in different positions? Can you perceive any difference in the sound or beat when steadily held to the ear in various ways? The hairspring should work freely between the pins, and should in every way be free from the bars of the balance and from the regulator itself. The action of the balance should be the same, in whatever position the watch is held. The beat, too, should be the same, however placed. Sometimes a minute piece of bristle may hang up and obstruct the freedom of a particular wheel, or a small piece of pegwood may be left in a jewel-hole (when it is a covered jewel), or in putting together you may have slightly burred one of the pivot holes in one or the other of the plates, which would bind the wheel when bearing to that side. You will see that the error complained of may proceed from a variety of causes. It sometimes happens that when a spring gives up the ghost, the chain is violently jerked against the staff, and unless the watch is fitted with a staff-guard pin, the pivots, or one of them, may get a trifle bent—not enough to altogether stop the watch, but sufficient to retard its action. Your best plan would be to take down the watch and closely examine every hole and pivot, if you cannot ascertain the cause otherwise. It is useless to overset the spring. A half or a three-quarter turn of the ratchet wheel generally suffices. In over-setting you run the risk of again breaking the spring, or, perhaps, the chain. You were perfectly in the right in oiling the jewel-holes. The policy of oiling the ruby-pin is open to question. In cases where the lever-fork is indented or rough, a little oil is a help, so long as it is free from coagulation. Should it thicken, it would prove more of a hindrance. A well-finished escapement and roller require little or no oil, excepting where the escape-wheels are made of steel; then it should not be omitted. Write again and report progress.—ALFOJOE.

[47211.] — **Magneto-motive Force.** — See answers to 47179, and also read carefully Prof. Ayrton's lecture on p. 4, and get acquainted with the Ammeter and Volt-meter there referred to. The methods of applying electricity to magnetic motors are very various, but the "Gramme" appears to be reckoned among the best—described in a back number of the ENGLISH MECHANIC.—J. H. HUXLEY.

[47214.]—**A Clock to Strike Quarter-Hours.**—In reply to "A Poor Irish Boy," I must say that I think you may as well try to extract sunbeams from cucumbers, or to make a silk purse out of a sow's ear, as to hope to make your clock strike the quarters. I know of no plan by which a clock of the kind described could be made to do so, unless it was by putting an entirely new set of wheels and levers in place of the present ones. In my opinion the game would not be worth the candle, as the saying is. I should be happy to assist you if I could see my way clear to do so; but I cannot. I imagine your clock is not a *gilt* one, if it is an American. The majority of the American clocks now in the market are lacquered in a manner that very closely resembles gilding. The colour is so nearly alike, and the finish so good, that an unpractised eye may easily be deceived. Unquestionably some of the best *are* gilt. Lacquering is done by boiling or dipping the metal in diluted nitric acid, and after being thoroughly cleansed and dried, it is heated and painted over with prepared and coloured spirit varnishes. A considerable amount of skill is required on the part of the workman to produce an even and satisfactory appearance to the work: so if you attempt the job, you must not be surprised if the condition of your clock goes from bad to worse.—ALFOJOE.

[47218.]—**Circulating Decimals.**—Three years ago I purchased a copy of Henry Clark's "Rationale of Circulating Decimals, &c." A new edition of 215 pages, and 6 copper-plates. London, 1794. It is the best work that I have met with on the subject. A. J. Smith, by appointment, can come any evening and read the 10 pages of preface and 70 pages of matter in the said subject, if he likes to advertise his address.—S. J.

[47226.] — **Picture-Frame Making.** — After trying various methods of making frames, I find I can make the best job by (after mitring) just touching each mitre with glue, letting dry a short time. This stops suction, otherwise the end grain of wood will absorb glue which is intended to hold frame fast. I then take the pieces, two and two, glue them, rub out superfluous glue, setting them to intersect perfectly. Leave them a sufficient time to dry, then put a brad or two in each; then put other joints together in same way, bradding them also when dry. In this way you can set each mitre properly, which is almost impossible to do by nailing at time of glueing. Although the job may be a little longer about, it is the best in the end. A trying-plane must be used, kept sharp, and I set the break-iron well back when making mitres. My mitre-board is simply a piece of inch stuff, with two pieces glued on at the proper angle, and held down on bench by two screws.—COTSWOLD.

[47226.] — **Picture-Frame Making.** — If Savory's mitring board is untrue, I should at once drop down upon him with a letter of remonstrance. He is a frame-maker, and is well-known in his own town and neighbourhood. His book upon frames and gilding gives also full details upon the subject, with illustrations. Mr. Hines, of Norwich, also sells a mitre-board and cramp, and so also do Booth Brothers, of Dublin. With sharp plane and true board, a mitre ought to come out true; but practice has something to do with it. If the pieces are put accurately in place for nailing, they will not remain so. Set one upright in the vice (properly protected) and let the other slightly overlap its true position; then bore and nail, and the act of nailing will drive it down into place. But Hines and others advertise clamps to secure the mouldings in place, which are advantageous to those who are not adepts. Practice on some ordinary bits of moulding: it is a pity to use special stuff until perfect in the manipulation. "J. J. A.," Liverpool, uses a good plane, and evidently succeeds.—O. J. L.

[47228.]—**Telephone.**—You will require from ¾oz. to 1oz. of 36 wire on the bobbin, but if you have only a short circuit you can use No. 30 wire. The bobbins ought not to be too wide; if the width is made equal to the diameter of the core, then wind until the depth of wire is equal to diameter of core, and you will have the most successful telephone you can make.—W. J. LANCASTER.

[47231.] — **Insulating Material.** — Field's Nigrite is the best substitute for indiarubber for insulation. It has nearly four times the insulating power of rubber, and is sold at a much lower price.—ARTHUR SMITH.

[47233.]—**To Mr. Lancaster.**—Any of the steel-tape makers would make the band for you. Perhaps Chesterman's, of Sheffield, would make it for you. Probably a good band-saw maker would do it; but I should prefer the steel-tape makers. You do not say what strength you want the steel; if very light, a clock-spring maker would be about the best to go to.—W. J. LANCASTER.

[47234.]—**Weight of Girder.**—A box girder 12ft. long, to break under a load of 1 ton, would be but a toy or model. The following would give such a model:—Top and bottom plates 3in. by ⅛in., webs each 2¾in. by ⅛in., four angle-irons, each ¼in. by ¼in. by ⅛in.; the breaking weight in centre by calculation of this girder, if fixed at both ends, would be ·94 of a ton; weight 77lb.—DITTON.

[47236.]—**Object-Mounting.**—You will find nothing better than glycerine and gelatine, and one of the simplest methods of making it is given by Beale. A small quantity of gelatine must first be soaked in cold water until it becomes quite soft, then melt it by putting it into some hot water—not too much, but sufficient to make it about the consistency of starch; then mix an equal quantity of glycerine with it, and before bottling it well mix the two together, then bottle it and keep it covered. When wanted to be used, put it in a cup of warm water for a few minutes. You will find this mounting-fluid capital for all tissues.—W. J. LANCASTER.

[47239.]—**Deafness.**—I suffer from chronic catarrh of the ear which has produced deafness. I went to Dr. Dalby, and he gave the same advice as Dr. Edmunds, only recommending Borrough's Inhaler, Snow-hill, London, price 12s., and to take air into the lungs, and to force some through the ears, which he told me would prevent my getting worse, which it has done. The inhaling requires great perseverance, it being six months before I received benefit from it. It has been beneficial to others who have received the same advice Dr. Edmunds gives. Could Dr. Edmunds tell me if he has had any experience in mechanical contrivances for the ear, and what is the best and most convenient? I want something to use in church, and at lectures, &c. Can they be safely recommended? Do they improve or injure the hearing?—JOHN ALEX. OLLARD, F.R.M.S., Enfield.

[47243.] — **Dry-plate Photography.** — If "F. J. N." will follow the instructions given by J. B. Stephen on p. 10 of this volume, I think he will be satisfied with the results. I have made two double dry slides at the cost of 4d. each, that is besides my own labour, not taking that into account. I got my board at a picture-framing shop, and gave 5d. for a 6ft. piece; hinges for the same three-halfpence per pair.—R. T. B.

[47244.]—**To Mr. Lancaster.**—About a month ago I gave the very instructions you ask for. You will find it under Medical Coil. The battery you speak of I suppose means a coil. If you cannot in back numbers find just what you want, let me know, and I will tell you exactly how best to go to work. At the same time, let me know whether you have any cells at all; if not I will tell you how to make the simplest form.—W. J. LANCASTER.

[47245.]—**Electric Bells.**—Most probably the fault is due to bad earth. I saw some time ago just such a case; the earth at one end consisted of a wire pushed into the ground about 1ft. When the ground was very damp bells would ring and all go right; but the moment ground was at all dry the bells and telephones ceased to work. Of course, I am assuming that your iron wires go to earth: if not, then, of course, the fault will not be as above; and I should advise you not to use the iron return-wire, but simply to carry a wire at each end, either to the gas-pipe or to the water-pipe. There is something wrong with the insulation somewhere.—W. J. LANCASTER.

[47256.]—**Surface Condensing-Engine for Launch.**—The difference will not be so much as you imagine, so far as driving and attention are concerned. In the first place, you will not have the benefit of exhaust fire-draught; but the boiler pressure need not be so high, as it is necessary to keep it in the "suffers." The chief extra you will have to watch is the vacuum gauge, which should be tested by indicator, as nine out of ten of them are an inch or so out. The vacuum should stand at least 24in.; the more you get the better. If the vacuum is found to decrease, try your hot-well (overflow from air-pump), for temperature with thermometer. If over 125° Fahr. your circulating-pump is not working well, or the tubes want scaling, and if not soon done, the increased heat will form a thick crust round them and prevent condensation altogether. Irregular, jerky movements of the gauge index point to the renovation of the air-pump packing. You should bear in mind that vacuum costs in production, nothing but the working and wear of pumps, and every 2in. is as effective as a pound of steam per square inch of piston, which cost coal and labour in putting in the furnace. You must also look out for leaks in exhaust-pipes, condenser ends, and tubes, so that no air can enter, and the drain taps on cylinder end kept tight: also piston seen to occasionally, as all these things are fruitful sources of annoyance to those in charge of condensing-engines.—FRED. WALKER.

[47259.]—**To Mr. Lancaster.**—You have insufficient wire and have wound it wrongly; you must wind round and round like cotton on a spool and not as on a shuttle; wind on each leg at least ½lb. to ¾lb. of, say, 16 cotton-covered wire. The armature is, of course, much more like a shuttle, and the winding is in same direction as the cotton on a shuttle; but the magnets must be wound differently unless you want to waste all your current.—W. J. LANCASTER.

[47264.]—**Lightning-Conductors.**—The best form is Vyle's patent easily-tested lightning-conductor, which is a cable made of 96 per cent. of pure copper, with an insulated wire as its core, for testing the condition of the conductor, and also whether it continues to make good earth. To make the best earth, is to carry your conductor undergronnd—away to water, if possible. If not able to do so, get a good clay soil, on which lay a bed of coke; wind the conductor round a large iron plate, and solder it on, laying the iron plate on the bed of coke, and then again covering it with coke; this will give you the best possible earth. I may mention that the cable testing wire for earth connection ought to have the resistance of 1 ohm.—DERBYSHIRE.

[47265.]—**Forecast of Storms.**—About the best book you can read is "Weather Warnings," Houlston and Sons, London. If you read this through several times, you will know more of weatherology than you appear to know now; but don't prophesy until you have made at least 50 entries that have all come true without one failure: then you will be on the right track. Don't endeavour to go further ahead than one day, or you will be wrecked.—W. J. LANCASTER.

[47265.]—**Forecast of Storms.**—My barometers were made as followz:—Two pieces of soft glass tube ⅜in. diameter were sealed each at one end by means of a spirit-lamp; next, one piece was bent about 7in. from the sealed end into a U-shape, allowed to cool, and then filled with mercury; it was then heated in the spirit-lamp until air-bubbles were expelled, and as soon as cool enough to handle the end was sealed. In this manner I had a glass rod 32in. long and turned up 7in., full of mercury, sealed at both ends. I afterwards discovered that good sealing-wax would effectually close the shorter limb if the after operations were carefully conducted. This mercury tube was sealed and suitably framed, the short end was opened by means of the spirit-lamp, and a register for three months was made out and filled up day by day, as my barometer indicated, and in three months I found that storms had passed over us as follows:—September 15th, 1880, an interval of 20 days and storm 5th October; interval of 22 days, storm 27th October; storm 14, 16, and 18th November. Interval of storms then appears to be about 20 days. I again made out a three months' register, with this result—November 18th to December 29th, a double period of 41 days and storm period light, but compensated in 19 days by the great snowstorm of January 17th and 18th, 1881. I next found the storms accelerated during the summer solstice, so that the interval was shortened to 15 or 17 days, and would ask my querist to look through pages 122 and 123 of E. B. Denison's "Astronomy without Mathematics," where he may find a reason for the difference thus noted. But return to our other tube left sealed at one end, then half filled with water, then bent in the spirit-lamp similar to the other tube, next drawn out even and straight, so that the short limb was no thicker at its termination than a pin such as ordinary stockings are knit upon. A turn or two brought sufficient water in my narrow limb of 8in. long, then it was framed and scaled, and hung in a cool shady place, and found to give unerring indications of coming rain, and especially thunderstorms. The two instruments are hung side by side. They are both valuable: the mercurial gives pressure only, while the water-glass gives notice of local rains, &c. If my querist sends me a stamped envelope for reply, he shall have diagrams of past storms, which will show him at a glance what my discovery is. A gentleman F.M.S. wrote me that he used the method, or interval of 20 days, but that certain others of the Meteorological Society wanted no information from outsiders. In reply, I would say, if they have secrets relating to weather science, that such secrets are likely to be discovered. It is singular, but true, that our worst storms have not been foretold by the scientific meteorologists, with all their first-class apparatus.—W. M. Gardner, Byfield R.S.O., Northamptonshire.

[47270.]—**To Mr. Lancaster.**—You can take the front lens to pieces, but be sure that it, the fog, is between the lenses; often the front surface of flint has an oxide on it giving it a foggy appearance; this you cannot remove. If it is between the lenses, then put lens on a plate and place in a warm oven, then when quite warm you will be able to slide the top lens off; clean when cold with turpentine, and re-cement with clean Canada balsam—bake until the balsam round the outside of lens is hard, then allow to cool; clean the balsam from round lens and put into cell again.—W. J. Lancaster.

[47275.]—**Oak Graining.**—You have nothing to do with umber mixed in table-beer; but first paint the ground the tint you require—if light, using white lead and yellow ochre; if dark, adding Venetian red or burnt umber; in fact, many pigments like sienna, burnt and raw chrome, Oxford ochre, &c. You can buy the graining ready made, or you can make it by grinding up burnt umber and raw sienna, or Vandyke brown instead of the umber if it is required dark; thin with equal parts turpentine and linseed oil. The beer business is for distemper work. Why don't you get one of the handy-books on painting, which will give sufficient hints to start you, and if you looked through back volumes of "ours" you would find many hints.—T. P.

[47275.]—**Oak Graining.**—Get a pint of linseed oil and a pint of turps mixed for thinnings, ¼lb. dryers, ¼lb. raw umber ground in oil, and half a ball of whiting. Mix whiting to a stiff paste with thinnings, then place it and the dryers in paint-pot, adding half the umber. Mix well together, then add about a pint of thinnings. When well mixed try it; if too light, add umber; if dark, add thinnings. When got to proper shade, rub a little on and comb it; if the combing shows a tendency to run, add more whiting till it has body sufficient to stand the comb, remembering at the same time that the principal thing is to rub the colour on evenly, which cannot be done unless it is very thin, and even then it requires a lot of practice with the brush to be able to do it nicely. The only difference between light and dark oak is the quantity of umber or other stain used in mixing, the whiting or dryers having no effect on the shade, merely forming the body. To overgrain it rub down with wash-leather damped with whiting and water, then take vandyke brown ground in water. Mix it very thin with beer and water, and darken styles and shade up where required, using a sponge to wipe out the lights and a badger to soften. Don't try to shade it up too much, as you are very liable to get it patchy: but keep it as quiet as possible, then nothing but the want of skill will prevent you doing it well.—E. Coker.

[47276.] — **Electrical Indicator.** — If "Troubled" will call or write me, I shall be happy to show him just the instrument he requires, also an electric water-alarm and register of the fluctuation of the same, as fitted to all locks on the River Thames. The apparatus he requires can be worked through a single wire, and reads the level to an inch for any depth, and can be fitted for a very moderate sum.—T. R. Brailsford, Thames Conservancy Office, 41, Trinity-square, E.C.

[47278.]—**Patented or Not?**—I made a tube magnet about fifteen years ago; it is no patent.—George Tolman.

[47278.]—**Patented or Not?**—Patented it is unless it has lapsed; but the patentee would scarcely fight the matter, seeing that the system was in use many years before the patent. Some applications of it might no doubt be patentable, but not the inclosing tube in itself.—Sigma.

[47279.]—**Spoilt Glass Shelves.**—Wash them in hydrochloric acid, then if that don't remove the cloudy patches, rub them with putty-powder (oxide of tin) and leather.—Albert Smith.

[47280.]—**Legal.**—It is really impossible for me to answer this question without having fuller particulars, as to the kind of name, and as to the terms of the dissolution of partnership. "G. B." begs the whole question by calling the foundry his own, when, up to the date of the dissolution, it was as much his brother's. If the brother went out of the business and left "G.B." the good-will, &c., he also left him the name, if it is not his own name, and he has no right to use it elsewhere. But I say this with reserve, as these points are difficult to decide in the dark.—Fred. Wetherfield, Solicitor, 2, Gresham-buildings, Guildhall.

[47281.] — **Tricycles.** — For good, all-round work I should recommend a double-driving chain machine, back steering, of the "Cheylesmore" style, where the rider is placed well over his work, and in the best position to utilise the greatest amount of power. Rotary motion is also much easier than lever motion, and friction is less than in lever machines. Challenge No. 1 is a very heavy machine, and not suitable for hill work.—Ariel.

[47282.]—**A Foreground Query.**—You should get "Hints on Sketching from Nature," by N. E. Green, published by Messrs. G. Rowney and Co. Get Part I., and read Chapters IX. and X., which will solve your difficulty.—A Student of Landscape Painting.

[47283.] — **Launch Tubular Boilers.** — The specific gravity of the water in the boiler should be under 1·087, as the salt commences to form scale above that point. The best plan will be to buy a cheap salinometer, about 2s., which is graduated to 32nds of saltness; at 3/32 a black line is drawn, and the density of the water should be kept below its flotation. As regards blowing-off, there should be two blow-off pipes to your boiler, one about half-glass, or ordinary water-level, and another at the bottom, both communicating with the sea. The first is a scum-cock, and should be used whenever there is a scum upon the surface of the water in the gauge-glass, that being a sure indication of scum upon the surface of water in the boiler. The bottom cock should be used, say, every two hours in sea-water, and if the feed-pumps throw sufficient water about ¼ of glass should be blown out, and salinometer tried for density and temperature. At specific gravity 1 087, it should boil in open air at 215° Fahr. I have found a good plan in such small boilers (in cases where the launch could stay for a couple of hours, at anchor or alongside a wharf), to draw the fire, save a small spark or so for relighting, then blow the boiler off, keeping the blow-off cock on after the boiler has ceased blowing, the vacuum that will exist within the boiler, will, by the external atmospheric pressure, cause the clean water to rush in through the blow-off, which shut when high enough in the glass gauge; fire up, and you will find that you have a clean start at a small expenditure of time.—Fred. Walker.

[47286.] — **Chromograph.** — Well soak your gelatine in cold water until soft. To every 2oz. of gelatine add 4oz. of glycerine and ¼oz. of oxide of zinc.—Albert Smith.

[47287.]— **Magneto - Electric Machine.** — When the bobbins are parallel with the magnet, the end of spring should be on the centre of the round part of the spindle where it is filed flat, but spring must not touch the flat part.—George Tolman.

[47292.] — **Bunsen Battery Connections.** — You can copper and solder a wire on, but it will need very careful protection against the acid. There is no reason why ordinary soldering flux should not be used in such a case, as it can be washed off; but rosin can be used instead.—Sigma.

[47292.]—**Bunsen Battery Connections.**—You might twist the wire round the top, and give a coating of Brunswick black, or drill a hole in the carbon and screw your wire into it. When you use spirits of salts, well wash the joints, so as to get rid of the acid.—Albert Smith.

[47292.]—**Bunsen Battery Connections** — Cast a leaden cap on top of carbons, inserting a piece of copper wire in the metal before it has set. Solder this wire to the one attached to the zinc. Spirits of salts may be used for soldering, taking care to wash off all traces of the salts afterwards. Arthur E. Morris.

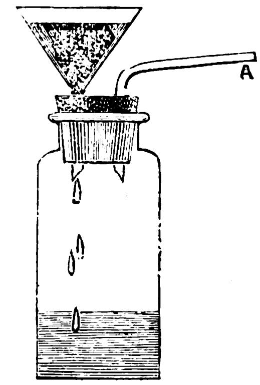
[47292.]—**Bunsen Battery Connections.**—If the carbons are of very hard stuff, drill a hole in the thickest end, tap it, and screw a brass terminal in. Have had some in use seventeen years, and are perfect at present. Carbons must be 3in. longer than porous cell, well waxed and varnished for 4in.—George Tolman.

[47292.]—**Bunsen's Battery Connections.**—Full instructions have been given many times in this journal for depositing copper on battery carbons. It makes a first-rate connection, if done as recommended by "Sigma." If you do not wish to use spirits of salts, all you have to do is to file some portion of the copper surface bright, sprinkle on a little powdered rosin, and solder in the usual way. I, however, never found the spirits of salts give any trouble; and it was much handier.—J. Hezmalhalch, Jun.

[47296.] — **Object-Glass Making and Correcting.**—As "J. C. L.'s" query on this subject really touches the very heart of the matter, and requires a lengthy explanation, I must ask him to wait some time yet. I have no doubt that he will find in the general description it is my intention to give in my letters on o.g.'s what he needs. I should like to read Mr. Godfrey's letters much; and thank "J. C. L." for his offer. Will he kindly send them to "Orderic Vital" for me?—Prismatique.

[47298.]—**Examination of Malt.**—Why not use a vacuum filter? They are very rapid.—Albert Smith.

[47298.] — **Examination of Malt.** — Rapid filtrations are usually performed by connecting the filter and its contents with a Bunsen or other form of filter-pump. When the pump is started, the air within is exhausted and a vacuum is formed; the pressure of the atmosphere on the surface of the liquid causes it to be rapidly forced through the filter. As filter-pumps are expensive pieces of apparatus, and, most probably, the querist will prefer something cheap, I will tell him how to make an affair to fulfil all requirements for a few pence. Get a large wide-mouth bottle, of about 60oz. or 80oz. capacity; fit it with a perfectly sound cork, through which bore two holes; in one hole insert a piece of bent glass-tubing and into the other the funnel. The filter is placed in the funnel, and the liquid to be filtered poured in; the mouth is then applied to the tube A, and the air sucked out; the atmospheric pressure forces the liquid through into the bottle. Too much pressure must not be applied, as it is apt to break the bottom of the filter-paper. A small cone of platinum-foil, pierced with holes, will prevent this accident.—Arthur E. Morris.



[47300.]—**Proportions of Cylinders.**—The rule for finding the proportion of the L.P.C. to H.P.C. in compound engines, is to divide the area of large cylinder in square inches by square root of rate of expansion; result, area of small cylinder. Still it is difficult to go into calculations on compound-engines without an elementary knowledge, at least, of algebra. The advantages of dry steam are (always presuming that superheating is not carried too far), increase of work done by engine, in consequence of pressure being raised; and in the case of well-lagged cylinder and steam-chest, considerable less loss by radiation than by wet steam, and the economy of the heating or drying process, which may be done by utilising the waste products of combustion before passing up the flue. The advantages of wet steam are: first, that it does not destroy the valve-face, cylinder, piston, and packing, like dry steam, nor does it require a superheater. I really am at a loss to answer your third question, without the aid of algebra; but I will cull an extract from Fairbairn's table that, perhaps, may suit your purpose—

Temp. of 1 atmosphere = 212° Fahr.
,, 2 ,, = 250 ,,
,, 3 ,, = 274 ,,
,, 4 ,, = 292 ,,
,, 5 ,, = 307 ,,
,, 6 ,, = 320 ,,

—FRED. WALKER.

[47301.]—**Vacuum Tubes and Coil.**—Your zinc is either broken, or the insulation is bad and the current escapes. Are the connecting-wires in contact properly?—GEORGE TOLMAN.

[47301.]—**Vacuum Tubes.**—The cause of dancing is an imperfect connection somewhere. The most likely place is at the loops of the tubes where the wire is simply hooked in.—SIGMA.

[47307.]—**Mildew on Vines.**—Have you tried permanganate of potassium? I think that might do. I have used it for other things.—ALBERT SMITH.

[47309.]—**Clarionet.**—1. The diameter of bore cannot be determined theoretically. In practice the following sizes are best:—C clarionet, 14·5 millimetres; B flat clarionet, 15·5 millimetres; A natural clarionet, 16·0 millimetres, although some makers bore all the set of clarionets at 15·0 millimetres. The objection to this is that the C clarionet is shrill, and the A clarionet too tubby. As to length of tube, C concert pitch takes a tube of 6¼in., 12½in., or 25in. long if perfectly cylindrical. As to holes, their position depends on their size, the lowest hole being half a tone higher than the cut-off tube, the highest hole being at least one tone high. They must also be placed in a geometrical ratio as to distance. There are no books on the subject that I know of. Boehm's book on the construction of the flute gives a few rules; it is published in German, at Munich; but if "Old Blowhard" chooses to advertise his address, I will give him some information on the subject.—VULCANITE.

[47312.]—**Dynamo-Machine.**—Make the F. M. of the form I described a fortnight ago, p. 354, in cast iron. The wound part must be 12in. high × 3 × ⅜. Perhaps you can fit it to your old pole-pieces, but don't spoil the machine on account of the old pole-pieces; better in one piece. Wind on 16 times the total length of wire of armature and the same gauge as a "shunt" dynamo. More advice if required.—GEORGE TOLMAN, Wolverhampton.

[47313.]—**Tartaric Acid.**—This acid often contains lime. When this is the case, it fails to dissolve in alcohol. It also contains bitartrate of potassium; in this case a residuum of carbonate of potassium is left upon ignition. It should not give a precipitate with chloride of barium. Carbonate of sodium sometimes contains sulphate of sodium, chloride of sodium, and the effloresced neutral carbonate.—ALBERT SMITH.

[47313.]—**Test for Soda Bicarbonate and Tartaric Acid.**—"Commercial purity" is a rather elastic term to apply to chemical substances. What is required, I presume, is to find out if they contain an extra amount of impurities. Soda bicarbonate, the commercial salt, usually contains a little sulphuric acid and chloride. The former is found by supersaturating the liquid with nitric acid, and adding baric chloride, when, if sulphuric acid be present, a white precipitate will be thrown down. The chloride is tested by adding nitric acid, as in previous case, and then argentic nitrate, with which it forms a white precipitate. The impurer varieties contain, in addition to the above, sulphide of sodium and sulphite and hyposulphite of soda; extract these by adding dilute sulphuric, and passing evolved gas through a solution of plumbic acetate. The precipitate formed ought to be white (carbonate of lead), not brown; also, no sulphur should be thrown down on addition of the sulphuric acid. Tartaric acid: The only impurities likely to be found are lime and sulphuric acid: the lime to be tested for by adding ammonia until the solution is neutral, and then ammoniac oxalate; the sulphuric acid by same method used for the soda. The commercial acid is generally pretty pure.—ARTHUR E. MORRIS.

[47314.]—**Rotation of the Earth.**—As the rotation of the earth makes the day, clearly the earth rotates just as many times as there are days—365, or 366 in a leap-year.—E. D. S.

[47314.]—**Rotation of the Earth.**—The querist is right in supposing that the Earth's rotation in space is different by one day in the year from its rotation round the Sun. The time of one rotation in space, as determined by watching transits of stars, is called a sidereal day, and of these there are 366 to the solar year of 365 days. If the querist will watch any star, he will see that it arrives at a given point, or at the meridian, about 3min. 56sec. sooner every day—that is, about 1-366th of a day less than the solar day. This is, of course, equal to the amount of the Sun's motion as seen from the Earth) among the stars.—PLONI ALMONI.

[47315.]—**Harmonium Pan.**—If "Gotha" has never made a harmonium pan before, I should advise him not to commence making one for 2½ sets of reeds. Let him first try his hand at one for one row of reeds, then, if he is successful in that, he will have gained some experience, and be better able to accomplish what he desires to do. To make a pan properly requires practice and some degree of skill. Harmonium pans should be made of well-seasoned wood, as any warping will render it useless. It is one of the most particular parts of the harmonium. Good pans can be bought cheap enough, and if you purchase one for 2½ sets of reeds it will save you a deal of trouble. Should "Gotha" be determined to make one himself, he will find all necessary instructions in back volumes. A pan with beech veneers is preferable to one constructed entirely of pine.—G. FRYER.

[47316.]—**North Pole of Electro-Magnet.**—You can wind from either end. The polarity depends on how you connect the battery.—GEORGE TOLMAN.

[47316.]—**Electro-Magnet.**—If you wind the wire in the direction of the hands of a watch facing you, that is a right-handed helix; if connected to the positive pole of battery, that end will be south. The negative connection to either end makes it north.—SIGMA.

[47317.]—**Lewis's Incandescent Gas-burner.**—I cannot give the particulars sought for; but if the querist wishes I can put him in communication with the parties concerned in the matter who could give him the information.—J. T. SPRAGUE.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last "Jack of All Trades" has replied to 46424, 46748; "Ditton," 46933.

46701.	Moment of Inertia, p. 183.
46705.	Cart Axle Grease, 183.
46706.	Bleaching Palm Oil, 183.
46722.	Clockmaker's Lathe, 183.
46723.	Marbling Chimneypiece, 183.
46736.	Deliquescence of Salts, 183.
46744.	Marble, 184.
46748.	Sharpening Carpenter's Saws, 184.
46749.	Hay, 184.
46750.	Tricycles, 184.
46751.	Windmill, 184.
46759.	G.W. Goods Engine, 184.

46996.	Italian and Spanish Locomotives, p. 271.
46998.	Organ, 271.
47005.	Bank of England, 272.
47017.	Tricycle Making, 272
47028.	Slow Motion for Lathes, 272.
47031.	Blocking Brass Musical Instruments, 272

Durability of Tubes.—In a recent paper read before the Institution of Civil Engineers of Ireland, by Mr. Martin Atock, the following is given as to the cost, durability, and efficiency of iron tubes, as compared with brass tubes of the same dimensions, viz., 10ft. long by 1¾in. outside diameter:—The iron tubes being 13 w.g. thick, and the brass tubes 10 and 12 w.g. thick, one iron tube would weigh about 18lb., and one brass tube about 22lb. Assuming 200 tubes to one set, then one set of iron tubes = 3,600lb., at 4d. per lb., £60; interest on £60 at 5 per cent. for 10 years, £30; credit for old tubes, *nil*; total cost of a set of iron tubes, £90. One set of brass tubes = 4,400lb., at 8½d. per lb., £156; interest on £156 at 5 per cent. for 10 years, £78; total, £234; less Cr. for old tubes = 2,200lb. at 4½d. per lb., say, £44; total cost of a set of brass tubes, £190. Both iron and brass tubes are credited with a life of ten years, which is about correct for a running of 20,000 train-miles, average, per annum, and where there are no unfavourable circumstances to affect either metal. Iron tubes are equal in durability and efficiency with brass in cases where the water was not injurious to the iron, and where it was comparatively free from lime. Surface water from bog land seems to suit iron tubes best.

Magnetic Bricks.—Some old bricks having been observed to affect the compass-needle by Herr Kepner, at Salzburg, in the Tyrol, he then had two bricks made from each of eight varieties of clay in the neighbourhood, one brick in each case being baked. The unbaked bricks did not affect the needle, but seven of the eight baked bricks proved polarly magnetic. Some further experiments have been made by Herren Kell and Triontl. Particles of powder of the magnetic bricks adhered to a steel magnet. Breunerite, mica-slate, argillaceous iron-garnet, chlorite, and hornblende were, before heating, unmagnetic, but intense heating produced a magnetic polarity, the axis of which seemed to be perpendicular to the plane of stratification.

QUERIES.

[47318.]—**Ink-Stains on Carpet.**—I should be glad if any of our readers could give me a reliable recipe for a preparation to remove ink-stains from a light-coloured Axminster carpet, if possible without taking it up, without damaging the colour?—NUDA VERITAS.

[47319.]—**Ordnance Datum.**—Would an obliging geologist tell me the meaning of "Ordnance datum," and what is the level of the water in water-bearing strata with regard to the sea-level? Does the water-level pass below Ordnance datum?—CRYFAX.

[47320.]—**Portable Target.**—Can some reader inform me what thickness of steel plate will repel a bullet from a rifle at 100 and 200 yards, and what weight per sq. ft.?—as I want to make a portable target, light and strong for rough usage.—YRNEH NAMSIAH.

[47321.]—**Electro-Deposition of Carbon.**—I have been experimenting in a small way, and have obtained a brilliant black deposit on zinc which adheres firmly; on copper it was not so satisfactory, but I am not quite certain in my own mind if it is pure carbon. Will some one kindly tell me how to proceed to arrive at a certainty? My apparatus are few and not adapted to quantitative analysis. The black deposit will not dissolve in any of the acids.—ZELIA NAIEN.

[47322.]—**Injured Thigh.**—To DR. EDMUNDS.—Some years ago playing cricket I got a severe blow of the ball in the thigh or groin, and after a little it swelled up and came to a suppuration, but healed up, and I have had not any trouble from it since, until a few weeks ago, when I felt it sore to the touch, and it became swollen again, and appeared as if it were going to suppurate again. I do not feel it sore unless anything hits it or it is pressed. I think at first the discharge was not fully drawn away, as it did not recede down quite level with tht skin after being healed up. My health has been always good, and is so at the present, and I am, and have always been, an abstainer from drink and tobacco, and have always minded health and cleanliness.—S. J.

[47323.]—**Steam Launch.**—Will some kind reader be good enough to give a specification, and, if possible, diagrams for the construction of a steam launch 22 and 24ft. long over all, stating strength of ribs, depth of keel, h.p. of engine, size of boiler, and giving a design for stern-post, together with all necessary particulars?—AJAX.

[47324.]—**Sketching-stool.**—Would any kind friend explain how the legs of the above are bolted or otherwise joined? The stool has three legs, and folds up as a round stick; it has webbing for the seat.—S. TAVENER.

[47325.]—**Street Medical Coil.**—To MR. LANCASTER.—Seeing that your hand is all right again, would you kindly give me full instructions how to make a street medical coil, as you promised me that you would about six months ago?—F. ROWE.

[47326.]—**Traction-Engine.**—I have a traction-engine laid in at my mill, and when it is at work with the reversing-lever full over, there is a loud blow heard at each end of the stroke, which entirely ceases when the lever is pulled up to within two notches of the centre, in which position it is usually worked. Would someone please tell me the cause and the cure?—DUSTY.

[47327.]—**Colouring Steel without Heat.**—I shall feel obliged if any reader will tell me how to make the blue, also the straw-coloured, composition which tool makers apply to new steel goods, such as chisels, choppers, &c. I have a quantity of slightly-rusted spectacles that I do not want to have to rub down and repolish: so shall be glad to have a hint anent the foregoing.—ALFOJOE.

[47328.]—**Siemens Armature.**—Thanking Mr. Tolman for his reply to the above, will he please say if No. 16 wire will not do instead of No. 14 for winding on armature, for I have 550 yards of this already? How many layers would it be advisable to wind on the above to obtain the best results if the armature was constructed as follows?—The shaft to be hollow (hole 5-16) and connected to inside of core by several holes; core to be wound in twelve sections with a division between each, and in these divisions several 1-16 holes are drilled—this to allow the air to circulate and keep the core cool. Should the commutator be constructed on Siemens' present principle or his old one?—ENGINEER.

[47329.]—**Boat-Building.**—I am a working man, age 40, married, without children. I have lately suffered a good deal in health, especially in my head, and I have a great fancy that living on the sea for a time would do me good. To this end I have been thinking that I could build a sailing-boat myself, in which, with my wife, I could take short trips round the coast from port to port, and perhaps run over to France or to Norway, and some other ports not far off, living and sleeping on board always, as it seems possible to live a few months very cheaply in this manner. I thought of building my boat about 25ft. long, 8ft. wide, 4ft. deep, of best yellow deal. I have an engine 4 h.p. Could I put this in to work a screw with advantage, or had I better depend on sails alone? Should I find any difficulty in building a suitable boat or in managing it after it was built? I am fairly handy with wood-working tools, but have no special knowledge of boat-building. I shall be very grateful to anyone who will give me practical advice in any of the above matters; more particularly as to size of boat, how to build it, the practicability of having both steam and sails, cost, and as to the difficulties of navigation? I may say I could not spend more than £20 altogether in fitting out the boat.—A WOULD-BE JACK SALT.

[47330.]—**Leaking Vats.**—I have a square wooden vat holding about a thousand gallons of liquid that corrodes metals. Could any reader inform me how to stop the joints from leaking? I have had them caulked, but that does not prevent it, for when the vat is empty I have to fill it with water to swell up the joints before I can use it again.—MANCHESTER.

[47331.]—**Brakes on the Midland Railway.**—With respect to the subject of continuous brakes, which is being so ably discussed by Mr. Stretton in your columns, I should like to ask him if it is true that the Midland Railway Company are about to remove the Westinghouse brake from their Scotch expresses and to substitute the automatic vacuum? I have noticed lately that the "M.S.J.S." carriages and Pullman cars have been fitted with the vacuum brake. I thought at first that the stock was fitted with connecting pipes only; but on inquiry I learnt that they were fitted with the brake itself. The Westinghouse has not yet been removed. A driver told me that the Westinghouse had been removed from engine 816 (one of the large express engines), and the vacuum substituted; also, that the Midland Company had sent fittings to the Scotch Companies which run in connection with them.—METEOR.

[47332.]—**Engine and Boiler for Small Boat.**—Will some reader give me dimensions (with sketch, if possible) of engine, boiler and screw for flat-bottomed boat 14ft. by 3ft. beam by 1ft. 6in. depth?—E.

[47333.]—**Drowsiness.**—I shall be greatly indebted to Dr. Edmunds for his advice on following: About four hours after rising every morning I feel a peculiar tightness and heaviness in the head, accompanied by a drowsy stupid feeling and loss of memory; the brain apparently becomes exhausted and ceases to act, so that it is impossible to work out a simple sum in arithmetic. Symptoms (aggravated by aperients) commenced seven years ago upon recovery from typhoid fever, when I was largely dosed with quinine to recruit strength. Having a large family dependent on my health, consequences are becoming serious. Age 35, spare, but apart from above, healthy, though not muscular; appetite good; total abstainer, non-smoker; occupation sedentary; hours 84 per week. Any assistance will be gratefully appreciated by a—POOR SCRIBE.

[47334.]—**Stiffness in Foot and Leg.**—To DR. EDMUNDS.—I have a pain in my right foot below the ankle when I do much walking, and upon rising next morning can hardly put my foot to the ground from stiffness, until such time as I walk it off. I find by rest and letting cold water run upon it, and using Elliman's embrocation, that it gets much better; also, if I sit cross-legged sometimes I feel pain as if pressing a leader. Can you tell me what it is or what I can do with it? It has troubled me now for the past six months.—G. F. F.

[47335.]—**Packing.**—Will any able correspondent inform me whether valve spindles and piston-rods, &c., that are packed with soap packing should need any oil or tallow to lubricate them? I have always understood that soap packing is a self-lubricant.—R. T. B.

[47336.]—**L.B. and S.C.R. Locos.**—Shall be glad of leading dimensions of Plumpton, 345, Beaconsfield, 211, 303?—H. S. P.

[47337.]—**G.E.R. Locos.**—Shall be glad of dimensions of Nos. 602, 305, and 580. Also, are the old eight-wheel tanks numbered 140—159 broken up, as I see new tanks built by Hawthorn numbered the same?—H. S. P.

[47338.]—**Leclanche Battery.**—I have had a battery of four Leclanché cells given to me. They have not been in use for about three years, so that I think they want a good clean out: the zinc rods are nearly all eaten away, and the porous cells are made of a kind of canvas. Will any correspondent tell me how to put them in working order, and whether I should change the canvas cells for the ordinary earthenware ones? Also, please say whether the four cells would work more than one electric bell?—J. W. B.

[47339.]—**Lameness.**—To DR. EDMUNDS.—Will you kindly give me your advice?—Two months ago I fell and hurt my knee. I was walking along the street when I trod upon a piece of orange-peel. I fell backwards with my foot under me, and my knee was bent right back; it seemed as though there was something tearing just down the left side of the knee-cap. I got up, but could not walk, it was so painful. I was taken home, and was bedfast five weeks. I have been walking about three weeks, but it does not get much better, although I can stand with all my weight on that leg without any pain; but when I commence to walk and bend my knee it pains me very much, and makes me walk as though I had a stiff leg. I may add it is a little swelled above the knee-cap, and my knee is slightly bent; age 24, and by trade a—MILLWRIGHT.

[47340.] — **Silvering Mirrors.** — Would Mr. Brashear, or any other friend, kindly inform me what proportion of water can be added to the 4oz. of solution—viz., 50oz. nitrate of silver to 2oz. water, 50oz. potassa to 2oz. water, or what per cent. of water can be added so as to procure a good film? If a standard per cent. of water could be given for this, it would easily be known what proportion of the solution would be required for a bath containing 50, 60, or 100oz.?—PRISM.

[47341.]—**Electric Locomotive Engine.**—I wish to make a small electric loco. engine about 1ft. long, and would feel obliged to any of "ours" who would kindly give such information in our valuable paper as would enable me to construct the above, having a good lathe and tools at command. I wish to make it on some modified dynamo-machine principle. A diagram would greatly assist.—GALVANI.

[47342.]—**Dialyte Telescope.**—Not so very many weeks ago Mr. Ingall was kind enough to send to the "E. M." a letter on astronomical subjects, and spoke of his observations having been made with a dialyte. Would Mr. Ingall oblige the readers of your journal by giving a description of this instrument, especially the foci and positions, &c., of the intermediate lenses for correcting the chromatic and spherical aberrations? And would Mr. Ingall also kindly inform us something about its performance on the planets—Saturn, Venus, and Mars? It is upon record that some of the very large and costly telescopes were excellent rather for showing minute stars and dividing close doubles, than defining planetary detail.—ARTHUR HINDE.

[47343.—**Rheumatism or What?**—Will Dr. Edmunds oblige by giving his opinion on the following? About six or seven months ago, when walking a considerable distance, I took a pain in the thigh, which next day extended down the outside of the back part of the leg, principally at the part above the knee, the calf, and the muscle behind the ankle on the outside of the leg. It continued more or less for a few weeks, after which I began wearing two pairs of drawers, when it got almost quite well. About three months ago it came on again when walking, and yielded to the same treatment. About 10 days ago it again returned during a walk of about twelve miles. This time it began about the sole of the foot and extended upwards, and still gives me a good deal of trouble. In some positions it is quite easy, and in others very painful. About seven years ago I had a pain in the other leg something like, but not altogether the same. My doctor said muscular rheumatism, and laid me up a month, when it was cured, and did not return for three years; when another doctor said sciatica, and laid me up a week, when it was better, and has not since returned. I cannot lay myself up or give up walking a good deal unless absolutely necessary. If you can help me I shall be very grateful.—HIGHLANDER.

[47344.]—**Small Dynamo-Machines.**—To MR. TOLMAN.—There are several questions I should like to ask about your small dynamo described last week which, I am sure, would interest many other readers of the "E. M." besides myself: 1. How are the wires from the armature joined to the commutator? 2. Does the current from one brush traverse the coils of the field-magnets and then run to one binding-screw on the top of the machine, and does the current from the other brush run directly to the other binding-screw? 3. Would there not be more power if there was a second armature at the top of the machine to supply the field-magnets alone? 4. What would be about the cost? 5. How much wire do you put on the field-magnets and armature? 6. How many Bunsens is it equivalent to, or what amount of light would it give in an arc or Swan incandescent lights?—SEAWEED.

[47345.]—**Indelible Stain for Stone.**—I want an indelible stain for stone so that the rain will not wash it off, either opaque with a body or transparent. How do dyers and clothprinters make the colours fast? Could not some mordant be used by which brick or stonework could be coloured in the same way and be washed down if necessary without coming off?—J. HARTSHORN, Kennington.

[47346.]—**Boomerang.**—Can anybody explain to me the scientific laws which govern the flight of the boomerang—the weapon of the Australian natives?—BUSHRANGER.

[47347.] — **The Moon's Declination.** — By Whitaker's Almanack for 1882, I find the declination of the moon varies greatly from day to day (from 21° 13′ 4″ N. on July 12th to 21° 5′ 27″ S. on the 27th); that the total variation is less in winter than in summer, and that the daily variation progressively increases or diminishes. I suppose it to be owing in great part to the inclination of the ecliptic to the equinoctial line, but should be glad if "F.R.A.S." will kindly explain, and what effect the inclination of the moon's orbit to the ecliptic has in the above. I find no mention of it in any book I have, nor in the letters of "F.R.A.S." on the Moon in Vol. X., with which I have been greatly interested.—J. C. L.

[47348.]—**Bending Copper Tubes.**—What is the practice of coppersmiths in making bends of 6in. radius in copper tube of $\frac{3}{8}$in. external diam.? I tried various ways, but failed to avoid dents on the inside of the bend.—SALOP.

[47349.]—**Dry-Plate Queries.**—(*a*) Pyro development.—What are the processes in the manufacture of dry-plates that determine why, in development, some require more pyro.—some more ammonia—than others? Does the "rapidity" of a plate regulate the proportions of ingredients in the developer—e.g., does a very rapid plate, as such, need more or less pyro. or ammonia or both than a slow one? (*b*) Oxalate development.—What is the effect of an excess of either ferrous sulphate or of neutral potassium oxalate? Assuming the proper proportion of these to each other to be employed, what is the effect of using it in strong or weak dilution—e.g., does a weak solution of ferrous oxalate give a weaker negative, or is it merely a slower developer than a strong solution?—W. H. S. W.

[47350.]—**The Baths of Wildbad.**—Dr. Pigott has benefited Wildbad by his authoritative approval of its baths, but humanity generally (i.e., those most deserving, to wit, the readers of the "E. M.") would be better served if by the doctor's agency the waters could be obtained in bottles or casks, thereby saving the expense and loss of time which a visit to the baths would entail. It would be interesting to know the analysis of the water, temperature, &c., and whether the waters could be used advantageously with apparatus at home, whether they would keep fresh, and how long; what the water would cost per hogshead, &c.? I don't think we should allow our reason to be baffled as long as there is a prospect of knowing the "reasons why, &c."—D. H.

[47351.]—**Mathematical.**—The writer will be extremely obliged if any of your mathematical correspondents will give a complete proof of the following:—

In the expansion of $(1 + x + x^2 + \ldots\ldots\ldots + x^r)^n$.

Where n is a positive integer, show that (1) The coefficients of the terms equidistant from the beginning and the end are equal. (2) The coefficient of the middle term, or of the two middle terms, according as $n\,r$ is even or odd, is greater than any other coefficient. (3) The coefficients continually increase from the first up to the greatest.—Todhunter's "Algebra," ed. 1877, chapter 37.—A. B.

[47352.]—**Ink.—Sealing Wax.**—Could any correspondent oblige with a receipt for a good quick-drying black endorsement ink that will not injure rubber stamps? Also, how to make green sealing-wax? Will an earthenware pipkin do to melt the ingredients in, and how formed into sticks? There is a receipt in a former number for wax, but it does not say what to melt in or how to form into sticks.—COLLODIAN.

[47353.]—**Gelatine Plates.**—Would any reader give me information as to the cause and cure of green fog in home-made plates? It was stated in a back number that insufficient washing was the cause; but I do not find any amount of washing get rid of it. Treating with bichromate of potash and hydrochloric acid before washing will take it away; but I don't like the remedy—it causes other faults. I make my emulsions by stewing at a low temperature for a long time with ammonia and by boiling, and by all three processes get this green fog, the shadows otherwise quite clear. I can dissolve it out of the plate after development, but that is not what I want. I wish to remedy the fault in the emulsion, and which, I am told, is a trade secret.—X. X. X.

[47354.]—**Green Stains for Deal and Other White Woods.**—I have tried without success to stain deal with a solution of one part verdigris and four of water. When sandpapered the stain comes off as fine green powder, and the wood remains but very slightly coloured. I want to obtain a good green that will eat into the wood. Will some practical contributor to ours solve the difficulty?—A. T. F.

[47355.] — **Excessive Perspiration.** — If Dr. Edmunds, or any reader of the "E. M.," can propose a safe remedy for the above, he will confer a boon on a patient whose infirmity the skill of several medical practitioners has signally failed to cope with. Atropia has been administered internally and injected subcutaneously. Sponging with dilute vinegar has been practised for upwards of six months without sensible effect. Tonics have been taken ad nauseam. Indeed, a month of entire cessation from all kinds of exertion mental and physical) and abandonment during that period to medical treatment has resulted in no appreciable benefit. The patient is about 45 years of age, engaged in sedentary office-work, is of strictly temperate habits, married, enjoys good general health, is singularly free from all such ailments as headache, indigestion, bile, flatulency, or any of the complaints most commonly heard of, but has a very rapid pulse, which he is informed arises from no organic disease or defect. He has suffered, but heedlessly, from an immoderate flow of perspiration on the slightest extra exertion or increase of temperature from whatever cause for upwards of 25 years, and has, during that time, often bedewed the surface of snow more than 6in. deep with sweat stained by the dye from his hat, from the brim of which it dropped as from an eaves-gutter after a rapid walk of half a mile. Having hitherto endured no observable inconvenience beyond the temporary discomfort of such a condition, he treated the matter lightly until informed lately that in advancing years nature would lose a certain capability it formerly possessed of withstanding the deleterious effects of what is pronounced now to be highly enfeebling and to absolutely require a check. This query is lengthy, but the facts stated will, perhaps, apologise for its length, and particularly if the additional remark is permitted that the case has been pronounced by several medical men to be, in their respective experiences, unique. If any reader has been subject to a similar ailment, and erived benefit from any source, a helpful hint from such would be gratefully received by the querist, who, singular to add, never perspires while asleep—i.e., is not subject to what is commonly termed "night sweats."—SUDOR.

[47356.]—**Cold Air.**—Can anyone give details of the arrangement whereby storekeepers or shopkeepers in Melbourne have a continued supply of cold air in any part of their premises? I have been told it is by pressure of water, of which, it seems, there is a good supply.—E. FITCH.

[47357.]—**Malleable Castings.**—Will anyone tell me how malleable iron castings are made?—MALLEABLE.

[47358.]—**Shocking Coil.**—Will any reader say what should be the sizes and weight of wire on an induction coil to give shocks, the core and bobbin being each 6in. in length?—ELECTRICIAN.

[47359.]—**Broadwell's Breachloading System**—Can anyone describe the Broadwell breachloading system as used by Krupp?—STEEL.

[47360.]—**Battery for Electric Clock.**—Will someone be good enough to tell me, from personal experience, the best battery for driving an electric clock? The power I require is that of two gravity Daniells, the plates of which are 2½in. in diam. and 4in. apart, the circuit being closed for about $\frac{1}{3}$ of a second every alternate second. I have tried several batteries, but cannot find any superior to the gravity Daniell. I find that by tying the zincs up in parchment paper, which practically forms a porous cell, the consumption of zinc is greatly lessened, whilst the action of the battery is not injuriously affected. I am now trying the effect of tying the zincs up in calico.—H. B. T. S.

[47361.]—**Watch Construction.**—Will anyone kindly inform me what to do with the hair-spring of a watch when it loses time? Ought the spring to be let out more or drawn tighter, and how is this accomplished?—G. FRYER.

[47362.]—**Watch Dials.**—How are dials fixed to watches, and how are old dials removed to replace with new ones? I wish to know how to put a new white dial to a watch which, at present, has a cream-coloured dial, which I dislike the look of.—G. FRYER.

[47363.]—**Watch Cylinder.**—Will "A Fellow-Workman" kindly say how bottom pivot is put in cylinder of Geneva watch, the plut having come out? and oblige.—HALL.

[47364.]—**Silver Filagree Brooches.**—How are they cleaned so as to give them that nice white appearance as when new?—HOPEFUL.

[47365.]—**Gold Coins.—Rings.**—To "ALFOJOE."—I want to hard-solder gold ear-wires to American gold coins, also to mend some broken rings? Will you kindly inform me what quality solder to use, and how to clean the articles after? Will nine-carat rings want recolouring after being soldered?—How is it done?—HOPEFUL.

[47366.]—**Stammering.**—I wish to ask Dr. Edmunds if he considers stammering and stuttering curable, and if so, by what means. Some advice on the above painful complaint would be very acceptable, not only to myself, but to a great number of your readers.—A STAMMERER.

[47367.]—**Heating Apparatus for Greenhouse:**—Would a coil made from a 1in. pipe of 12ft. long, heat about 20ft. of 2in. pipes? Also, would the above coil and pipes be sufficient to heat a house 16ft. by 8ft. for cucumber growing? If not, should be glad of any practical information on the above.—R. H.

[47368.]—**Incandescent Lamps.**—A week or two ago a querist (47084) asked if he might use Leclanché cells instead of Bunsens to light an incandescent lamp, said to be lighted with two Bunsens. Now will this querist, or any other person, say if two Bunsens will really light the lamp, and if the lamp has a carbon filament? The Lane-Fox lamp is said to take 15 Bunsens, and to me two Bunsens seem very little. I was not aware any lamps were sold under 5s.—W. L.

[47369.]—**Preserving Mosses.**—Will any fellow-reader kindly inform me how I can preserve common field moss in order to keep its natural colour? I want it for use in mounting birds, &c.—E. Jowett.

[47370.]—**Dynamo-Machine.**—Will anyone possessing the requisite knowledge give his opinion of the following?—Gramme armature 5in. when wound with No. 16 wire, length of magnets 14in. between the A frames with cast-iron poles, magnets wound with 14 wire, speed 2,000 revols. per minute. How much wire will be required for magnets, and what candle-power may be expected?—W. L.

[47371.]—**Photographic.**—Could any correspondent explain what the "oyster shells" and opaque white spots on wet plates really consist of?—why do they remain white under iron developer? They cannot be dried nitrate silver, as many operators call them, or they would blacken in time. Is any effectual remedy for removing them known? I have some iodide of lithium which by keeping has become deliquescent, and liberated iodine, being now dark red colour. Could any correspondent advise a remedy to restore it so as to be serviceable in photography?—Shah Yehan.

[47372.]—**Lens.**—I have a double convex lens 1½in. focus which I want to convert into a 5in. focus by the addition of an unequal concave lens. The curve or focus of one side of the lens I want to fit the double convex lens. What curve or focus must the other side of the concave lens be to bring it to 5in. focus?—Focus.

[47373.]—**Old Cracked Varnish on Globes.**—Can anyone advise me how to remove this with the least injury to the paper? Under-scraping with a knife is apt to remove letters and figures.—J. C. L.

[47374.]—**Ulcerated Varicose Veins.**—Will some of our able friends give advice?—How I shall keep clear of the ulceration, and how to act if it shows signs of ulcerating? I have been clear of it for four years, but have suffered much pain and inconvenience for six months, twelve months, and five years at a stretch. The wound is at bottom of inner right ankle. I always stand on that leg, and am on my legs from 5.30 a.m. to 10 p.m.; a quick walker, and age more than 72, with a great deal of young blood left yet.—G. B.

[47375.]—**Lightning Conductors.**—To Mr. Lancaster.—Our factory-chimney is about 60ft. high, and in some alterations done at the bottom they have altered the lightning conductor, and now, instead of it going straight down, they have taken the conducting wire round the corner of the basement, and the wire presses on the stonework of the basement, and also on the corner of the brickwork. Will you please tell me if there is any danger?—William Clark, Beeston.

A Remarkable Gas Well.—The well finished in April last by the Niagara Oil Company, in Washington county, Pa., is one of the greatest gassers of modern drilling days. The sands found were not regular, nor as expected, neither did they appear to be oil-bearing. After a six months' struggle with the drill, a depth of 2,200 feet was reached, when a vein of gas was struck which threw the tools clear out of the hole, and more than fifty feet above the top of the derrick. The strength of the gas can be imagined when it is known that the tools weigh about 800 pounds. All work was then out of the question, as the gas made such a roaring noise that the drillers had to go away from the well fully 300 yards before being able to make themselves understood. The company have expended already more than 20,000 dols., and have nothing to show for their money but leases of 60,000 acres of land and the great gas-blower. The well is eight miles north of Washington, Pa., in Mt. Pleasant Township. It is just twenty-two miles from Pittsburg, and may be utilised by the latter city in case the supply does not become exhausted soon.—*Petroleum Age.*

The Hardening of Rubber Goods.—In the opinion of Herr W. Hempel the hardening of vulcanised indiarubber, which takes place with piping and other goods after a short period of use, is caused by the gradual evaporation of the solvent liquids contained in the indiarubber, and introduced during the process of vulcanisation. Herr Hempel has made experiments for a number of years in order to find a method of preserving the indiarubber. He now finds that keeping in an atmosphere saturated with the vapours of the solvents answers the purpose. Indiarubber stoppers, tubing, &c., which still possess their elasticity, are to be kept in vessels containing a dish filled with common petroleum. Keeping in wooden boxes is objectionable, while keeping in air-tight glass vessels alone is sufficient to preserve indiarubber for a long time. Exposure to light should be avoided as much as possible. Old hard indiarubber may be softened again by letting the vapour of carbon bisulphide act upon it. As soon as it has become soft it must be removed from the carbon bisulphide atmosphere and kept in the above way. Hard stoppers are easily made fit for use again in this manner, but the elastic properties of tubing cannot well be restored.

ANSWERS TO CORRESPONDENTS.

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⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, July 5, and unacknowledged elsewhere:—

Foster and Williams.—Hickson and Co.—T. Fletcher.—Boyd Moss.—G. Pottier.—Rev. A. Willan.—R. E. Harrild.—J. B. Stephen.—Pat. Steam Boiler Co.—Rev. J. H. Cole.—Phosphor Bronze Co.—W. Granger.—W. Hayward.—Rev. W. H. Wright.—J. Mabson.—W. H. Nelis.—J. Stott and Co.—C. A. Day.—H. Merrifield.—H. Milnes.—R. Bailey.—F. Weatherhogg.—J. T. H.—H. Stooke.—Holmes Bros.—A Fellow of the Royal Astronomical Society.—Metal.—Bone.—Fellow Workman.—Sax.—G. R. T.—Antares.—M. B.—Mechanic.—Electra.—A Young Engineer.—H. J. Nolan.—Ll.B.A.—H. S.—C. Woodhead.

Dog Star. (It is the correction to be applied to the observation of any given observer—in other words, the fraction of time to be added to or subtracted from the time as given by an individual.)—A Fuming Microscopist. (We cannot undertake to say that it does; but we are certain it cannot improve vision.)—D. H. (The "Albo-carbon" is not a purifier, but an enricher of gas. See p. 17, No. 781, for an illustration of the arrangement. We know nothing of the other affair.)—Sportsman. (The easiest process is to heat the barrels until they are pleasantly warm, and then coat them with a paste of chloride of antimony and olive-oil. A little nitric acid hastens the effect.)—F. H. H. (Without knowing the construction of the lamp referred to, how can any one answer? 2. The dynamo would be cheaper and more durable. Secondary batteries are not required when the current is supplied by ordinary batteries. 3. First hand, of course. 4. Diffraction halo, due either to something in your eyes or to vapour in the atmosphere. Looking across a furnace chimney, or a flue from which steam is escaping would produce the effect.)—Plumber. (No, for the piston of the pump creates a partial vacuum, and the water consequently boils or gives off vapour at a lower temperature than when exposed to atmospheric pressure. Where boiling hot water has to be pumped, the working bucket is placed below the level of the water, so that the latter follows it by gravity.)—F. Feist. (The drill is a "spark" of diamond, mounted in a tube rolled up of thin tin. See p. 125, No. 343.)—S. Norman. (What do you mean by "chemical food"? See p. 70, No. 861. If you want the advertised preparation you must procure the patent specification.)—Air. (Certainly; several motors are at work. We do not know of any book specially devoted to the subject, but there are several papers on the subject in back numbers.)—Post. (The principal advantage is that plates can be carried about anywhere and developed at leisure.)—Fait. (If you mean the common process, that is done by pouring mercury over tinfoil and sliding the clean glass on, weighting down for some hours; but if you wish to silver glass you will find many recipes in back volumes. See the last index for instance.)—Halesowen. (Not if it is only kept for private use; but if used in trade probably you are compelled to put the name on.)—One that has been had. (You have no remedy, the month having expired.)—Audio. (If the wife is the sole legatee, the will is quite safe.)—Holiday Seeker. (By North-Western and South-Eastern to Dover or Folkestone, and thence by boat. You will find plenty of English boarding-houses.)—Hopeful. (Yes, can be had through any bookseller, or post free direct for 10d.)—Prismatique. (We have no choice; perhaps it would be as well to finish as we have begun.)—W. M. Gardner. (You seem altogether to misunderstand our correspondent, and really the few successful forecasts you mention can hardly be accepted as establishing the truth of your system.)—An Ex-M.R. Co. Fireman. (Dr. Edmunds would not advise in such a case, we are sure, without seeing the patient. He would probably do so at the Temperance Hospital if you sent your wife there. You should, at any rate, have some medical advice for her.)—Llynvi. (The duty is very heavy on such articles in America, but, on the other hand, you would have to pay more to buy on that side the water.)—A Subscriber, Brook's Bar. (What do you mean? If the Science and Art Department examination, procure the syllabus from the Secretary at South Kensington.)—Kent. (No, the coil is useless for the purpose, and at least six such cells would be necessary.)—Electrician. (Inserted.)—W. Coates. (1. No such cement is known. 2. Is there any starch in it? 3. Asbestos is a non-conductor, the other is a conductor. 4. If you really wish to know, apply to him for the address of the makers.)—An Amateur Polisher. (For full instructions in French polishing, see Nos. 814, 816.)—E. Clyde. (Given many times. See the indices—the last, for instance.)—Cabinet Maker. (We do not insert such inquiries as queries; but if you look in last week's "Sale Column" you will find what you want. The address must be advertised for if wanted; but we can tell you that it is in London. You can hardly expect the correspondent to advertise it.)—Argentometer. (Quite possible, but certainly not cheaper, and rather more troublesome from changes of temperature. See the discussion on sterling silver mirrors in Vol. XXX., and recent back numbers.)—T. T. T. (The composition referred to is made in the proportion of 4lb. glue to 1lb. treacle. Sometimes beeswax is added, ¼lb. to the quantity named, but to render the mould proof against the water in the solution it is immersed in a solution of bichromate of potash and dried in the light, or tannic acid is added to the compound.)—Mancunium. (Will not that described on p. 353 suit you?)—J. Caithness. (The quantity depends on the bore of the tube. All you have to do is to put the quicksilver in, removing the weight. You must adjust by some standard instrument, or a good aneroid.)—Student. (Isinglass dissolved in acetic acid and used warm is the cement recommended in the Physical Laboratory instructions at South Kensington. Cover the joints afterwards with glued paper. Weinhold, in his "Experimental Physics," recommends cutting the prism out of a glass lamp chimney, and closing the ends with flat plates.)—J. W. R. (All windows, doors, &c., should be closed, and the neighbourhood of fireplaces, especially on ground floors, should be avoided. A cellar is usually a safe place.)—H. Field. (The remedy almost universally adopted by the profession is an active purgative, followed by salt water injections.)—Kelt. (It depends upon you, not the book. The volumes issued in Collins and Sons Advanced Series will suit.)—Perplexed. (How can Mr. Wallis, or any one else, tell you what he thinks of your voice without hearing it? If you put the average at two octaves for men and two and a half for women, that will be approximately correct for the most distinguished vocalists.)—An Amateur Electrician. (There is no really satisfactory way of mending broken carbons; but if you take care that the edges join very closely you can keep them together by running a band of sealing-wax over the crack, making it about a quarter of an inch wide, but taking care that none gets in between the edges. Dust, to take the term literally, would be too fine, it would pack too close. Borings and broken turnings are suitable.)—Electron. (Please refer to indices. Several of both have been described.)—H. B. (Yes, certainly. The regulator is always full open whilst running, and the cut-off is regulated by the link. The point of cut-off depends on the load, the gradient, and to a certain extent on the driver. 2. It depends on which kind of catalogue you want. The list in Webb's "Celestial Objects" is quite enough for most amateurs.)—Cleaner, Salisbury. (Forney's "Catechism for the Locomotive" is an American book, which can probably be had of Trübner. Messrs. Lockwood and Co., Stationers' Hall-court, E.C., publish several works on Locomotives and Locomotive Driving; but without knowing exactly what you wish, we cannot pick out the book which would suit you best.)—H. Ashworth. (Probably you mean a notice of Hunter's "Mechanical Dentistry," a work which can be had of Messrs. Lockwood.)—Delta Sigma. (No such substance is known.)—B. B. (How would you propose to work it with another battery? You seem to have a very vague notion of the office of a contact breaker in a coil.)—Omega. (See p. 203, No. 867; p. 33, 808, and the indices generally. If you cannot do that, procure Watts's "Electro-Metallurgy," Lockwood and Co., Stationers' Hall-court, E.C.)—Retailer. (Your questions have been recently answered. See p. 237, No. 868, and the index of the last volume. For the cement, try isinglass dissolved in acetic acid, or shellac cement coloured to suit.)—Erin-go-Bragh. (It was illustrated on p. 14, No. 781. For numbers of specifications you must apply to a patent agent, or search the files of the *Journal* of the Commissioners of Patents, which you will be able to see in Dublin. The specifications, when number and date are given, can be obtained from the office for the sale of specifications, Cursitor-street, Chancery-lane, E.C.)—X. (Sutton's secondary battery was described on p. 414, No. 876.)—Engineer. (See answer to "Sportsman" above.)

Velocity of the Wind.—The mean daily motion of the air at Greenwich Observatory in 1881 was 291 miles, being 12 miles greater than the average. In January and September the mean daily motion was 70 miles and 72 miles below the average respectively: in April, August, and November it was 70 miles, 60 miles, and 71 miles above the average respectively. The greatest daily motion was 999 miles on October 14, the day of the great storm, and the least 59 miles on May 25. A velocity of 61 miles an hour was recorded on October 14, and one of 58 miles an hour on April 29, these being both greater than any recorded in previous years. The greatest pressure was 53lb. on the square foot on October 14; pressures of 46, 47, 47, and 48lb. were also registered during the same gale. On April 29 a pressure of 49½lb. was recorded at a time when the hourly velocity was 50 miles; the pressures corresponding to the maximum velocity of 58 miles an hour were not registered, the cord of the pressure pencil having slipped off the pulley.

The *Moniteur de la Flotte* describes a proposal for placing passing ships in communication with existing submarine cables. The projector would float buoys with the necessary connecting wires and apparatus at intervals of a day's journey along the line of the cable, each numbered and properly lighted at night, and he considers that the plan presents but few difficulties, and would obviate much anxiety and many dangers.

The Channel Tunnel works at Dover are being continued, it is stated, with very satisfactory results. The total length of the heading is now stated to be considerably above 2,000 yards.

CHESS.

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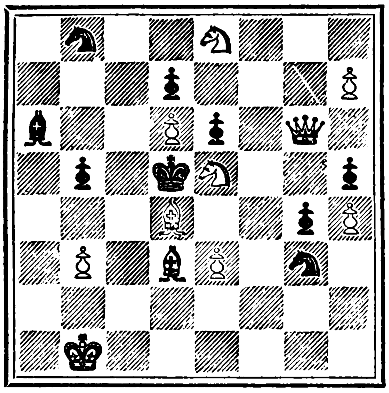
ALL Communications for this department must be addressed to the Chess Editor, at the office of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden. W.C.

PROBLEM DCCLXI.—By W. J. MCARTHUR.

Black.



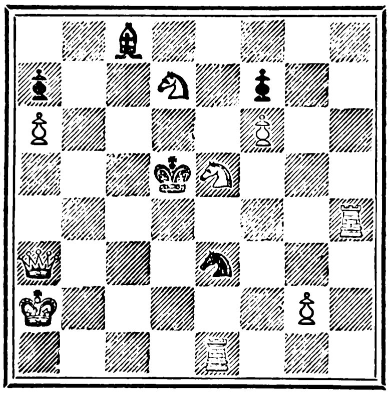
White.

White to play and mate in three moves.

PROBLEM DCCLXII.—By "ENDYMION."

From the *Brighton Guardian.*

Black.



White.

White to play and mate in two moves.

SOLUTION TO 757.

White.	*Black.*
1. R to K 5	1. K takes R (a)
2. B to B 7 (ch)	2. Kt takes B mate
	(a) 1. K to Q 2
2. Kt to K 4	2. R takes B mate

SOLUTION TO 758.

White	*Black.*
1. Q to Q 4	1. Anything
2. Mates	

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 757 and 758 by Schmucke and Sehguh to 755, 756, 757, and 758 by Celsus.

SEHGUH.—We always acknowledge correct solutions.

J. W. STAINFORTH.—Your problem is too easy. It can also be done thus—

$$1. \frac{\text{Q to Q 7}}{\text{B to K 2}}.\ 2.\ \text{Q takes B, \&c.}$$

$$1. \frac{\quad}{\text{B to K Kt 2}}.\ 2.\ \text{B to K 5, \&c.}$$

PROBLEMS received with thanks from J. W. Abbott and J. P. Taylor.

A CHESS GARDEN PARTY.—Mr. Gastineau's annual gatherings are always attractive; but the one on June 27th was even more than usually so: the weather being splendid and a large number of well-known chess-players being present. Amongst them we noticed Rev. G. A. Macdonald and Messrs. Adamson, Coster, Laws, Marks, Webber, McLeod, and Lovelock. Games, consultation and otherwise, were the order of the evening, and the greatest satisfaction was evinced by all present—even the losers.

Holloway's Pills thoroughly purify the blood, completely cleanse the lungs, re-invigorate debilitated or vitiated nervous action, strengthen the muscles, and clear the brain. These excellent Pills are particularly recommended to all persons whose occupations are sedentary, or conducted in close rooms, and to the nervous, dyspeptic, and the low-spirited.

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OUR EXCHANGE COLUMN.

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The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

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Oil and Limelight **Dissolving View Apparatus** for Screw-cutting Lathe, Twist Drills.—D. W. N., Ernest Cottage, Peyton-place, Royal Hill, Greenwich.

A one-horse **Water Motor** in exchange for a good Perambulator (rubber tires), or offers.—WM. O'BRIEN, 113, Haddington-road, Dublin.

Sociable **Tricycle**, for two or three persons, cost £24 nearly new condition. Exchange good Photographic or Dissolving View Apparatus, or offers.—WRIGHT, Photographer, Northampton.

Powerful **Intensity Coil**; for good Field Glass, model engine or offers.—SPENCER, 26, Dysart-road, Grantham.

Half-horse and one-horse **Engine Castings**, cylinders bored, &c.; or two-horse ditto. Offers.—JAMES SUTCLIFFE, Engineer, Princess-street, Granby-row, Manchester.

Medical Coil, Galvanic Battery, Engines, and Lathe, Castings, Field Glass, Screw Press, for Warping Flecks, ENGLISH MECHANIC, *Engineer*, &c. Offers.—JAMES SUTCLIFFE, Princess-street, Granby-row, Manchester.

Wanted in exchange, portable **Gas Bottles** in iron, and boilers.—JAMES SUTCLIFFE, Princess street, Granby-row, Manchester. Works, Levenshulme.

Have a number **Amateur Views**, very good, size about 19in. by 6in. Will send sample, 6d. stamps. What offers?—Address, PHOTO., 182, Trongate.

Will exchange my **Violin**, good tone, for Electric Lighting Apparatus, or what offer?—E. CLYDE, 6, Hale-street, Arlington-square, Islington, London.

Small Treadle **Lathe**, with tools, all iron, and watchmaker's throw. What offers?—11, Queen-street, Belgrave Gate, Leicester.

14 Vols. "**English Mechanic**," 3 bound. What offers?—A. H. VESEY, Knockholt, Sevenoaks.

I have a first-class **Wringing and Mangling** MACHINE, new, cost 50s.—What offers in exchange for it?—JAMES HARROP, Slip End, Luton.

1½ **H.-P. Table Engine**, feed pump, governors, &c. 7ft. vertical tubular boiler, water and steam gauges, nearly new, worth £30.—Exchange to value £25.—Apply, J. ELLIOT, Engineer, Kent-street, Portsea.

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"**English Mechanic**," Vols. **XXI.** to **XXXI.**, bound, XXXII. to XXXIV unbound. All in first-rate condition. Offers wanted for whole or part.—H. CLARK, Inland Revenue, Cleckheaton, Normanton.

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50in. **Bicycle Wheel**, good tyre, cranks, pedals, bearings. Exchange anything. Tools wanted.—Particulars, W. W., 82, Bayham-street, Camden Town, London.

Type, several founts, press and accessories, for amateur use. Offers requested. Optical work preferred.—L., 16, Addington-street, Ramsgate.

Astro. Eyepieces wanted for cash, or new books, or other exchange.—Address as above.

"Flat" or Plane **Mirror**, about 1½in., warranted perfect. Wanted for exchange.—Address as above.

Wanted, 6in. gap screw-cutting **Lathe**, for new Domestic Machines. Say what you want.—MONKHOUSE, Gandy-street, Exeter.

Horizontal **Engine and Boiler**, all fittings complete, 4 horse-power boiler, 9ft by 2ft. 7in. Exchange for larger. D. SCREEN, Wolverhampton.

Bicycle, 50in. Roadster, Singer's Special Challenge, suspension saddle, patent cycle bearings, front spoon brake (also trailing brake), good lamp, tool-bag, &c. Cost £13 two years ago. Exchange for Microscope, or good standard scientific books.—C. R., Junr., 9, Woodville terrace, Bradford, Yorks.

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Medical Coil and Battery, and two Electric Bells new. Will exchange for good Watch.—J. ASH, 75, Temple-street, Wolverhampton.

Prize Drawing.—First prize: new Printing Outfit, value £30. Second prize: Two Electric Lamps and Battery. Winners' names in E. M., 29 July. Tickets one shilling; 12 for ten shillings; 26 for £1. Will exchange for anything useful.—M. BARNARD, Henfield.

THE SIXPENNY SALE COLUMN.

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Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

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Lantern Photographs, 10,000, with readings, from 6d. plain, 1s. coloured.—A. PUMPHREY, Emily-street, Birmingham.

Gelatine Films for photographs, reduce cost and labour of photography to minimum.—A. PUMPHREY, Birmingham.

The **Filmograph** carries 100 films or 12 plates! Lightest Photo. Apparatus. Illustrated tests.—PUMPHREY, Birmingham.

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"**The Night-light Clock.**" Illustrated and described on page 370, No. 848. Price, carriage free, 5s. 6d.—F. ROBERTSON, 13, Greek street, Soho, W.

Stocks and Dies, now in extensive use. List one stamp.—F. M. ROGERS, 21, Finsbury-pavement.

Electric Lighting.—Inventors wishing to perfect, patent, or sell inventions connected with electric lighting should communicate with F. M. ROGERS, 21, Finsbury-pavement, E.C.

Micro. Photos.—List of 350 one penny stamp.—E. and A. DANCER, 436, Stockport-road, Manchester.

Lathes, Lathes, cheap good screw-cutting, from £10. Easy payments. Hire system. First-class tools.—MAKIN, Cupola, Sheffield.

Electric Machines, Indicators, Bells, Batteries, Wires, Switches, Terminals, Carbons, &c.—KING and Co., Electricians, Bristol. (List Twopence.)

Beautiful **Cloth Dress**, in all colours, price 8s., or 8d. yard. Patterns, one stamp.—FIRTH, Kirkgate, Wakefield.

Amateur Mechanics.—A complete set of Castings, Tubes and Lenses, for making large Compound Microscope, 12s. 6d., and instructions. Amateurs supplied with materials for Optical Instruments.—MASON, 38, Park-road, Clapham, S.W.

Saw, for cutting all metals, very useful, post free 15 stamps.—POOLE, 303, Fulham-road, London.

Stammering speedily and effectually Cured, personally or by correspondence. Testimonials from all classes.—VOX. M., Ward's Library, Grosvenor-road, Highbury, London.

American Organ Tubeboards, with Munroe voiced reeds. Reduced prices.—RAY, 86, Poplar Walk-road, S.E.

Oval Frames.—CAPELL, Oval Turner, 79, Milton-street, Dorset-square, N.W., London.

Bench Drilling Machine, very strong, invaluable to amateurs. Securely packed for 30s.—BLEACHING and GOOT, Marcham-le fen, Boston.

Photographs (Scottish scenery), extraordinary value, 7in. by 4in. size 4d. each.—FINLAY, 135, Renfrew-street, Glasgow.

Electro-Motor Engine, working model, post free 6s.—J. SUTCLIFFE, 63, Cedar-street, Hulme, Manchester,

Photograph, new and old Eddystone Lighthouses, 7 by 5, post free fourpence.—PUMPHREY, Publisher, Birmingham.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, JULY 14, 1882.

SLIDE-REST TOOLS AND CUTTER-BARS.

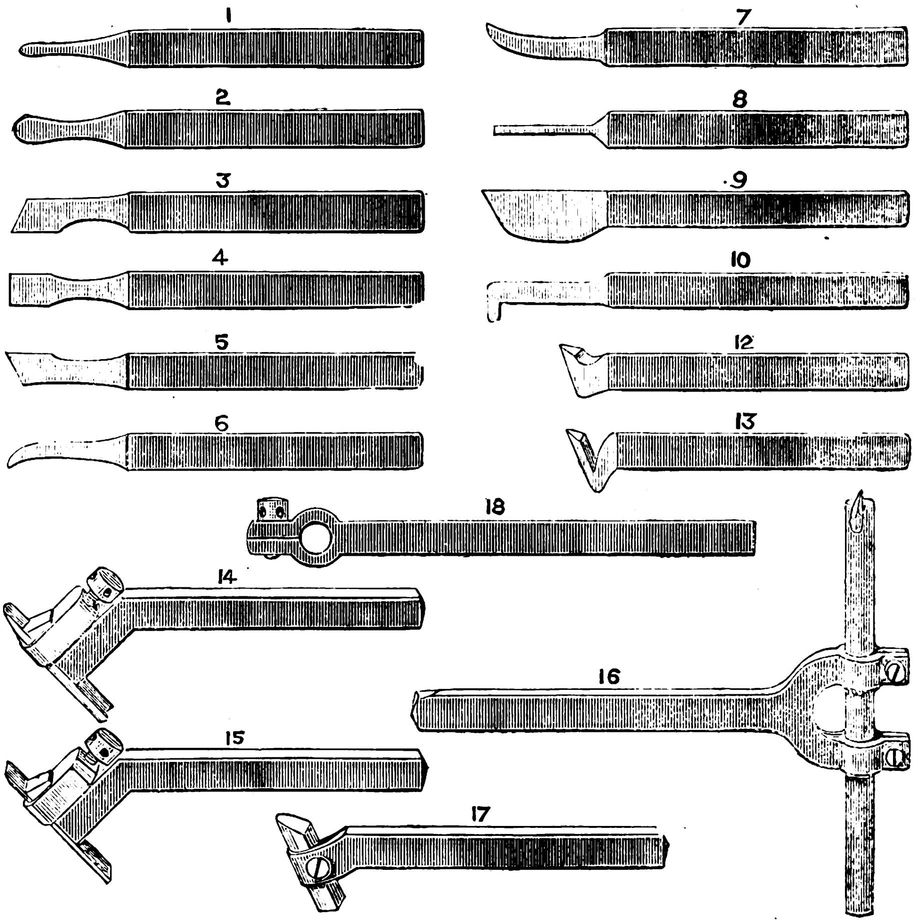
By J. H. Evans.

THERE having been, from time to time, many different tools of this kind illustrated in these columns, I still think that it will be of great interest to our amateur turners to have before them those of the present day. The cutter-bars have, so to speak, exterminated a great many of the old-fashioned slide-rest tools; but, for all that, the latter must not be despised, and they will at times be found more convenient for many purposes than their successors, therefore I have deemed it necessary to illustrate a few of those that are found most useful for general amateur purposes. In making such tools as figures 1, 2, 3, 4, &c., &c., it will be necessary to have them forged from the very best cast steel, and I consider Marshall's steel the finest for the purpose. There are two distinct ways of making them: that is, they may be constructed to suit both the metal-turning and the ornamental slide-rest. If for both, that part extending from the end of the square to the cutting edge must be shouldered down, and then filed, so that the cutting edge is in a line with the centre of the square, which should be 9-16in., to fit the tool-box of ornamental slide-rest; but if to be used with the metal-turning rest only, it is better to file the top surface flat all along; the tools can then be left more substantial. The round-nose tools, Figs. 1 and 2, are used for roughing-out work, brass or gun-metal; but if used for iron or steel, such a tool should be made similar to Fig. 12, which, it will be seen, has considerably more cutting angle—viz., about 80°, that for brass being about 70°. I say about, because, as I have previously stated in other articles, I am of opinion that practically the precise angle within a few degrees does not matter as long as the tool cuts. The diagrams, No. 3, 4, and 5, represent the right and left-side tool and the front tool, which would be used for hard-wood turning more than anything else, the front of each of the side tools being ground to an angle which will admit of them being used to turn out square corners; for instance, the lid or bottom of a box forms a very good example of the work they are adapted for, especially as the bottom can be taken quite square and sharp in the corner without in any way touching or destroying the sides or cylinder part. The next tool, Figs. 8 and 9, gives two views of the parting tool, used, as may be taken from its name, for dividing or cutting off the work done, from the chuck upon which it has been turned; this, it need hardly be said, is one of the most necessary adjuncts to the slide-rest. It will be seen that this tool is narrow on the cutting-edge, being well relieved from the front to back, in order that it will not wedge; but with all this precaution it should be withdrawn occasionally to clear it of the dust that will accumulate during its progress through the wood. Fig. 9 shows how it is strengthened by the blade being made considerably deeper; it is always as well to have two or three such tools, in case of one breaking; at the same time, there is no reason why it should break, if carefully used.

We now come to Fig. 10 which is practically a boring-tool, although it may be used for any internal woodwork or metal, and the cut may be taken in either direction, as the rough edge will suggest. Figs. 6 and 7 show a pair of right and left side tools for brass or metal, for turning out such work as cup chucks, &c., will be found very useful; the same forms, in point of fact, are used for iron as brass in most instances, the difference being that those for iron and steel may be made of less width and angle, the latter being from 65° to 85°, and that for brass from 70° to 95°. These, of course, are varied according to the work done. The materials used differ for roughing or smoothing, and finishing the work. Fig. 12 is a kind of heel tool, and when using steam power, will be found an excellent tool to take off a good shaving. Fig. 13 is descriptive of a spring tool; this, also, is a most useful tool for heavy work, and may be used also in a planing machine to great advantage. The cut may be modified in this tool by taking off some of the spring; this is done by placing a wooden wedge in that part which is cranked down. So far, then, I have detailed a few of the necessary fixed tools generally supplied with such a slide-rest, as figured in p. 295, June 9th., some of which are absolutely necessary.

I will now proceed to describe a few of the various cutter bars now in use. Fig. 14 is what is commonly known as the gouge cutter-bar, it being obvious that such a tool, under the guidance of the slide-rest, must turn the work with greater facility than the ordinary gouge held by hand; such a tool being subject to considerably greater strain than when used by hand, it need not be made so wide, but must be stronger to admit of the increased strain upon it. The stems of these instruments, it will be seen from the diagrams, are rectangular to the holding power of the tool-box or holder. They are made of the best fagotted iron; it is made to hold separate blades, and the latter are held firmly in place by a steel strap and screw, which latter draws the blade tightly to the bar against the bent part, which should be at such an angle that the tool when fixed into it is in such a position that a good clean shaving will be the result of its operation. The blades being short, are capable of being adjusted exactly to the necessary height of the centre. Fig. 15 shows another cutter-bar of this description; but to hold a chisel-blade, which for smoothing a large surface or cylinder is a first-rate tool, more especially for turning wood that is cut plank-ways; but for this it should have a round-end blade, in place of a square-cornered one.

Fig. 16 is a cutter-bar, quite new, and one that I have lately introduced. It will be found a most useful addition to any amateur work-shop, as it saves a deal of trouble in shifting the slide-rest; it will be seen that the bar is made after the same fashion as the others in the stem, and forked at the end, and through the centre of that part a steel rod runs in a transverse direction, the bar is split at the end of each fitting, and a steel screw passing through in front of the bar, when these latter are set up the bar is held firm at any position it may be required in. The steel bar revolving in its fitting it facilitates the setting of the cutter to the centre of the work; but if the tool is correctly made, it should be always at the proper centre when central to the square stem; it is not a difficult or expensive tool to make, and I am able to record a good sale of them, which is the best evidence of their value; therefore, I consider it a most successful idea, and as such things generally do, the same emanated from a very ingenious amateur. When using this tool for turning out a deep box, it will be seen that the bar holding the cutter is in the same position as if an ordinary tool had been placed in the rest, and the latter turned round to the surface; but in the latter case only the depth of the stop-screw can be turned out, and this is not sufficient for many purposes; but with this



improved bar the whole length of the main-screw could be used, if found necessary; but that is not at all probable; but I simply draw attention to the fact to illustrate more fully the advantages of the tool in question, when devoted to the purpose for which it is intended. Fig. 18 is a side view of this instrument, showing how the ends are split to allow the screw to tighten the bar in its place. It is cut through with a frame saw, the screws being tightened. The transverse bar is held quite firmly, and will admit of a heavy cut being taken without its moving. This I may mention has been found a very useful tool for factory purposes, and by those who have tried it for amateur work it is pronounced quite a success. There has been so much said at different times upon the subject of tools and cutter-bars, that it is not worth while for me to expatiate further upon them; but for the benefit of the readers of the English Mechanic who have not probably read all the different works upon the same, I thought a brief outline of those here illustrated would be found useful, and enable those not in possession of them to make for themselves, if desirable so to do. As I have been requested by several readers to continue the illustrations of specimens of work done, I propose to do so in my next article.

THE BEST GAS FOR THE GAS-ENGINE.

At the recent meeting of the Gas Institute, an interesting paper was presented by Mr. Charles Hunt, M.I.C.E., containing the results of a number of experiments with different qualities of gas employed in driving an Otto 12-horse engine. The calorific value of different qualities of illuminating gas is a question that has been much discussed, but it is generally accepted that the higher the illuminating power the greater is the heating value, though not in proportion. Dr. Wallace's estimate gives, taking 14·75-candle gas as unity, a heating value of 1·295 to 26·24 candle gas, while its value for lighting is 1·769. Thirty-three candle gas has, however, a lighting value of 2·230, while its heating value is only 1·496; that is, while its illuminating power, as compared with common 14 or 15-candle gas, is more than double, its heating power is not quite one-half more. To put the matter in another way—increases in illuminating power of 77 and 120 per cent. correspond respectively to increments in heating value of only 30 and 50 per cent. In view of those figures, it might be supposed that the commoner gas is quite good enough to use in a gas-engine, and that gas having a high illuminating power would be out of place. It appears, however, that the value of illuminating gas for motive power increases in a greater ratio than its value for heating, though still falling short of the value for lighting. The action of the gas-engine depends upon the heat of combustion, and the effect produced by any gas or mixture of gases, when tested by a dynamometer applied to the engine, should give an almost accurate measure of their calorific values; but the main object of the experiments made by Mr. Hunt was to determine the relative values of different qualities of illuminating gas, when used in the gas-engine. Before commencing the trials, the engine was thoroughly cleaned, and the bearings adjusted and lubricated. The diagrams were taken with a Richards indicator, six diagrams being taken for each quality of gas, and as they were repeated three times, the summary gives the average of 18 indications. The engine was weighted with its maximum load, which involved an explosion practically every second revolution, and the actual horse-power was obtained by applying a strap-brake to one fly-wheel, so that the actual loss by friction of the engine itself was also ascertained. The gas used in each case was the absolute product of the coal or cannel, distilled and purified in the usual way, without any admixture of air, and the burners used for photometrical purposes were a No. 1 "London" Argand for gases up to 18 candles, and for higher qualities a steatite batswing. The precautions to insure accurate results were apparently all that could be desired, and there seems no reason to suspect the returns on that head. The gas was, in all cases, supplied at a uniform pressure, and it was noted that the speed of the engine depended entirely upon the extent of opening of the gas-valve; for instance, if the valve was adjusted for 17-candle gas, the engine would not start with 29 candle. It was also noticed that once in about 35 or 40 revolutions, the regular explosion was missed, the following explosion being, however, of greater intensity. The general tendency observed throughout the trials, says Mr. Hunt, was towards a deeper diagram with the richer gases, apparently indicating a slower combustion, and slightly greater force exerted throughout the stroke. The quantity of gas expended per horse-power varies, it is found, considerably with its quality, and consequently it becomes a question of relative price of different qualities of gas, before the real economy of the gas-engine can be arrived at. Users of these valuable motors, must, therefore, look to the price and quality of the gas supplied in their towns, for while the small-sized gas-engine is cheaper than its equivalent steam-engine in places where illuminating gas can be had at 4s. per 1,000 cubic feet, it is vastly more economical where gas of say 25-candle power can be had at that price. Taking the whole series of Mr. Hunt's trials, the loss between indicated and actual power shows that about 25 per cent. is absorbed in the friction of the moving parts, an amount which compares favourably with steam-engines, and the summary shows that a 12 horse-engine indicating 19 horse-power may be relied upon to give quite 14½ horse-power actual by the brake. The most interesting figures in the elaborate and reliable tables given by Mr. Hunt are, however, those which show the quantity of gas of different qualities consumed per horse-power per hour, and these we set out in a tabular form, preferring the actual horse-power to the indicated as probably more trustworthy:—

Candle power.	Gas. cub. ft.	Actual H.-P.
11·96	40·08	14·49
15·00	32·55	14·50
17·20	30·64	14·36
22·85	23·56	14·60
26·00	21·55	15·03
29·14	20·34	14·35

It will be seen that about half the quantity of rich gas suffices to yield a horse-power as compared with the common 12-candle gas; and that result holds good with gas prepared in the manner suggested by Dr. Siemens; in fact, the lower the illuminating power of the gas, the greater the quantity necessary to yield a horse-power. Mr. Hunt, for obvious reasons, does not give the relative price per 1,000ft. of the rich and common gas, for that varies with the locality; but a simple calculation will enable any owner of a gas-engine to ascertain which quality will be most economical, and a little extra calculation will enable anyone to discover what advantage is to be gained by enriching common coal-gas with one of the light and cheap hydro-carbons. These calculations obviously depend on the prices in any given locality; but the facts brought forward by Mr. Hunt are interesting and valuable, and will give a stimulus to the introduction of the gas-engine, especially where gas of high illuminating power can be had at a low rate. For instance, to take two qualities which compare readily with the table: 30-candle gas at Galashiels costs 3s. 4d. per thousand, while at Bristol 17-candle gas costs 2s. 10d. According to Mr. Hunt's results, the difference between 17 and 30-candle gas is as 30 to 20 in quantity used, while the difference in price in the towns cited is as 40 to 34; showing that users of gas-engines in Galashiels can have motive power at a cheaper rate than users of similar engines in Bristol.

THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURAL, AND LODGMENT.*

By John Watson Warman,

Associate of the College of Organists, London.

SEE at this stage what was said under Head of Man-to-Ped. Coupler (at *r*, *Bis*, ante and on), concerning an objection to the foregoing method of Regulation in respect of its tending to throw the contact of such Coupler to a point which is *inside* the regular Pallett Action point on the same Key.

i. It is to be noted also that such type of Regulators will be difficult if not impossible to carry out in conjunction with a Swell-to-Pedale Coupler of the *Part* kind (see again *q q q q*, next), even with the aid of the Wire Cranked Sticker (see again at *z*, ante), and of such Crankings' being extended above the Noses which carry the Screw-Wires; because the space between the two Great-Org. Stickers *cannot* even then be rendered wide enough to accommodate the two Regulating Buttons, without risk of a fouling.

j. It is now to be pointed out that the Regulating appliance just described, though quite practicable and effective so far as its own function is concerned (unless, as just intimated, there be two Action-Noses on one Key-tail), will inevitably sacrifice the *Participation* of the Key with which it is connected (see at *n*, ante). To regain this, therefore, something more is required. The method devised by the present writer, and which method will probably be found in practice as satisfactory as any available, consists in the addition to the aforesaid Screwing Button of that which will be termed in the present Treatise a *Button-Clip*. This Clip consists of a strip of thin sheet-metal of suitable kind (common "Tin" will usually do quite well), about 1¼in. long, and rather narrower than the *plan*-width of the [Manual] Key-tail: this Strip is so cranked at its middle as to assume, on *elevation*, a *Bayonet-like* form,—the amount of the cranking being exactly equal to the vertical thickness of the Regulating Button: at one end, it (the Strip) receives a small Screw-hole, and at the other end a short Notching just wide enough to admit the stem or screwing portion of the Regulating Wire. Note:—If the Clip do have to operate between two Stickers (see last preceding parag. but two), its rear or notched end must of course be diminished in width accordingly (see here at *m*, next, 2nd parag.; and at *p*, next, 9th parag.); say that such width should then be about ¼ of inch, or, if possible—as when the Stickers are of the Wire-Cranked form—, a little more. Such narrowing, however, should be for only such portion of the Clip as actually enters between such Stickers, the remaining portion being left untouched. And if there be a Coupler-Regulating Wire passing (see at end of present parag.) through such Clip, the length-total of the latter should be so increased as that the Hole for such Wire shall be made in the un-narrowed portion of the Clip. In all cases the aforesaid decrease in the width of the Clip should be accompanied by a slight increase in its thickness. The Clip as so, or however, formed is now placed upon its Key-tail in such a way that the rear or notched end of such Clip lies on and gently presses the top of the Button—the Wire itself having passed into the said notch—, and, the exact posit, for the fore end of the Clip having been found, a suitable Screw is passed through the Hole in the latter, and turned

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"home" so as to press only lightly upon it. It will now be evident that (1) the Action-Nose will not be able to rise without lifting the Key-tail with it, that (2) the Button will be left perfectly free to be turned round in Regulation, and (3) that any lateral warping of the Key cannot cause any "binding,"—because the Screw through the Clip will act as a pivot to allow the latter to partially rotate, and so accompany and accommodate itself to such lateral derangement. It will be obvious that the Taking *out* of any Key which is thus "Clipped" will be just as easy as though such Clip were absent, for the Clip-Notch will quite freely leave the Screw Stem; but the *replacing* of such Key will not be quite so quickly done, because the Notch will then have to *find* the said Stem. If this Button-Clip be applied to any Key which is driven by a Coupler the contact of which is made beneath the Tail of such Key—and consequently beneath such Clip—, the *Regulating Screw* of such Coupler (see 88, *u*) had generally better be made to pass —free—through a suitable Hole made in the higher part of the Clip,—so that the said Screw may be brought, on plan, as close as possible to the said Screw-Wire in the Action-Nose (see *m*, ante).

jj. At this point see again what is said in Treatment No. 3 (at *m*, next, 2nd parag., Diff. 8), and in that of No. 4 (at *p*, next, 9th parag., and on), with reference to the more exact posit of the Swell-Org. Key Square Nose, and the relation which such posit has to the question of the Regulation at and by such Nose. It is to be here observed that an additional argument is furnished against such a Regulation by the fact that either the *Clip* just described must partly enter between the Great-Org. Stickers, or the latter must be absent (as in Treatment 5½, see *uuu*, next, 5th parag.), or the said Square or other Action Nose must be elongated frontward beyond such Sticker, or the Participation of the Key must be given up.

k. Finally, as regards the Action, it is to be noted that in all cases where a Backfall, a Lever, or a Square has to possess, in addition to its regular Nose Contact point, a *second* similar Contact point—such as that of the Swell-to-Ped. Sticker just described—, it is essential that such Backfall, Lever, or Square be made of sufficient Radial length to prevent such second Contact point from coming *too near* to the fulcrum center of such Square, &c. This matter, together with that of any Square, &c., extra *elongation* which may be rendered necessary by the providing of Front-Regulation in co-existence with a rear-extended lowermost Key (see *rr*, *Bis*, ante and on), and also the proper *form* which the Square, &c., shall assume for affording such second Contact, or for giving the correct crossing of line of centres with a Regulating-Nose (see here again at *h*, ante, 3rd parag.), will of course be fully gone into in *Departments* COUPLING-ACTION and KEY-ACTION. If it be found impracticable to secure the aforesaid sufficient Radial length *without* giving up the said Front Regulation, then the latter may be considered to at once become inadmissible, unless there be really no other method of Regulation practicable.

kk. It remains here only to observe that in all cases where—as in the preceding—the Noses carried on the Swell-Org. Key-tails extend far enough forward for their Regulating Buttons to be in line with the line of the Great-Org. Key Sticker wires, the said Tails of the Swell Keys will *not* extend back beyond the Tails of the said Great Keys. (See here No. 4 *Treatment*.) Bear always in mind that such extension of the Nose of a Key Square, or any other circumstance that affects the Radial size of the latter, or any arrangement that affects its position (as, for instance, whether such Nose shall be set on the Key-tail, or contained in a Forking of the latter), will determine or modify the exact level occupied by any [horizontal] *Tracker* actuated by such Key Square.

l. As a *Summary* of this No. 2 *Treatment*, we may confidently say that it is the best which is practicable for the particular Lay-out for which it is intended (see at *d*, ante, 1st parag.), unless one of the still better Treatments which include a *Clear Coupler* (see *r*, next and on) be substituted—, on this last point remembering also that the presence of any Stickers rising from the Key-tails is unfavourable to the having of a a *Detached Buffet* (see *r*, next, 14th parag.). The Merits and De-merits of the present Treatment therefore rise or fall along with those of such Lay-out itself. Concerning this latter, the reader has already been referred to the *Pro-Department* ENTIRE ORGAN for a fuller Description and Criticism of the Faringdon Instrument; it will, however, be well to add here a few remarks on those points with which the structure of the Keys is involved:—

(1) The Projection of the Manuals enables the Player to better judge of the effect he is producing, and also to hear more of the Voices he is accompanying. (2) The Key-Action of the Great-Organ becomes very simple,—the Fanned Backfalls rendering more than a few *Rollers* unnecessary. (3) By the Great-Org. Backfalls' being kept above the Key portion of the Swell-Org. Action, not only is (as already said) the Crossing of these Actions avoided, but no part of the Key-Action of either Manual descends below the level of the Great-Org. Key; and thus there exists more space to devote to the Bellows, or to any other portions of the work which it may be desirable to locate just beneath such Key-level. (4) The Skewing of the Swell-Org. Keys does not involve any more workmanship in the Key-Action generally: see on this point what has already been said as to the Setting-out of the *Roller-Boards* (at *c*, ante, 2nd parag.), in the analysis of the present Lay-out.

But there are the disadvantages that:—(1) In consequences of aiming at Fanned Backfalls to the Great Section in conjunction with Projecting Manuals, there here arises necessity for having the Palletts of such Great Section placed at the front of the Instrument: this is bad, because it interferes with access to such Palletts—partly by reason of the presence of Conveyances to the Show Pipes—, and because it throws the Pull-Wires of such Palletts and the rear ends of the Man.-to-Man. Coupling Backfalls more out of reach — so rendering Front Regulation more imperative—, and also because it takes such Palletts away from under the Reed Register (see *Department* WINDCHEST). (2) The mainly Semitonal Pipe-Order necessary to secure the Fanning of the Backfalls brings Pipes of rather larger size to the middle of the Organ, and so partly obstructs the Swell-Section Tone (see *Pro-Department* ENTIRE ORGAN) whenever the Box Shutters are Open. (3) After that this simple Key-Action *is* obtained, its very directness makes it less pleasant in the using than if it possessed more Centers, because there is, in the virtual absence of both Trackers and Rollers, nothing whatever to cut off the Pallett "Pluck" from the player's fingers (see more fully on this in *Department* KEY-ACTION),—the Palletts in this particular Soundboard being of the common kind. (It has already—at *g*, ante, 1st parag.—been seen that the Position and Fanning of the Great-Organ Backfalls are unfavourable to the application of a *Clear* Coupler.)

It is to be observed, in palliation of the foregoing Defects, that the Projection of the Manuals (of course in itself good) was here made obligatory by the very mistaken position of the Instrument,—saddled, I believe, upon the Organ-Builder by an uninformed parochial coterie; and also that, owing to a still further limitation as regarded height, it was rendered very desirable to avoid the obstruction which would have been presented by a second *Whole* Roller-Board s coming beneath the Soundboards. At this stage compare yet once more the arrangement of the Faringdon with that of the Hoddesdon Specimen,—now next following.

m. *No. 3 Treatment.*—This is an Instance afforded in the Organ, so often quoted, erected by Henry Willis, during 1865, in Hoddesdon Episcopal Church, Hertfordshire. At this point refer to *Department* CASE—at 60, *r*—for some further particulars of this Instrument. To this it is to be here added that the two Manual Sections are of the usual kind—viz., Great, and Swell—; and that the General Lay-out of the Inside is, as regards Involution with the Claviers, the same as that of the Faringdon Instrument except;—(1) That the Manuals, though like those in the latter Organ in respect of their not being Reversed, yet do not Project beyond the Face of the Organ-Case; (2) That the Palletts of the Great-Org., equally with those of the Swell-Org., are set at the points nearest to the Passage-board which separates the Windchests of these two Sections; and (3) That the Great Org. Section, as well as that of the Swell, has here its Order so that its smallest Pipe comes at Middle.

The treatment of the Manuals themselves (see here at *r*, *Bis*, ante)—including their vertical distance between Playing Levels—, and of the Key-Action involved with the Manuals, is also the same as in the Faringdon Instrument, with the exception of the following:—(4) The Backfalls of the Great-Organ are, on Plan, not Fanned, but Parallel and Square,—that is to say, *nearly* Square, they being given a very slight slant in order to bring their rear ends into [Plan] correspondence with the Tails of the Swell-Organ Key. Of course, the [Great-Org.] Roller-board is a "Whole" one. (5) In consequence of such Non-Fanning of the Great-Org. Backfalls the Manual-to-Manual Coupler can be, and is now, driven—instead of by a Block affixed to the Great-Org. Sticker—by a short *Wire Tracker* threaded through the said Great-Org. Backfall, and running down to and through the fore Nose of the Coupling Backfall, —the actual posit of such Wire being close behind the Great-Org. Sticker. This Wire has a Stopping Eye and Collar Button (no Screw thread) at its bottom end, and a Regulating screw Button at its top end. (6) The said Great-Organ Stickers are here shorter than in the Faringdon Design; they now, of course, carry no Driving-Block; they are well broadened out where—and *only* where—they pass between the Swell-Org. Keys; and they now carry *no* Regulating Button. The Notching of the said Swell Keys (see *u*, ante) is of course cut to an extent corresponding with such broadening of the Sticker. (7) The Sticker of the Coupler Swell to Pedale is now—instead of acting directly upon its Key-tail—Wired into the [T] Square Nose which rests upon the latter; and by reason of this the said Swell Key-tails do not now extend beyond those of the Great, but the Tails of both the Manuals finish at one same areal line. (8) Although—in consequence of the preceding *Wiring*—there is no need, so far as the Swell-to-Ped. Coupler is concerned, for the Swell-Org. Key-tails to extend back past the Great-Org. Stickers, yet such extension is partly observed in the present Treatment, these Stickers being placed forward [towards player] sufficiently to leave just a long enough amount of such Swell Key-tails behind them for these latter to carry their (Wood) Action Square Noses without such Noses passing in between the said Stickers. The reason for this is simply that as *Crank-Wired* Stickers (see *p*, next, 8th parag.) are not here admitted, the space between any two of the Wooden ones actually employed is not sufficient to accommodate a Wood Square Nose and yet at the same time to leave enough free space to prevent possibility of rubbing or of consequent cyphering on any casting of such Sticker. The Notchings in these Swell-Org. Keys will thus be formed as in the preceding Treatment (see at *d*, ante, 2nd parag.),—or nearly so. Of course the rearward extension of the Great-Org. Key beyond its regular Sticker will be made use of for the Insertion of the Sticker of the Great-to-Ped. *Coupler*, and thus there will exist no risk of the fore-lifting already spoken of (at *rr*, *Bis*, ante), —this last Sticker being set at the extreme end of its said Key: such use, in fact, constitutes the sole reason why the Great-Org. Key-tail is thus extended. See here at *rrr*, *Bis*, ante.

(*To be continued.*)

WATCH-CLEANING AND REPAIRING.

By "A FELLOW-WORKMAN."

(*Continued from page 371.*)

Depth Tool.

MANY amateurs when they consider to what nicety a depth tool must be made, think that it would be an impossibility to make one; and so it would be to those who don't know how to go to work. But if you work the proper way it is perfectly easy, and, with care, you may be able to make a tool that shall not be wrong, even to a hair's breadth. Fig. 63, therefore, shows the centre and third wheel, so placed between centres that the distance between A and B, C and D, E and F, and G and H are *just* the same. Now the question we want is, how to place these two bars so that they may be moved to and from each other, and so that, let the distance between E and F be what it may, the distance from G to H would be *exactly* the same. Now look at Fig. 66, and there you see the bars are so placed in two separate frames, that when you slide these frames to and fro, the distance from the points I and J is exactly the same as the distance from the two centres at F and F and M and M, also L and L.

FIG. 65.

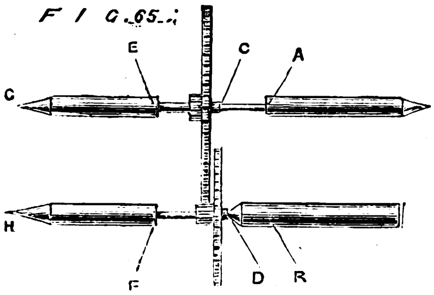
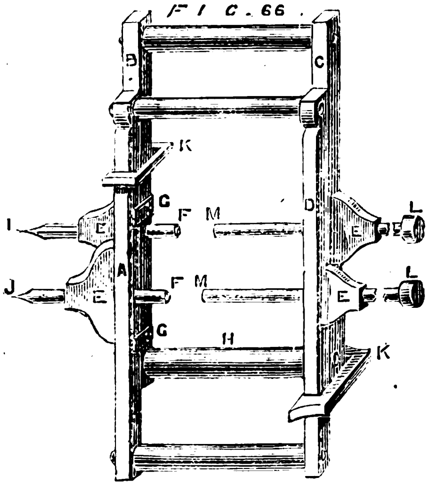


FIG. 66.



Now we must make four sides, Fig. 67: the right edge should be perfectly straight, and at right angles with the *inside* (see Fig. 66). I used the top-side of the arm, or body of my turns, as a straight-edge, which I found perfect. Now take all four sides and solder them together *at the ends*, so that the straight edges all come perfectly true; now with gauge (Fig. 70) mark the dotted line, as shown Fig. 67; now same the other side, and make a centre mark where the lines cross, and be sure and always work from the straight edge. Now place the sides on to the chuck in your turns and drill holes right through. If you have not a chuck, you can drill half-way through, then reverse and drill the other half, and finish with rimer or broach. Now turn up four posts, Fig. 68; they should be slightly chamfered round the pivot, to allow the outer edge to take its bearing, one side being pinned and the other side riveted, same as American clocks. Now put the frames together and rivet two pieces of brass (G, Fig. 66) on each side. These will keep the frames in position while you slide them to and fro. Now solder on to the plates your blocks (E, Fig. 66), which should stand flush with the straight edge. Now, with your gauge (Fig. 70), mark off for holes for bars (L and L); these should be as near the "straight-edge" as is safe, for the hole not to break out. Mark them all alike, working from the straight-edge. Now mark from the end of the plate, where top-end of dotted line terminates, to the middle of the blocks; measure all four alike, and centre-punch where the lines cross.

FIG. 67.

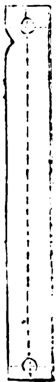


FIG. 68.

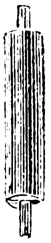


FIG. 69.

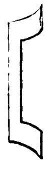
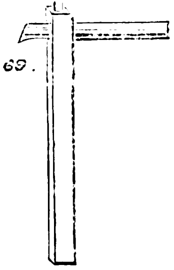


FIG. 70.



Now put one centre mark on the male centre in the middle of your chuck (Fig. 54), and the drill (H, Fig. 54) in the other centre mark; set the frame running, and your drill, if properly made, will find its way direct for the other centre mark. When you have drilled through this back, reverse the frame and drill the other side; next turn up the bars to fit the holes, or you could get a piece of straight steel wire the proper size at Cohen's, Kirkgate, Leeds, for 2d. The bars should fit tight; place in turns with the outside running true; make a point at one end, then cut asunder with the graver while in the turns, and leave two female centres; the same with the other bar. Now make two clamps (Fig. 69), hook on the top-end and then squeeze on the bottom-end, and that will hold frames firm together, while you score off on plates.

(*To be continued.*)

THE ACHROMATIC OBJECT-GLASS.—V.

By W. BRADBURY.

(*Continued from page* 393.)

I HAVE recently received the following table of curves employed by Dollond. It is copied from "Smith's Mechanic," 1825.* The numbers given are diameters; if they be taken as radii, the compound focal length will be double the one specified.

Diameter of the Spheres to which the Lenses are Ground.				Compound Focal Length in Inches.
Convex Crown Lens.		Concave Flint Lens.		
1st Radius.	2nd Radius.	3rd Radius.	4th Radius.	
3·2	5·3	5·3	8·8	5
6·4	10·6	10·6	17·6	10
9·6	15·9	15·9	26·4	15
12·8	21·2	21·2	35·2	20
16·0	26·5	26·5	44·0	25
19·2	31·8	31·8	52·8	30
22·4	37·1	37·1	61·6	35
25·6	42·4	42·4	70·4	40
28·8	47·7	47·7	79·2	45
32·0	53·0	53·0	88·0	50
35·2	58·3	58·3	96·8	55
38·4	63·6	63·6	105·6	60
41·6	68·9	68·9	114·4	65
44·8	74·2	74·2	123·2	70
48·0	79·5	79·5	132·0	75
51·2	84·8	84·8	140·8	80
54·4	90·1	90·1	149·6	85
57·6	95·4	95·4	158·4	90
60·8	100·7	100·7	167·2	95
64·0	106·0	106·0	176·0	100

As no mention is made of the kind of glass employed, the table is incomplete. All the numbers have the same standard, so that they serve only for one pair of glasses. The contact of the inner curves is preserved throughout the series.

Whatever may have been the optical properties of the glass used by Dollond in these combinations, the ratio of curvatures adopted is a very curious one. The same ratio, practically, is used for both flint and crown lenses. The first pair of radii are very nearly as 3 to 5, and the second pair are essentially the same. Such a combination would be very much under-corrected, as the spherical error of the concave is far too little to counterbalance that of the convex. It is possible to make such a pair of lenses aplanatic by "local correction," but it must have been a very long, tedious, and troublesome task. "Our" practical master says: "The old plan was simply to smooth over, and *polish* until a fair result was obtained; figuring, as now understood, had no existence in object-glasses in those days. The aim was to produce *definition*, and *suppose* all surfaces perfectly spherical when that was arrived at."

We can thus form some slight estimate of the labour these old artists had to expend in the production of a fine object-glass. Tulley seems to have found the advantage of using a much flatter curve for the back of the flint lens. No less ratio than 2 to 1, and very often 4 to 1, is found in his combinations.

Huyghens had discovered a rule by which the aberration of a lens might be easily computed when the rays were incident parallel to the axis. But this condition can only apply to the front lens of an achromatic combination; those rays falling on the second lens must have a certain degree of vergency. No rule then existed by which the aberration of a lens under this altered condition could be ascertained. Hence, the only way was to find by trial what kind of lens was most suitable to combine with another, and then to compare the aberrations of each for parallel rays. This result furnished a sort of guide to the selections of those curves which would approximately balance the opposing aberrations.

It is obvious that such a method could only be successfully applied by an optician having ample opportunities for experiment. This Martin had not; and it remained for Tulley to devise a rule which should give results near enough for practice. Before treating of the improvement which the latter effected, let us examine the question in the aspect it presented itself to Martin.

Huyghens' equation for computing the aberration of a lens is (R and r being the front and back radius respectively, and T the thickness of the lens):-

$$\frac{4\cdot5\,R^2 + Rr + 1\,{}^1/_6\,r^2}{(R + r)^2} \times T.$$

For the sake of convenience, and to save repetition, let us represent the value of the fraction by A, then (crown. ab^{rn}) = A. T. We can either keep it in this form, or introduce the focal values, which is the better plan. Now, the thickness of a lens expressed in terms of the semi-aperture, focal length, and refractive power is (Y being the semi-aperture. F the focus, and μ the refractive index): $T = Y^2/2 \,.\, F. (\mu - 1)$. Hence (crown. ab^{rn}) $= A\,Y^2/2 \,.\, F\,(\mu - 1)$. We will employ the same smaller letters to represent the same quantities belonging to the flint lens; then (flint. ab^{rn}) $= ay^2/2 \,.\, f\,(\mu' - 1)$. These are the aberrations of the lenses for parallel rays, and in comparing them, some of the terms disappear. (c. ab^{rn}) : (f. ab^{rn}) : : $A\,Y^2/2 \,.\, F\,(\mu - 1) : ay^2/2f\,(\mu^1 - 1)$.

Since the diameter of each lens is the same, we may omit y in each, and also the divisor 2. Also since $F = f \times \delta$, erase f and write δ instead of F. Then we have :—(c. ab^{rn}) : (f. ab) : : $A / \delta\,(\mu - 1) : a / (\mu' - 1)$. Now, if the aberration of the crown be made equal to that of the flint, obviously $A\,(\mu' - 1) = a\,(\mu - 1)$; or $a = A\,(\mu' - 1) / \delta\,(\mu - 1)$. The quantity A is known, for it is the value of the fractional part of Huyghens' equation. By multiplying it by the quantity indicated, we get the value of a for the flint lens, and thus find the ratio of its surfaces.

But it will be apparent that this reasoning can only be correct when rays of the same nature strike on each lens; and as the first incident rays are parallel, and the second diverging, the value of a is very much altered from that found as above. No direct method of computing it was known, and the only resource was to vary the multiplier of A until it gave such a result as agreed with experiment. Martin does not appear to have met with such a number as would generally be applicable; Tulley succeeded better. Observing that the multiplier of A consists of the product of two quantities, the ratio of the *refractive* powers, and the ratio of *dispersive* powers; he confined his investigations to such changes in the first quantity as at length gave a number near enough for practice.

The refractive index diminished by unity $(\mu - 1)$ is a measure of the refractive power; hence $(\mu' - 1)/(\mu - 1)$ expresses their ratio; but in this instance it is preferable to take the reciprocal of this quantity, viz. $(\mu - 1)/(\mu' - 1)$. Let this value be denoted by η; then instead of a multiplier, we get a divisor, composed of the product of two decimal fractions δ and η, for both these numbers are always less than unity. Hence our equation now stands thus, $a = A/\delta\eta$. The result of Tulley's experiments showed him that instead of the simple factor η, it should be $\eta^2\sqrt{\eta}$; and the value of a thus found gave a suitable ratio for combination curves. Therefore the corrected aberration equation is $a = A/\delta\eta^2\sqrt{\eta}$.

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* For this table I have, through this note, to thank some gentleman unknown to me. The signature "Alpha" appears in his letter. If he should chance to meet with other interesting matter of like nature, I trust we shall hear again from "Alpha," but not from Omega.

Let us state in words what this implies.

First, the refractive and dispersive powers of the glasses must be known; these will give the values δ and η, from which the corrected divisor may be found.

Secondly, assume a pair of curves for one (it is immaterial which) of the lenses, such as will satisfy the required focus: substitute them in the equation of Huyghens and find the value of A. Correct this by the correcting divisor, and thus obtain the value of a. Thirdly, having found a, by an inverse process, determine the radii from the Huyghenian equation, which will satisfy this quantity. These will be the radii of a lens which will approximately correct the spherical error of the other.

If we assume the curves of the crown lens, the quantity $\delta\eta^2\sqrt{\eta}$ is a divisor; but if those of the flint are assumed, it is, of course, a multiplier.

With respect to this method of computing the aberration of a lens for vergent rays, it must be observed that its application is probably very limited. However correct it might be for the kinds of glass used by Tulley, it is by no means certain that it would be equally so for modern glass. In his time the refraction varied from about 1·57 to 1·60 for flint, and 1·5 to 1·53 for crown, and the dispersion from about 0·65 to 0·75; hence the correcting divisor would lie between narrow limits. No matter how nearly correct the ratio of aberrations may be, there still remains this source of error—viz., that the same equation is used for both lenses. Whereas its coefficients, depending for their value on the refractive index, must vary with each glass, and the greater the difference in the indices, the greater will be the error introduced. But as a simple practical rule, for optical data lying near to the numbers above mentioned, Tulley's rule is well worthy to be remembered, for, as I have previously said, the value of an optical rule depends, not so much upon its absolute accuracy, as upon the certainty with which it can be relied on, to give results of one definite character.

The general problem, considered theoretically, of expressing the vergent in terms of the parallel aberration has not, so far as I am aware, yet been solved. It may be possible to find a simple factor composed of the refractive and dispersive values, which shall show the relation between the two quantities. If it can be done calculations for matching two lenses would be much simplified, and tables showing the ratios of curves suitable for combination, might be easily prepared. Tulley's empirical factor embodies δ, and the root of the fifth power of η; it is impossible to say how far these are correct, but I think it highly probable, that if a true factor can be found, it will contain a higher power of δ than the first. Those who are acquainted with Coddington's method of computing spherical error will know that there is much similarity between the aberration equations for parallel and for vergent rays—the second virtually embodying the first. Considered in this way, the theoretical solution of the problem, which Tulley solved practically, does not seem to be impossible.

This optician has left a table containing the optical properties of several of the glasses that he used.

TABLE I. SPECIFIC GRAVITY AND REFRACTIVE INDICES OF SIX KINDS OF GLASS.

Kind of Glass.	Plate No. 1.	Plate No. 2.	Dutch Crown, No. 3.	Ratcliffe Crown No. 4.	Flint, No. 5.	Flint, No. 6.
Specific Gravity	2·428	2·450	2·519	2·527	3·192	3·466
Refractive Index.	1·502	1·504	1·524	1·528	1·5735	1·599

ACHROMATIC COMBINATIONS.

Kind of Combination.	Refractive Indices.	"Ratio of refractive powers = $\frac{d\mu'}{d\mu}$	Ratio of dispersive powers, or value of .
R. Crown, No. 4.	1·528		
Flint, No. 5 ..	1·573	1·524	·7127
R. Crown, No. 4.	1·528		
Flint, No. 6 ..	1·599	1·757	·645
Plate, No. 2 ..	1·504		
Flint, No. 5 ..	1·573	1·623	·70
Plate, No. 1 ..	1·502		
Flint, No. 6 ..	1·599	1·195	
Plate, No. 2 ..	1·504		
Flint, No. 6 ..	1·599	1·65	·721
Plate, No. 1 ..	1·502		
Flint, No. 5 ..	1·573	1·167	

I do not attach much importance to the numbers in any of the plate-glass combinations. They are apparently mistakes or misprints. It will be observed, that with the standard crown glass, the numerical ratio of refractive powers gives a difference of 0·233 as due to the change in the density of the flint glass. Whereas, if either of the plate glasses be taken as a standard, the like difference is only 0·027, or less than one-eighth of the former. Moreover, the value of δ increases with the density of the flint, whereas, to be consistent with the tabulated results for the crown glass, it should decrease.

I will now give an example of Tulley's method of computing the radii of a combination, taking as data the glasses united in the first section of the second table.

From the refractive powers ·528 and ·5735, we find $\eta = \cdot 92$, the root of the fifth power of this, multiplied by δ, gives ·578, which is the correcting number. Suppose the object-glass to have 30in. focal length: then—

F (focus crown) $= 30\ (1 - \delta) = 8{\cdot}64$. f (focus flint). $= F/\delta = 12{\cdot}13$.

Next, assume that the crown radii are in the proportion of 2 to 3, that is $R : r :: 2 : 3$ or $R/r = \frac{2}{3}$, which value we will denote by q.

Then, to find R, we have $R = F\ (\mu - 1)\ (1 + q) = 8{\cdot}64 \times \cdot 528 \times {}^5/_3 = 7{\cdot}6$. $r = 7{\cdot}6/q = 11{\cdot}4$.

To determine the aberration due to these radii, it is not necessary to know their actual value, but their ratio (q) only. For, if we substitute q for R/r in Huyghens' equation, it becomes—

$$\frac{4{\cdot}5\,q^2 + q + 1\,{}^1/_6}{(1 + q)^2} = A.$$

And since the value of q is $\frac{2}{3}$, the value of A is found to be 1·38. This must be divided by the correcting number ·578. and the quotient is 2·387.

This is the value of a, and by putting it in place of A, and solving the equation, the value of q' for the flint lens is found to be 2·06, or practically 2. Hence $R : r^1 :: 2 : 1$. (R is the outer, and r the inner curve of each lens, so that in this case the back curve is longer than the inner one). By the same formula as for the crown lens, $R_1 = f\ (\mu' - 1)\ (1 + q') = 10{\cdot}43$, and r' is $10{\cdot}43 \times q = 20{\cdot}86$.

Therefore, the combination is:—

$$\left.\begin{array}{ll} \text{Crown lens} & R = 7{\cdot}6 \\ \text{bi-convex} & r = 11{\cdot}4 \end{array}\right\} \begin{array}{ll} \text{Flint lens} & r' = 10{\cdot}43 \\ \text{bi-concave} & R' = 20{\cdot}86 \end{array}$$

Compound focus = 30.

By referring to the table of Tûlley's curves previously given, it will be seen that these numbers vary very little from the first combination there specified.

If the above example be worked out according to Coddington's formula, it will be found that with the same values for the crown radii, the flint curves will be almost identical with those calculated by this method.*

I shall now quote an example of the radii of a triple object-glass computed by Tulley's rule. In this case, as the refravtion is divided between two lenses, the aberration is much diminished; and as the convex lenses are of equal foci, each of them must be double the focal length of the single convex, producing the same refraction. The same kinds of glass are supposed to be used, as in the previous example on the double objective—viz., crown, index 1·528: flint, index 1·5735. Dispersive ratio, ·7127.

In adapting the formula for computing the curves of a triplet, it was found by a number of experiments, that the best results were obtained when the calculated aberration of *each* convex lens was equal to that of the concave. From this it would seem, that the correcting factor gives too great a spherical error for the concave, since it needs double the amount of positive error to correct it. But I think the true explanation of this seemingly paradoxical result may be found in the fact that the separation of the lenses will greatly reduce the error; and, moreover, the convexes being of the same form, but placed in opposite positions, would tend to counteract each other's errors. So that the whole effective aberration of the two outer lenses would really be much less than its theoretical amount; and as appears from experiment, very little if anything in excess of that due to the inner lens.

(*To be continued.*)

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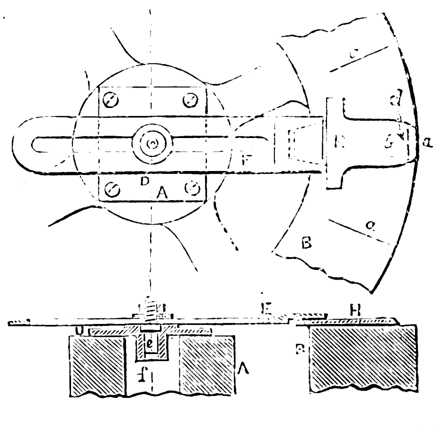
* Brewster gives tables for calculating the radii of lenses for object-glasses in his article "Telescope" in the *Edinburgh Encyclopædia*; and at the end of his edition of Ferguson's Lectures. Professor Robinson has an article on the "Telescope" in the *Encyclopædia Britannica*, in which an explanation is given of Boscovitch's formula. Brewster's tables are, I believe, founded upon this formula. An example worked by this method is given in Rees; but as no general explanation of the formula on which it is based appears, I have not quoted it. It would appear from this example that Boscovitch takes as one condition the equality of the interior curves and makes the front radius longer than the inner one. I trust this notice may induce those who can examine the above books to copy out and send to these columns the tables at least, and if not too intricate, the essential parts of the formula also.

DEVICE FOR LAYING OUT THE TEETH OF GEAR-WHEEL PATTERNS.*

IT has often occurred to the writer that a device something like that shown in the accompanying sketch, would be useful in laying out the teeth of gear wheels on wooden patterns, particularly as tending to greater exactness in the operation. As this is usually practised, the curves of the teeth are struck with the dividers directly on the pattern, and in the instance of a wheel with a large number of teeth, there are a great many chances to make slight mistakes, to say nothing of the chances of making one or two large ones. This is without questioning the propriety of laying out the teeth with the dividers. Then again the job is somewhat tedious. The chief point to be made, however, is the probability of greater accuracy.

In the sketch (which is not to scale, and in which some of the parts are purposely exaggerated for the sake of clearness), the rim B is supposed to have been divided in the usual manner, and radial lines *a a a* representing the centres of teeth drawn on the edge. The hub A is recessed, or it may be bored entirely through, as shown at *f* somewhat larger than the boss of the plate D. This plate has a hole bored entirely through it, which hole is recessed from the outer surface, and the pin *c* with the collar near the centre, is fitted to be revolved without lost motion. This pin, which may be ½" or ⅝" diameter, extends above the collar and is provided with a thread and nut, also with a blank portion on which the slotted bar F is fitted to be moved the length of the slot, or to be securely clamped by the nut. One end of this bar (which may be 3-16" by 2", or of any other convenient dimensions), is made thicker and grooved to receive the shank of the templet tooth H. The templet tooth, of metal, say steel 1-16" thick, has a notch in the end, as from *d* to its periphery, and from *d* it is beveled back, as shown in the section, and a plain line *d*–*b* is made on the beveled part.



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* By F. F. HEMENWAY, in the *American Machinist*.

In using this device, the plate D should be laid on the hub, and using the bar F as a tram, should be set and held by the four screws shown in plan. A better way for setting and holding the plate than the one shown, would be to make the screw-holes in the plate considerably larger than the screws, and cover them with thin washers; then, when the plate is screwed down, it could be rapped a little to tram the wheel.

To mark off the teeth, bring the line on the templet to coincide with the lines *a* as in using a vernier, and as shown at *d*, and scribe around the tooth. Of course, as fitted up, the tooth template must be radial, but it is not absolutely essential that the line *b*—*d* should be either central or radial.

The template can be laid out directly by the use of the marking point and rolling segments, or in any way thought advisable. However it is done, there is but one tooth to lay out as against a good many, if laid out directly on the pattern. To make such templates would not be a very troublesome nor a lengthy job for a good tool-maker. The template could be used as a guide by the pattern maker as the work progressed.

The particular detail of construction is not offered as the best, but simply as a illustrative of the idea. One suggestion might be the fitting of the template tooth to a piece separated from the bar, but adjustable on it to compensate for projecting hubs.

Incidentally, this templet business suggests the propriety of enticing our tool manufacturers to furnish the device with a full set of teeth (or as many as required), by which means something might be done towards bringing about uniform practice.

ELEMENTARY LESSONS IN DRY-PLATE PHOTOGRAPHY.—XIV.[*]

(*Concluded from p.* 372.)

IN conclusion we have but little to say. We have endeavoured in our "lessons" to give as clear and as practical instructions in the various manipulations connected with negative making and printing as possible. It must be understood, however, that few rules or instructions appertaining to photography are absolute; they are all varied by circumstances. All that can be done by written instructions is to guide the intelligence of the beginner. When he ceases to be a beginner, he should depend on his own intelligence and faculty of observation more than on any instructions. Let the beginner not be discouraged by failure. Failures he is certain to have. Even the most experienced fail occasionally, the majority more often than they are willing to allow; and if they do not always succeed, it is unreasonable for the tyro to expect to do so. Nevertheless, he should aim at perfection, and should not be satisfied until he reaches it. Let him remember that at least in landscape work no amateur need despair of reaching the highest degree of perfection. Amateurs and professionals compete continually against each other, and the former as often as not carry off the palm. The young photographer should, from the first, exercise his faculty of observation, and note the most minute departure from received rules. Frequently, a fact noticed by one comparatively inexperienced in photography may give the hint to a more experienced investigator, who may make good use of it. Another thing to be impressed on photographers is that they should not fear to give others the benefit of their observations merely because it is possible that similar observations have been made before. It is sufficient that a fact is not generally known or appreciated to justify its publication, and the oftener it is published until it is appreciated the better. We have before remarked that, if the beginner can get the help of a photographic friend, he will find his first labours much lightened. We would now urge upon him that, whenever he has begun to feel his way, he should, if possible, join one of the numerous photographic societies which there are in the country. Let him not suppose that he will meet with ridicule or contempt on account of his comparative ignorance. We were for some time ourselves deterred from joining a photographic society for such a reason; but, on attending the first meeting, all our fears were dissipated. The terrible "professional" whom we had dreaded to meet we found to be a most kindly individual, willing—nay, apparently anxious—to give what aid he could to anyone who asked advice or assistance from him.

Finally, we repeat our advice that the reader, while he is still unfamiliar with the various manipulations, should follow to the letter our instructions; but that when he begins to feel his way, he should trust to his own intelligence as his great guide. If he does so, we are sure that from the time he first succeeds in producing by development *something* on his plate, till the time when he has arrived at such perfection that he need not hesitate to hang his pictures on the walls at photographic exhibitions side by side with those of the first photographers of the day, he will feel that every step in advance which he makes is a triumph, and will find his work—or play, as he likes to consider it—a more absorbing and delightful one than almost any other that he could have taken up. Let him bear in mind that every operation is but a means to an end (the end being the picture), and that *any* means that conduces to the end is permissible.

We believe that we have filled a little gap in photographic literature—that we have produced the first set of instructions for working modern dry plates which pre-supposed no knowledge of any other photographic process.

ELECTRICAL ACCUMULATORS OR SECONDARY BATTERIES.[*]

By Prof. OLIVER J. LODGE, D.Sc.

(*Continued from page* 373.)

I NOW proceed to the complete investigation of the most advantageous conditions when charging a set of similar secondary batteries with a shunt dynamo driven at a constant speed:—

Let P be the horse-power actually applied to the driving of the dynamo when it is in full action, at the given speed, as determined by a dynamometer.

Let P^1 be the power required to drive the dynamo at the same speed when it is not allowed to produce any current whatever; that is, the power necessary to overcome the friction and the resistance of the air. So that $P - P^1$ is the whole horse-power available for electrical purposes, and of this some will be expended in heating the armature and field magnet wires.

Let A be the resistance of the armature wire in ohms.

B the resistance of the wire on the field magnets.

R the resistance of the leading wires conveying the current to the cells.

r the resistance of each of the cells.

Let N ($= n\ m$) be the number of cells being charged—arrange *n* tandem and *m* abreast.

e the maximum electromotive force in each cell opposing the charging current in volts.

c the current flowing through each cell in ampères.

b the current flowing through the field magnets of the dynamo.

E the difference of potential between the terminals of the dynamo when it is in action charging the cells.

Of these quantities it is essential that E shall be greater than $n\,e$ if the cells are to be charged at all. If $n\,e$ is the greater they are slowly discharging themselves through the dynamo and are helping to turn it. The nearer $n\,e$ come up to E the easier will it be for the engine to drive the dynamo, and as soon as $n\,e$ exceeds E it will begin to drive the engine instead of the engine driving it. If the engine strap is slipped the dynamo will go on turning at the expense of the now discharging battery in the same direction as when it was charging it.

The following relations hold among the above quantities:—

$$E = n\,e + n\,r\,c + m\,R\,c \ldots\ldots \quad (1)$$

$$E = B\,b \ldots\ldots \quad (2)$$

$$746\,(P - P^1) = E\,(mc + b) + A\,(m\,c + b)^2 \ldots \quad (3)$$

$$E + A\,(m\,c + b) = \Phi\,(b) \ldots\ldots \quad (4)$$

The last being a statement that the whole electromotive force generated by the revolving armature is a function of the current flowing round the field magnet; but what that function is depends upon the construction of the machine, and especially upon how near the iron of the magnets is to being saturated. If it is saturated the function is a constant; if it is nowhere near saturation, the function is simple proportion. It can be determined by experiment and plotted.

Of all the above quantities,

P^1 has a fixed value determined by the speed employed, and ascertainable by direct measurement.

e and *r* may also be taken as fixed and known quantities, for the size of the cell is a matter of convenience, and this determines *r*; while *e* is a function of the materials used in the cells, and for Planté or Faure it is about $2\frac{1}{2}$ volts.

R is easily measured, and can be made as small as convenient.

A and B are also easily measurable, and though not uncontrollable, must yet be considered fixed for a particular dynamo.

n and *m* are of course completely under control, and we have to determine what is the most economical ratio $n : m$. But at present they can be regarded as given quantities.

The remaining four of the above quantities, viz., *c b*, P, and E, are dependent variables, and are given in terms of the others by the preceding four equations.

The number of thermal units (water—gramme—degree—centigrade) produced every second is:—

At the bearings and in the air churned by the machine, $178\,P^1$;

in the armature $\frac{A}{4{\cdot}2}\,(m\,c + b)^2$;

in the field magnet $\frac{E^2}{4{\cdot}2\,B}$;

in the cells $\frac{1}{4{\cdot}2}\,N\,r\,c^2$;

in the leading wire $\frac{1}{4{\cdot}2}\,R\,m^2\,c^2$;

The energy utilised as chemical work is $N\,e\,c$.

What we want of course is to make this last term as great as possible in comparison with the preceding five terms. Now it goes without saying that the smaller P^1 and R can be got the better. It also appears from the second and third of the above terms that it is good to have A small and B large. But what about N? N appears as loss only in the fourth term, and as gain in the sixth; hence it must be advantageous to make N large. But then N contains two factors *n* and *m*; and the second of them appears squared in two of the above loss terms; hence, though it is good to have *n* as large as possible, it is quite a question how big *m* should be. We find, however, by a little calculation, that to make $N\,e\,c$ as large as possible, compared with the other terms, that is to make the ratio of useful work to the waste a maximum, we must have—

$$\frac{m}{n} = \left(r + \frac{e}{c}\right)\left(\frac{A + B}{B^2\,(A + R) + 2\,A\,B\,R + R^2\,(A + B)}\right)^{\frac{1}{2}} . \quad (5)$$

or since R and A are, in practice, small, compared with B, we may say that the best possible value of the ratio $m : n$ is very approximately

$$\frac{m}{n} = \frac{e + r\,c}{B\,c}\sqrt{\left(\frac{A + B}{A + R}\right)} \ \ldots\ldots \ (5^1)$$

We perceive, therefore, that the best value of *m* depends upon *c*. If the current flowing through each cell is very weak, a large number may be arranged abreast; but if *c* is pretty strong *m* must not be great. Now, the permissible value of *c* depends entirely upon the size of the cell, for it is the "intensity," or as some call it the "density," of current—that is the current per unit area of electrode—which is to be kept small. But though a very small current is economical, not only because it reduces the waste heat, but, more important still, because it allows the chemical changes to go on slowly and steadily without evolution of gas or secondary disturbances; yet in practice a charging current of only one ampère through large cells would be felt to be somewhat tedious, and an allowance of five ampères would still be very moderate.

I will therefore suppose that the actual value of *c* is determined by practical convenience, and is measured by a galvanometer. Equation (5^1) fixes the best value of *m* in terms of *n*—but what is the best value of *n*? The equations indicate that the nearer $n\,e$ is to its maximum permissible value the better. This maximum value is

$$E_0 = \Phi\,(b_0) - A\,b_0 \ \ldots\ldots \quad (6)$$

But if it is too near this value, not only will the charging be very slow, but, unless the engine is absolutely steady, there will be a risk of the cells sometimes helping to drive it. It need not be so very far short of this upper limit, however, for the current tapped off through the outer circuit ($m\,c$) will not be usually great enough to reduce *b* much below its maximum value b_0, nor E much below E_0; and so we may put pretty nearly

$$\begin{aligned} n\,e &< E_0 - A\,m\,c \\ &= B\,b - A\,m\,c \ \ldots\ldots \quad (7) \end{aligned}$$

Or, putting in the best value of *m* from (5^1) we get

$$n = \frac{b\,B^2\sqrt{(A + R)}}{c\,B\sqrt{(A + R)} + (e + r\,c)\,A\sqrt{(A + B)}} \ldots (8)$$

The current through the field magnet which enters into this expression is not an absolute constant, even at a given speed, since it depends somewhat upon how much current is tapped off through the outer circuit—that is, upon $m\,c$. Nevertheless, if the wire on the magnet has a properly high reristance, it will be found that *b* is very nearly independent of $m\,c$, unless the latter is enormous. And as we have expressly said that $m\,c$ is not to be very great, we may regard the value of *b* at the given speed as nearly constant, and may measure it with a galvanometer.

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[*] Condensed from the *Photographic News.*

[*] From the *Engineer.*

Practically, the value of *n* would be determined by adding to the series of cells until the current is brought down to the desired small value, taking care that the limit E is not too nearly approached, for fear that a diminution in the speed of the engine might cause it to fall below *n e*.

Observe that the greater *n* is the greater *m* may be too, so as to maintain the most economical ratio (5).

INJECTING SPECIMENS FOR MICROSCOPICAL EXAMINATION.*

By T. CHARTERS WHITE, M.R.C.S.

I HAVE placed under my microscope this evening an injected preparation from the small intestine of the Guinea-pig, not as an example of perfect injection, but to show more clearly what I mean by having a regard to the other elements of a structure besides the vessels; and I will describe the *modus operandi* by which I produce that preparation, and advise such of you who may wish to follow up this branch of work to undertake it with the full assurance that what I have but imperfectly performed would, with more time and attention than I could give, be attended by far more beautiful and instructive results. I do not wish to say anything relative to *opaque* injections, because I have had no personal experience in their production; but I shall confine myself to the making of transparent injections with cold injection fluid, although I believe that very beautiful preparations could be made by the amateur with a little attention to temperature, by using a warm injection of gelatine stained with carmine. With regard to the instrument to be employed, I may say that although a syringe is generally recommended to force in the injection, I found it attended by so much unsteadiness and fatigue, followed often by bursting of a vessel and consequent extravasation, that, however deftly it may be employed by the professional injector, I gave it up, and resorted to gentle and continuous pressure by a falling column of the fluid injection. The injection I used was Beale's Blue fluid, and as this requires a little care in its preparation, directions for its proper combination may be fitly inserted at this stage of the description. The formula I have found most satisfactory is that given by Dr. Beale in "How to Work with the Microscope," at page 114, and is as follows:—

Glycerine, 2 ounces.
Wood naphtha, 1½ drachms.
Spirits of Wine, 1 ounce.
Ferrocyanide of Potassium, 12 grains.
Tincture of sesquichloride of iron, 1 drachm.
Water, 3 ounces.

The ferrocyanide is to be dissolved in one ounce of the glycerine, and see that every particle is dissolved before proceeding to mix. The tincture of iron may be added to another ounce of the glycerine, and well stirred in; now add these two solutions gradually to each other, well shaking them in a bottle after each addition.

The iron must be added to the solution of ferrocyanide; this is strictly imperative. When thoroughly incorporated this mixture should produce a dark blue fluid without any flocculi, and with no sediment; the naphtha may then be mixed with the spirits of wine and the water, and gradually mixed with the blue fluid.

Having now made your injection, it may be placed in a wide-mouth glass jar on a shelf, about five feet above your table; cut two holes in the cork, which should fit the bottle accurately; in one hole place a small funnel, so that air may get to the interior of the bottle, and should the injection threaten to become exhausted before the completion of the process, some more can be poured in; in the other hole insert a bent glass tube, one end of which should reach in the inside of the bottle to the bottom; the other end may be left four inches long and turned over in a good arch; on this end fit about six feet of indiarubber tubing of a size to tightly embrace the glass tube; in the distal extremity of this tubing fasten a small stop-cock. If now suction be made at this, the injection will flow out of the bottle down the tube; the stop-cock can be turned, and thus the tube will be charged without containing any air. Having now your injection so far ready, prepare some nozzles of a suitable size to the vessel you intend to put the injection in. The best can be made from a piece of the glass tubing of the same calibre as that inserted in the bottle; draw some pieces of about two inches in length to capillary points in a flame, and then break off the tips to correspond with the diameter of the blood-vessel you select to operate on; twist some fine wire round the wide end of each of these canulæ and fix them with some sealing-wax; slip over the end of that you intend to employ a short length of the same tubing that you have attached to one end of your stop-cock. Now, having all these appliances at hand, select the subject to be injected. This may be either a young kitten, or a rat, or such-like small mammal; it must be procured alive, and may be drowned or chloroformed to death; and *directly* after death, the sooner the better, the thoracic region may be well laid open by cutting with a stout pair of scissors through the ribs on each side of the chest; never mind the intercostal vessels, they will not let out much injection, at any rate nothing to signify.

Now, although life may be perfectly extinct, the muscular contractility of the heart will exert itself, and the pulsation of that is an indication of the elasticity of the vessels; when once that has ceased the injection will not flow so freely, as an impending *rigor mortis* will have taken possession of the coats of the vessels, and will be a serious hindrance to the access of the fluid into the capillaries; lay open the pericardium, the bag which envelops the heart, and you will see the aorta springing from the left ventricle, and arching over by the left side of the spine, descending to the abdomen; cut off the apex of the heart, and insert the nozzle you have prepared first taking the precaution to fill it and the attached tube with water; push it gently upward though the cavity of the heart till you see it enter the aorta, when with a curved needle you may pass a ligature under aorta and pipe, and tie them, securely fastening the ends of your ligature to the wire studs twisted on your glass tube, that will prevent it slipping out again; see that it is filled with fluid to the top, so that all air may be excluded, and then make your connection with the stop-cock, first letting a few drops of the injection flow through it, when your tube is continuous turn on the stop-cock, and you will soon see the various organs become tinged with blue, the larger vessels first, and coursing along these it will branch off into innumerable fine channels, till the whole capillary system is full, and the excess coming out of the right side of the heart will tell you your work is complete.

Your subject may remain to be cut up at your leisure, for the glycerine in the injection will act as a preservative for some considerable time. This, then, was the process adopted for the injected preparation under my microscope this evening. You will see that the blue fluid has run into the finest capillaries. But it is said we learn more from our failures than from our successes, and therefore, as that preparation is far from what you can admire from an æsthetic point of view, it will prove all the more instructive if I point out an error I fell into. You will see that in a great many places the blue injection has entirely faded out, and in others that it is very pale. I believe this has arisen from the blue fluid not being sufficiently acid to neutralise the alkalinity of the blood remaining in the vessels; and this seems substantiated by those specimens where the preparation has been put into ammoniacal solution of carmine, which has entirely obliterated the blue, only sufficient traces of it being left to tell of its departed beauty. The next time I do this I shall put a little acid into my blue injection. I once derived much good from having two wide-mouthed jars, one containing a weak warm solution of salt-and-water, which I allowed to flow through the capillary system in a similar manner to that I have described as employed for the blue fluid prior to sending in the injection, while my subject was manipulated under warm water; this excluded every possibility of air getting into the circulation, which is always to be avoided as most ruinous in its results. These perhaps wearisome details comprise the whole of the process I have always employed. Of course, others have tried the same process, but I thought that it would be better to tell you how I acted, as if no one else did the same thing, because I could make my short paper more didactic, and you will see by my poor specimen that with greater care this process is capable of producing some beautiful and instructive results. You will, in the subsequent examination of it, be able to determine how much is the result of the mounting medium in which I have placed it. For my part, I believe it is entirely due to this that not only the villi but the Lieberkühnian follicles are most clearly shown with the capillary vessels coursing all though and around them; and I must aver that had this specimen been mounted in balsam or dammar, every detail would have been sacrificed. I consider balsam to be the greatest bane Histology has to fight against. The specimen I show to-night, after being saturated with the glycerine from the injecting fluid, only required a little weak glycerine and camphor water to put it up in, and you will see the consequence is a preservation of everything that would be otherwise blotted out.

ELECTRIC LIGHTING FROM A PHOTOGRAPHIC POINT OF VIEW.*

WE have, from time to time, laid before our readers particulars of progress in electric lighting as bearing directly or indirectly on the work of the photographer, and nearly a year ago we referred to the Pacinotti machine as having been mainly instrumental in bringing about the present condition of electrical activity. Not only did Professor Pacinotti anticipate, by the construction of his now celebrated machine, the so-called dynamo or regenerative principle, as enunciated seven years afterwards by Siemens and Wheatstone, but he gave to the world the first magneto-electric armature, in which the magnetic changes are progressive rather than sudden, a condition of affairs which not only enables us to obtain a current of absolute equality and constancy, but also much of the heating which ordinarily results from the quick reversal of magnetism in soft iron is obviated. For these reasons, and more especially on account of the diminished heating of the rotating armature, the Pacinotti machine has been found to be by far more effective than the older machines constructed with the armature of Siemens. Although the *Nuovo Cimento*, which contained a description and drawing of the Pacinotti machine, found a place in several of the public libraries of Great Britain, and fell into the hands of most scientific men, it appears that very few appreciated the importance of the invention, and probably not half a dozen models of it were made in this country until M. Gramme constructed the Pacinotti machine on a much larger scale than had been attempted by the original inventor, and called prominent attention to its industrial value. It may interest our readers to know that about fifteen years ago M. Gramme assisted Mr. Woodbury in the arrangement of a magneto apparatus and Lenoir gas engine, used in the production of the electric light for photographic purposes at his premises in Brompton, and after this M. Gramme remained for some time helping Mr. Woodbury in the manufacture of his gelatine reliefs. This was, however, before the commercial advent of the Pacinotti machine.

Gramme, after having devised several new commutators, so far modified the commutator or collector of the Pacinotti machine as to replace the alternately placed strips by parallel conducting rods mounted somewhat like the staves of a barrel or tub; but the experience of more recent times seems to show that Pacinotti's original method of so alternating the strips as to insure the contact of each brush with two successive studs or strips is preferable, and calculated to reduce sparkling at the commutator. We see a return to Pacinotti's original commutator in the Brush machine, while the Weston machines are made with slightly bent strips, and a similar end is attained by the use of two brushes on each side of the commutator, as exemplified by the Hefner Altneck machines.

In October last we detailed some particulars as to the use of the Swan incandescent lamp for photographic portraiture, and described a number of experiments in which an ordinary or full-sized Swan lamp was used in conjunction with thirty cells of Grove's battery. We mentioned at the time that the lamp could not be satisfactorily worked by a small hand Gramme (Pacinotti) machine, with which we tried it. Since the time referred to the smaller, or five-candle, Swan lamps have been introduced into the market, and it was found that the hand-machine in question would work from three to five of these when arranged in parallel circuit; in fact, this was shown not long ago at a meeting of the Society of Arts; while on the occasion of one of Mr. W. H. Preece's juvenile lectures at this institution the same hand-machine was used to generate a current by which more than 500 buttons were electro-plated with silver in a few minutes.

In order to render the machine in question more effectual as an electric generator, we determined to try the effect of a small electro magnet so placed as to form consequent poles with the permanent magnets of the machine, and the result proved so satisfactory that it became possible to produce a sufficiently actinic light for ordinary portraiture by the current produced when the motive power is no more than can be generated by easy turning with one hand.

The diagram (Fig. 1) represents, in a manner which will be sufficiently intelligible to any one familiar with electrical matters, the machine with the additional magnet; and the machine in this form may be regarded as standing between a magneto machine and a dynamo machine. Non-electrical readers must understand that the representation of the wire is intended only to indicate the manner of coiling, not the amount used.

The advantages of the arrangement in question will be understood if we point out the way in which a current arises in a dynamo machine. When the armature is turned, a weak current is generated, owing to the residual magnetism of the field magnets, and this current circulates round the field magnets in such a direction as to tend to increase their activity. If, however, the resistance in the exterior circuit is very great, it may happen that the intensity of this current is below that minimum which should suffice to induce an amount of magnetism corresponding to the residual magnetism of the soft iron field magnets. In this case the dynamo is practically inactive, as the cumulative principle does not set in. If, however, the speed of the armature is so far accelerated as to bring the intensity of the current above the before-mentioned minimum, the cumulative action will set in; or the machine may be put into full action by temporarily reducing the external resistance. It follows, from the above considerations, that there is a certain external resistance, which will serve to prevent any given dynamo machine from starting into full action for each rate of speed, and this limiting resistance will be higher as the coercive force of the metal of the field-magnets is greater; but, as the coercive force of the field-magnets is raised, the machine approximates more and more nearly to a magneto machine, and is so much less serviceable as a pure dynamo or regenerative machine. The apparatus figured above unites in itself the principal advantages of a magneto machine and dynamo machine. When the armature is made to rotate, and the external circuit is left open, a considerable difference of potential arises between the poles, although this is, of course, not so great as would have been the case if the soft iron of the electro-magnet were not so placed as to form a keeper to the permanent magnet; and this initial potential is sufficient to insure the efficient action of the machine even when a very high resistance is included in the circuit. When a five-candle Swan lamp is placed in circuit, and the machine is turned with the full force of one hand, the lamp is almost immediately destroyed, the thread breaking, and volatilised carbon being deposited on the inside of the bulb; but, by working the machine at a lower rate of speed, any required temperature, from a low red heat upwards, can be readily maintained.

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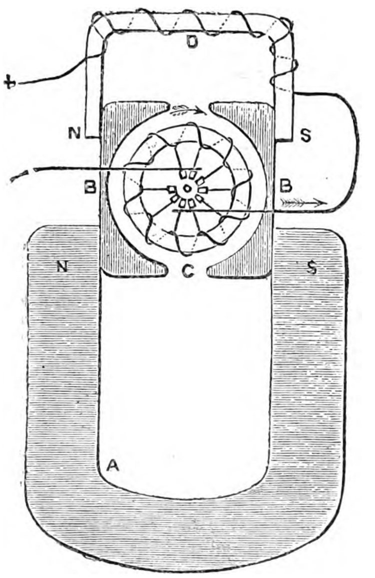
* Abstracted from a paper read before the Queket Microscopical Club.

* From the *Photographic News*. We are indebted to our contemporary for the loan of the blocks.

Fig. 1.



A, compound permanent magnet; B, B, jaw pieces; C, five-inch Pacinotti ring; D, electro magnet. (One of the commutator strips, with its conducting wire, has been omitted from the diagram).

By keeping the carbon thread at a temperature somewhat short of that required for its rapid destruction, a highly actinic and intense light is produced, and this is so effectual as a photographic illuminant, that when the lamp was placed at a distance of 4ft. from the sitter, a bust portrait was readily obtained with an exposure of from two to three seconds, a 1 B lens being employed. Here we have an advance of nearly twenty times, as regards rapidity, on our previous experiments; and instead of thirty cells of Grove's battery, a machine which can be easily turned with one hand is used. Several determinations gave us from 200 to 300 as the candle power of the lamp during the experiment. It will be understood that under these circumstances the incandescent lamp will not remain effective for a very long time; but several experiments indicate that on an average from fifteen to twenty portraits may be made with each five-candle lamp as at present sold. Considering, however, that in most cases the rupture of the thread took place at a weak point, and long before the whole of the filament had become considerably attenuated by the volatilisation of carbon, there is every reason to hope that as the manufacture of the lamps is improved, two or three times as many exposures may be reckoned on from each lamp.

At the present time, it is evident, from various estimates which have been made, that the cost of incandescent electric lighting is approximately equal to that of gas-lighting; or that the difference is, at any rate, not very great. If it could be made practicable to work incandescent lamps at a high temperature, as in the case of our experiments, the cost of incandescent lighting would immediately fall to about one-fortieth that of gas, as the high incandescence does not require a correspondingly increased consumption of electric energy. It is, however, difficult to conjecture as to what body, considerably more refractory than carbon, and yet a sufficiently good conductor, we may hope to make available; but problems seemingly more difficult than this have been solved by modern research.

Assuming that the incandescent lamps are finally sold at fifteen pence each, each exposure will cost rather under one penny; but if, at the same time, the durability of the lamp is increased, the cost will be notably lessened.

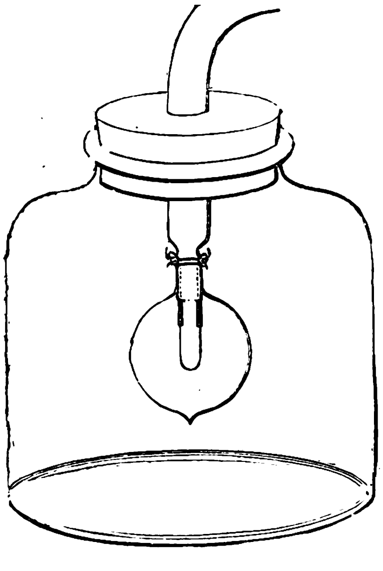
It must be remembered that the experiments we have described were performed with the small, or five-candle, Swan lamp; but, by using the larger lamp, and a proportionately powerful current, there can be little doubt that still more satisfactory results might be obtained.

Mr. Peter Mawdsley—who was with us when some of our experiments were carried out—suggested that in many cases it might be advantageous to employ a powerful gas-light to lower the intensity of the shadows cast by the electric light.

It appears to us that the incandescent lamp, actuated by such a hand Pacinotti machine as we now describe, would form a very suitable arrangement for optical lantern work.

The subjoined cut represents an arrangement which we found convenient for mounting Swan lamps, the conducting wires passing through the cork of a wide mouth bottle. The bottle forms a protection against fragments of glass, should the lamp fly on the powerful current being suddenly passed through it.

Fig. 2.



The same arrangement would probably be a most convenient one for the non-actinic incandescent lantern, a ruby or orange bottle being employed.

We hope, before long, to be in a position to give our readers some useful information regarding the use of the Planté secondary battery as a means of producing a light for photographic purposes.

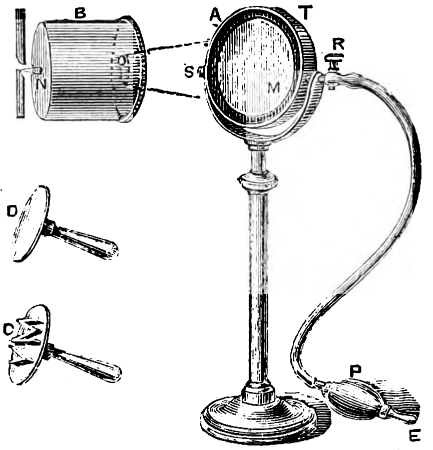
MAGIC MIRRORS OF SILVERED GLASS.

A YEAR or more ago, the scientific world was much interested in the very curious effects obtained with the magic mirrors of Japan, and several successful efforts were made in Europe to imitate them, the material employed being, as in the imported article, metal.

Recently, M. Leon Laurent, an optician of Paris, has greatly improved on these curious apparatus by constructing them of glass—a material which is found in some respects much better adapted for the purpose than metal.

M. Laurent has succeeded in constructing two series of the apparatus for lecture and experimental purposes: (1) Compressed and curved mirrors; and (2) mirrors of various thicknesses and forms (plane, concave, and convex), heated in a peculiar manner. For the first of these he uses commercial glass of about one millimetre in thickness, upon which he engraves designs of uniform depth. Glass thus engraved is more flexible than when the designs are in relief. After engraving, the glass is silvered, and the silver is polished. The mirror thus formed is mounted on a standard with the necessary accessories for manipulating it. (Fig. 1.) The following is a brief description of the arrangement, as shown in the figure:

M is a plane mirror silvered on the outer surface. The design is engraved on the back, and is consequently invisible in the ordinary state. The mirror rests against the hollow frame or drum, T, which is movable on the pivots, R S. A is a binding ring lined with cloth for fixing the mirror in place. There are three of these mirrors, one being concave, one convex, and one plane. These may be changed, one for the other, at will, as may be also the rings, A. P is a rubber bulb with which the air contained in the frame may be exhausted or compressed. At R is a cock which permits the exhaustion or compression to be maintained for some time. B is a special cap, having two apertures, O and N, and which is substituted in the lantern for the ordinary tube that holds the lenses. The apertures N and O limit the size of the luminous point and restrict the divergent fascicle. Finally, in front of the cap B, and the aperture N, are seen two carbons, between which is produced the electric light designed to illuminate the mirror.



The apparatus thus arranged is manipulated as follows:—

The cap B is placed in front of the light support, and at about one metre away from it, and the magic mirror is placed at about two metres from the cap. The screen is set up near the light, thus making it about three metres distant from the mirror. Thus arranged, if the mirror be left at rest, it gives on the screen only a white light, without any figure or design. But if the bulb be compressed with the hand so as to compress the air in the hollow frame, the glass, M, becomes convex, and there is thrown on the screen a *black* and magnified image of the invisible design engraved on the back of the mirror. On removal of the pressure, the mirror assumes its former shape, the image becomes white, and the design disappears. It should be remarked that it is not absolutely necessary to use the electric light; for the oxyhydrogen light, or even a good kerosene lamp (and, under some circumstances, sunshine) will answer just as well. In all cases, these experiments are very curious, and it is, indeed, truly *magical* to see these mirrors, on which no design can be perceived, reproduce on the screen, through the simple compression or exhaustion of the air, the most varied figures, such as flowers, animals, arabesques, &c.

In the second kind of apparatus, M. Laurent has obtained another property of mirrors through the dilatability of glass by heat. In this form of the mirror he substitutes ordinary silvered-glass of commerce of about four millimetres thickness for the engraved mirror, M. The implements for producing the figures consist of metal discs, on which are formed the designs in relief, like the one shown at C. One of these is heated to a point where it can be just touched without burning the hand, and then applied to the silvered part of the mirror, when the designs will immediately exhibit themselves *in white* on the screen. As the mirror becomes heated by the application, a cold disc is substituted for the hot one, with the result of giving on the screen a design *in black*. By placing two of the figured discs, one of them cold and the other hot, on the mirror, two images may be obtained—one white and the other black. The thickness of the glass makes no difference in these experiments; nor does the varnish which protects the silvering have any effects on the results. As the metallic dics, with figures in relief, are pretty expensive, there may be substituted for them designs made as follows:

Take an ordinary visiting card, and trace upon it any design whatever; then, with a pin, prick through all the lines of the drawing so as to have the design in relief on the other side. Or take a piece of tinned paper, such as that usually used for covering chocolate, and make the drawing on the plain surface, bearing down pretty hard so as to have the design in relief on the metallic side. By applying a design made in this manner to the sildered side of the mirror, and holding lightly against it a plane heated disc, D, the design will be reproduced in white on the screen.

An explanation of the theory of these interesting apparatus may be given in a few words, as follows :—If we suppose a mirror to be absolutely plane—that is, without the least elevation or depression on its surface, it will reflect light uniformly, and the image that it gives on a screen will be perfectly white. But if there be a slight irregularity in the surface, the rays that such irregular part receives will no longer be sent normally to the surface of the mirror, and hence there will be a diminution of the image on the screen—that is to say, the production of a shadow. If this irregularity follow the lines of an object—of a flower or of a letter, for example—the shadow will conform thereto, and there will appear on the screen an image of the object; and, according as the designs are depressed or in relief, the image will be black on a white ground, or white on a black ground. The description given of the apparatus as modified by M. Laurent, shows how the compression or exhaustion of the air, as well as the application of heat, has for result the production on the surface of the mirror of very slight elevations and depressions corresponding to the elevated or depressed designs, invisible on the mirror itself, but rendered visible on the screen because of the power of the luminous source employed to reflect the image from the mirror.

IMPROVEMENTS IN BOILER CONSTRUCTION.*

REPORTS have been made heretofore covering nearly or quite all matters pertaining to the subject of the best material, form and proportions for locomotive boilers, and there seems to be but little matter that has not already been brought to your notice in reports and the different points discussed. As regards material in the construction of boilers, the use of the best quality of homogeneous steel, as now made by our manufacturers in this country, leaves but little more to be desired. Yet, notwithstanding its excellent quality, we are not entirely free from ruptured side sheets in the larger class of locomotive boilers, where the box is deep and water used such as deposits a hard scale on the sheets. The fault, in most cases of failure, is not with the material, but rather that it is required to stand what in the nature of things may be said to be impossible—strains from compression and elongation beyond the elastic limit, without final rupture. That firebox sheets, under circumstances frequently occurring, are subject to such strains was, I believe, conclusively demonstrated in a series of tests made by the writer, and published in the tenth annual report. The formation on the sheet increases the expansion of the metal by allowing it to attain a higher temperature than it otherwise would, developing strains in the sheet that sometimes produce a permanent elongation or shortening, as the case may be, in a comparatively small section of the sheet; and, when the temperature becomes uniform in all parts of the sheet, the part under tensile strain is liable to rupture, beginning always at a stay-bolt hole, but extending through the sheet between the stay-bolts as likely when once started as from one hole to another.

On some of the divisions of the road with which I am connected, a large number of engines have been in service more than 10 years doing heavy work, and not 5 per cent of the steel firebox sheets in them have cracked during that time. The water used in these boilers is such that hardly any scale is formed on the sheets. More than 80 per cent. of these engines have their original fireboxes, which are still sound and apparently good. On several other divisions the case is somewhat different, more particularly the St. Louis division, north of the Ohio river, through the State of Illinois, where the water used is more or less impregnated with lime and other impurities, forming a hard scale, and in consequence reducing the life of the fireboxes to about one-half of that in the case of engines on most of the divisions south of the river.

The character of a water used in a boiler, as regards the deposits left in it from evaporation, determine, to a great extent, the durability of the fire-box and tube-ends, yet, with the best quality of water, a fire-box has its day. It perishes, however, from a different disorder than the one in a boiler supplied with water that deposits a heavy scale. In the former case, the flanges of the flue sheets and the back sheet from the top of the grate to about 36in. up are the points that ordinarily give out first; the flanges become overheated or burned and crack from the rivet out, and the cracks gap open and leak. The sheets also become thin at the corners below the grate from corrosion, while in its other parts the fire-box remains sound.

In the latter case, the life of the fire-box is too short for producing this effect on the flanges of flue and back sheets, as the side sheets give out at the stay bolts from cracks extending from them to a greater or less distance, until renewal becomes necessary.

It is important in all cases that the flanges of fire-box sheets be as short as possible. The closer the seam is to the corner the longer it will last. It remains cooler than if more exposed to the effect of the fire. I have noticed a number of flue and back sheets within the past two years that had to be removed simply on account of the burning and cracking of their flanges, that were otherwise good for several years' service, and many more that must soon be removed from the same cause. The flanges were originally made too long, extending out from the face of the sheet as much as 3in. Had they been but 2in., they would doubtless have lasted much longer. This is a matter which, from my observation, I conclude is very often overlooked in the construction of the firebox. All laps exposed to the fire should be as short as possible, more particularly where the heat is great. The flanges, if properly turned, need not at most be more than 2in. from the face of the sheet in the vertical seams for a distance of 2ft. or 3ft. above the grate. A lap of $1\frac{3}{4}$in. for the seam is sufficient at that place. At greater distances from the grate, the lap and length of flange may be greater without any evil results. I have noticed many cases also where tube-sheets were much worn around the end of the tube in the form of a counter sink, about $\frac{1}{4}$in. wide and the same in depth, around the lower and central tubes the sheets becoming so thin as to require removal, while at all other parts they were apparently good. Such sheets were in nearly, or quite, every case in fireboxes of engines doing heavy work, and having boilers comparatively small for their cylinders and work. In the case of copper tube-sheets, this defect seems to be greater even than with steel sheets.

The cause of this cutting away of the sheet in the form of a groove around the tube-end is due, I suppose, to the particles of coal and cinder drawn towards the tube by the force of the draught, and those striking the outer slope of the head on the end of the tube, where it projects into the firebox, turn outward toward or from the tube, striking the sheet and in time cutting a groove or valley around the end of the tube, as stated; while the projecting end of the tube itself suffers comparatively little—the action of these particles of coal and cinders on the sheet around the tube being the same as that of sand in the sand-blast machines for sharpening files. If this theory is correct, then it will be best to have as little projection of the tube end as possible beyond the face of the sheet in the firebox. To countersink the tube-hole sufficiently to receive the head of flange on the end of tube, without leaving a sloping projection on its outer edge, will add to the life of the sheet.

In the matter of improvements in the designs of boilers and in their construction that is new and valuable, I have little or nothing to offer. What may seem to be new in these latter days is generally found to be some slight change in an old plan or pattern, or something long known to the public presented in a modified form.

The first successful locomotive boilers made were of the tubular pattern, the fire-box surrounded by a water space; and we are using the same form today, not having found a better one; and until some new method of generating power is discovered we may be obliged to continue the use of the present pattern without material alteration. The "Verderber" without water space around the fire-box, tried on several locomotives on one of the Hungarian State roads, in Europe several years ago, seems to have been a failure as regards an improvement on the common form of boiler for generating steam.

There may be in the economy of nature "thus far shalt thou go and no farther" for a time at least, and until such time the wisest course will be to endeavour to perfect that which we have. That we have arrived at perfection in the construction of the locomotive boiler no well-informed person will, I think, assert; nor that some one class of boilers will answer best for all classes of engines, kinds of fuel, and different qualities of water that must be used. The character of the water as regards the impurities held in solution in it, the quality of the fuel to be used, as regards its evaporative power, the grate area, the quantity to be evaporated in a given time, and the class of engine, must all be intelligently considered in fixing upon the form and proportions of the boiler in order to give the best results.

In illustration of the fact that the character of the coal to be used should be considered in proportioning the grate area of the firebox, I will give the results of a series of tests made in the boiler of one of the passenger engines running on the Louisville and Nashville R. R., between Louisville and Nashville, in the months of April and May, 1882, in testing the difference between seven different kinds of coal. The engine had 18in. by 24in. cylinders, 5ft. 3in. drivers, was an eight-wheeled engine, with a boiler 54in. in diameter, the waggon top raised 6in. above the cylinder part and a 30in. dome. The firebox was 72in. by 34in. at the grate; 191 2in. tubes, 11ft. $5\frac{1}{2}$in. long.

The firebox was fitted with the brick arch supported on four water-pipes tapped into the sheet below the boiler tubes and into the crown sheet 13in. from the back sheet. Grate area, $12\frac{1}{2}$ft.; (live grate) tube surface (inside diameter), 1,052ft.; heating surface of of firebox, 115ft.; total, 1,167ft. (deducting for tube holes, fire door, and surface below the grate).

During these tests the engine was run and fired by the same men, the coal carefully weighed, and the water accurately measured.

The average speed of the train, including stops, was 27 miles per hour, and the average number of cars per train 67-10. The condition under which the tests were made were as near alike as it was practicable to make them. Wood was used for firing up, the water was gauged when the first coal was put into the fire-box previous to starting on each trip.

					Evaporation of water to 1lb	
Eng.	No.	1	Miles	374	of coal	7·311lb.
,,	,,	2	,,	561	,,	5·828 ,,
,,	,,	3	,,	374	,,	6·402 ,,
,,	,,	4	,,	374	,,	6·269 ,,
,,	,,	5	,,	374	,,	5·393 ,,
,,	,,	6	,,	748	,,	5·482 ,,
,,	,,	7	,,	561	,,	6·327 ,,

Average temperature of water in tender 65° Fahr.
,, steam-pressure in boiler, 130lb.

The total engine mileage was 3,366 miles, and the average evaporation was 6·002lb. of water to 1lb. of coal consumed. Each trip or run was 187 miles.

Coal No. 1 was the best quality of Pittsburgh, No. 2 an inferior quality, No. 3 Alabama coal, No. 4 Tennessee coal from near Chattanooga, No. 5, 6, and 7 from mines in central Kentucky. The difference in evaporation between the best and the poorest of these coals was 26 per cent.; in other words, the poorest coal (No. 5) evaporated 26 per cent. less water to the lb. than the best coal (No. 1); to evaporate the same quantity of water in a given time, 26 per cent. more of the No. 5 coal must be burned than if the No. 1 coal were used; and if the grate area was the correct proportion for burning the best coal, it was too small for the poorest, and *vice versâ*.

The train average in cars was the same in both cases, and the speed the same, and the tests made going the same way (south). The difference in the results, therefore, was due to the difference in the coal. This will serve to show that our monthly reports of coal burned per mile and per car hauled are of no practical value for comparison except where the coal is uniform in quality.

Comparing the performance of an engine using coal No. 5, with one using coal No. 1, would be very unfavourable for the former, taking quantity only into account. The boiler using that coal would be considered very inferior, or the one using coal No. 1 would be credited with merits not due to it if the quality of coal consumed were not considered; the whole difference being due to the fuel, and not to any difference in the boilers.

As a rule, it may be said that the area of "live grate" should be as small as possible that will burn the amount of fuel necessary to generate the required amount of steam. The area of grate to give the best results will depend largely on the quality of the coal used.

For instance: a grate area of the proportions generally used in the Wooten boiler would certainly be wasteful in fuel where a good quality of bituminous coal was used, but would, perhaps, be the most economical where a very inferior quality of anthracite or semi-bituminous coal is burned.

As nature has made the coals to differ greatly in kind and quality, equal variety in the proportions of grate, and to a certain extent of fire-box and boiler, seem necessary, in order to obtain the best results in its consumption. Careful tests and observations must be relied on mainly to determine the proper modifications necessary to suit each variety of fuel. No one pattern will answer best for all kinds. It is important, more particularly, however, where bituminous coal is used that is rich in gas, that the area of fire-box be large enough to give time for the perfect combustion of the gases before they enter the tubes, that the heating surface be as great, and the boiler as large as possible, within the limits allowable for the class of engine in which it is used.

A large quantity of water in the boiler gives a large capacity for storing away heat (power), accumulating it when the demand for steam is comparatively light, and giving it out as required in the variable quantity of steam required in a given time, in the ordinary use of the engine, without causing the great variations in boiler pressure that occurs when the boiler is deficient in capacity.

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* The report of Mr. Wells, Chairman of Committee on boilers at the Master Mechanics' Convention, Niagara Falls, New York.

A large boiler, like a flywheel, accumulates power when it would otherwise be wasted in part, and responds to sudden demands for it, for a time at least, without much apparent diminution of its force.

As regards the material for boilers, and character of the workmanship, there need not be any great differences; all should be as nearly perfect as possible. A boiler that is strong enough may be said to be as strong as it is worth while to make it, no matter how constructed; but a boiler may be strong enough when new and yet not be strong enough to withstand with safety to a good old age the weakening influences of corrosion, unequal expansion, the springing of the sheets from their original shape by pressure, and the strains from boiler attachments.

Theoretically and practically our boilers are ample in strength when new, but in the course of time the influences referred to have in many cases so operated on the boiler that it is found to be in parts, both theoretically and practically, too weak. Where the metal is $\frac{3}{8}$ or 3-16in. thick originally, it is found to be perhaps less than than $\frac{1}{4}$in. thick in places; and at others, where the thickness has decreased but very little, cracks or furrows are more or less developed, caused by expansion and contraction, or other strains that spring the sheet —I refer to the shell of the boiler and not the firebox—and this, too, before the boiler has been in service half its natural lifetime.

Patching or replacing these defective sheets then begins, probably too, at a time when it is most inconvenient to do it.

Testing a large number of boilers by hydraulic pressure, that have been in service a number of years, as they came to the shop for repairs, convinces me that the margin of safety between the ordinary pressure carried and that necessary to produce rupture in the weakest place is unpleasantly narrow, in the case of many old boilers in service on the roads in this country.

At the base of the dome seems to be the weakest point in many old boilers, insufficiently braced, as far as my observation goes. Much improvement has been made of late years in increasing the strength of boilers by the use of thicker sheets, a better plan of joints and seams, and better bracing; but, as a rule, there is still room for improvement in that direction.

Our English friends are far ahead of us in the strength of their boilers. We think they go to the extreme in using butt-joints, outside and inside welt-pieces, drilling and reaming all rivet-holes, and in the thickness of plates used, &c. And perhaps to a certain extent they do; yet I am satisfied that if we imitate them a little nearer in the thickness of plate for the shell of the boiler, and strengthening the base of the dome, it would be a paying investment in the matter of durability and lessening the cost of repairs.

As a rule, the metal used in the shell of our boilers is not thick enough; not that the boiler is deficient in strength to withstand the steam pressure with perfect safety when new, or that the seams are not strong enough, but there is a want of stiffness or rigidity about it. In other words, the shell of the boiler is not as strong proportionately as the other parts of the engine, and it is generally the first among the expensive parts to require repairs.

When the diameter of what was considered a large boiler some years ago was 44in., the thickness of the sheets was seldom or never less than $\frac{3}{8}$ of an inch. Now, when the common size for a large engine is 54in., the thickness is seldom more than 7-16 of an inch. The diameter has been increased 22 per cent., while the thickness of the sheets has only been increased about 16 per cent.

Consider that the steam pressure has also increased with the increase in the diameter of the boiler, to the extent of perhaps 8 per cent., the thickness for the sheets for the shell of a 54-in. boiler should be half an inch, to be as strong proportionately as the 44-in. boiler, when that was the general size in use.

The "Belpair" boiler, extensively used in locomotives in Europe with very good results, has heretofore been but little used in this country. The Rogers locomotive and machine works have, however, built several of these boilers within the past year for the Denver and New Orleans Railroad.

The Belpair boiler has an arched crown-sheet supported by radial stay-bolts from the shell, with no crown bars. A number of plugged holes are located along the sides for the introduction of a hose nozzle for washing the mud off the crown sheet.

The water used in them is said to be very bad, but they have not yet been in use long enough to determine their advantages as compared with the common form of boiler; but, so far, it is claimed that the results have been very satisfactory.

A slight curve or oval in the shape of the crown head, or a slope backward, would, I think, be an improvement in allowing any loose deposits on it to work off and pass down to the mud ring.

The Rhode Island Locomotive Works built two of the Belpair boilers for burning anthracite coal for the State Line and Sullivan Railroad in 1877, a tracing of which I inclose, which was kindly furnished me by Mr. J. A. Durgin, the superintendent of those works.

I have failed, however, in my efforts to obtain any information from the parties using these engines, as to how they compared with those having boilers of the ordinary type; but I learn from Mr. Durgin that so far they have given entire satisfaction.

The connection sheets between the firebox shell and the cylinder part of the Belpair boiler should, in my judgment, be made of thicker plates than the other parts of the boiler; otherwise they would be liable to furrow on the inside at the short curves, from unequal expansion and contraction. Experience has shown that with light plates furrowing manifests itself, sooner or later, in sheets of that form connecting the two parts of the boiler.

Where water is used that deposits little or no scale on the firebox sheets, the Belpair or any similar plan, without crown bars, would, perhaps, show but little superiority over the common plan in evaporation or durability, if the crown bars are high enough above the sheet—say, 1$\frac{1}{2}$in. or 2in.—to permit a free circulation; but in the case of water, such as is used in a large proportion of the boilers in service, containing lime and other impurities which is deposited in the form of scale on the inner surface of the boiler, it would seem that the boiler, having the least area of surface where this deposit on it would have an injurious effect, would be the best; other things being equal.

Where bad water is used, the difference between the two plans of boiler, it seems to me, is this: In the one having crown bars the whole of their surface affords area on which the deposits of scale are formed. They are not heating surface, and the deposits on them would do no harm, except that when they became heavy more or less of the scale breaks off and falls on the crown sheet, preventing the water at such places from coming in direct contact with the sheet, and if not promptly removed the sheet becomes overheated, and in time "bags" down between the bolts, making a pocket in which additional scale falling from the crown bars is held, and the evil increased. In the case of the boiler having no crown bars, this source of evl does not exist to so great an extent, and in that particular, at least, it is the best.

Now, if we assume that a crown sheet, 72in. by 46in., is supported by crown bars, 14 bars made of two pieces of 5 by $\frac{3}{8}$ iron, will be required. These have their outer and inner surfaces in contact with the water. Each bar (pairs) has a surface of about 1,000 square inches of surface exposed to the deposits of the impurities in the water, in addition to the surface of the sheet itself, and that of the braces and stays that may be situated directly over it and below the water-line.

In the case of a crown sheet of the above dimensions stayed by bolts to the outer sheets of the boiler, about 126 bolts 1in. in diameter would be required. If the depth of water carried over the crown sheet averaged 12in., the surface of these bolts exposed to deposits of scale would be 4,747 square inches, or only 33 per cent. of the surface presented by crown bars.

From this it is safe to conclude that the crown sheet stayed by bolts, without the use of crown bars, will receive only about one-third as much of this detached scale falling from the surfaces of the bolts, and bracing directly over it, as the one supported by crown bars; and, as the detached scale falling from the crown bars and braces where the water is very impure is a troublesome and expensive matter, the question of reducing the dead surfaces, as they might be called where these deposits are formed, to the lowest practical point, is one that seems to me worthy of more consideration than is generally given to it.

Preserving Yeast.—For the conservation of yeast the following has been recommended in the *Chemical Review*:—"The thick portion of the yeast is filled into a champagne bottle, and on top of it is poured about 2$\frac{1}{2}$cm. of olive oil. The bottle is then closed by tying a bladder over its top, and in order to protect it from explosion a pin is put through the bladder. So the yeast will keep well for a long time if kept in a cold place. Yeast, if mixed with about one-eighth of pure glycerine, also keeps well for some time if kept in a cool place."

THE National Association for the Promotion of Social Science will hold their Congress at Nottingham from the 20th to the 27th September.

SCIENTIFIC NEWS.

TO No. 2434 of the *Astronomische Nachrichten*, Dr. Vogel of Potsdam contributes some observations on the spectrum of Comet Wells, in which, following Dr. Copeland and Mr. Lohse in the Dun Echt circular 52, he calls attention to a remarkable bright line corresponding to sodium line D. This notable feature in the spectrum of the comet has been seen by Drs. Müller and Kempf, in company with Dr. Vogel, and also by Prof. Bredichin, and others at Moscow. Since 1864 about twelve comets have been spectroscopically examined, but Wells' comet appears different to all, as its proper light proceeds principally from incandescent vapour of sodium, and it is consequently, in Dr. Vogel's opinion, among the most interesting subjects of observation in the new department of spectrum analysis.

We understand that, despite the announcements made by the daily press, the results of the recent eclipse expedition amount to very little beyond what was expected, and throw no light whatever on the so-called dissociation of the elements.

Baron Dembowski's double star observations are to be published under the superintendence of Prof. Schiaparelli, in the *Atti* della Reale Accademia dei Lincei. They will occupy about three or four volumes.

The Emperor of Brazil, in a telegram to the Academy of Sciences of Paris, reports that Comet Wells was seen on June 17 at Rio de Janeiro, and that three days later, the nucleus was very bright, and the tail 45° long. As to the latter statement, it is legitimate to suppose there may be an error in the telegram.

Besides the transit of Venus observations in December, other efforts will be made to determine independently the solar parallax, Mr. Gill having arranged for corresponding observations, to be made at several places in both hemispheres, of the minor planets Victoria and Sappho, the former of which will, when in opposition on Aug. 24, be distant ·89 of the earth's mean distance from the sun, and the latter be within ·85 on September 24. In the *Astronomische Nachrichten*, Mr. Gill gives a list of the proposed comparison stars.

Messrs. Longmans have issued, under the title of "Studies of Venus' Transits," those portions of Mr. Proctor's "The Universe and the Coming Transits" which relate to the transit of 1882 and to that of 1874. Some of this matter is out of date, but all that relates to the coming transit, and to the comparison between that and the transit of 1874 is as trustworthy as when originally published in the *Monthly Notices*.

Messrs. Crosby Lockwood and Co. have issued Mr. Michael Reynolds' book on Continuous Brakes. It contains illustrations and discriptions of all the best known brakes, with accounts of the various trials. We shall take an early opportunity to notice it at length.

We have received Vol. III. of the "Geology of Wisconsin," accompanied by an atlas of maps. It is a portly volume of about 750 large octavo pages and numerous plates, many of them coloured, and is an excellent example of how thoroughly the Amercians do the work of surveying their enormous country.

Dr. K. Remeis has, it is said, left a large sum of money to found an astronomical observatory in his native town of Bamberg. He has also bequeathed the observatory his 10in. refractor, and some other instruments.

The Darwin Memorial Fund amounts to about £2,500, and the memorial will take the form of a marble statue, to be placed in the large hall of the new Natural History Museum at South Kensington.

The *Panama Star* of June 8th, gives some news which should be of considerable interest if true. In repairing the cable of the West Coast of America Telegraph Co., the break was found some 400 nautical mile south of Chorillos, off Point Pescadero, in a depth of about 800 fathoms. The cable, when grappled, brought up great masses of trunks, roots, and branches of trees, and the question is, how came the trees there? as Indian tradition, like history, is silent as to any great convulsion.

The attitudes of the horse in its various paces are difficult to represent correctly in painting. Artists will doubtless be greatly aided by recent progress in instantaneous photography. A recent device for their benefit, by M. Cuyer, enables an artist, knowing the position of one limb at any period of a pace, to find directly that of the three other limbs. A jointed figure of a horse is supported above a board, on which are placed sheets of pasteboard, with figures representing the positions to be occupied by the hoofs. The hoofs have all different colours, and the figures on the pasteboard are coloured to correspond. These figures are numbered, and are in sufficient number to give several periods of the same pace. The hoofs are placed on their corresponding colours and on like numbers. Other figures give the position of other parts of the body.

A suggestion lately made by Mr. Porter, of New Haven, for deepening the Mississippi, is to produce mechanical disturbance of the bed, so that the silt, which is extremely light and soft, might be prevented from accumulating, being thrown again into suspension in the water. He proposes that a series of endless chains, running over pulleys at various distances, sunk in the stream, should be kept in motion by windmills on the bank, so as to scrape a continuous furrow in the mud.

An automatic instrument for closing a gas-supply at a given time is a welcome aid in the chemical laboratory. One such has been recently described in the Berlin Chemical Society by Herr Michaelis, and is said to have given good results in practice. It looks like a small, round alarum-clock, and has on either side a nipple, for connection of the caoutchouc tubing (thus passage is afforded through the body of the clock). A hand corresponding to that of an alarum, is set to the hour at which the gas is to be shut off; a wheel liberated at that hour closes a cock on the tube within the instrument. There is a slit in the top of the clock, with a projecting brass arm connected with the cock; by turning this, one may, independently of the clock-work, lessen, or shut off altogether, the supply of gas. The apparatus, it is noted, will serve for other kinds of gas besides luminous; and another application is, automatic stoppage of gas-motors.

From an examination of a number of firing arrangements for steam-boilers and in dwelling houses in Stuttgart, it has been inferred (we learn from the *Chemiker-Zeitung*) that the increase of carbonic acid in the air is due to other kinds of fires more largely than boiler furnaces. It is reckoned that house-fires increase the carbonic acid about 100, boiler-fires about 60, breweries about 8·5, bakehouses about 0·5, forges about 2·7, and casting-houses about 5·4 per cent. The 222 boilers produce daily 194,000 cubic metres of carbonic acid, and 467 cubic metres of sulphurous acid.

It is noted in the Berlin *Reichsanzeiger* that a violent thunderstorm which burst over Berlin on Whit-Monday did no damage to the telephonic lines or insulators—an evident proof that these lines do not attract lightning, and present no danger. The lightning conductors, at offices where telephones were in use, did good service. While these were in action, communications were, of course, temporarily interrupted.

At a recent meeting of the French Physical Society, M. Bouty described a form of the Daniell devised by M. Terquem. It differs from the Callaud pile only by addition of a stopcock at the lower part of the vessel, allowing, from time to time, part of the liquid to run off, so as to avoid the deposit of copper on the zinc, due to diffusion of sulphate of copper. By removing every 24 hours a litre of liquid, and replacing with an equal amount of sulphate of zinc solution, the battery is kept in good condition. The liquid removed rests on granulated zinc, which precipitates the copper and produces sulphate of zinc; it is this liquid that is introduced anew into the battery. The resistance of these elements is pretty great, but it varies very little.

The Committee of the Municipal Council in Paris, which has to do with the question of a Metropolitan Railway, has recently had a table prepared, showing the traffic on the various lines of omnibuses and tramcars in the city. It appears that the line on which most passengers are carried is the omnibus line Madeleine-Bastille. This is also the shortest line in Paris, being only 4,588 mètres, while that between the Panthéon and the Place de Courcelles is 7,567 mètres. On the Madeleine-Bastille line, the number of passengers last year was 14,803,632. Next comes the tramway between Montrouge and the Chemin de fer de l'Est, which has about 10½ million passengers. Then, in order, the tramway Etoile-La Villette, over 9 millions; the tramway Saint Ouen-Bastille, nearly 9 millions; the omnibus line Clichy-Odeon, ditto, &c. The lowest number given is that for the line Forges d'Ivry-Mont St. Michel, 333,095.

The history of that important invention, the Giffard injector, is related by M. Barrault, in a recent number of *La Nature* (July 1st). Again, we note that, in *La Lumière Electrique* (June 24th), M. De Chanzy traces the early history of electric incandescent lamps—a matter he long occupied himself with. He was incited to invention in this sense by his professor and friend, M. Jobard, of Brussels, who, in 1838, published his idea that "a small carbon, as conductor for a current in a vacuous chamber," would give an electric lamp of intense fixed and durable light. M. de Chanzy first tried to make such lamps in 1844 with retort carbon; and having made this homogeneous by filling the pores with melted resin, or saccharine matter, and annealing, he produced a lamp which was an experimental success, but not applicable practically. He next tried platinum; but for the rest, we must refer to his paper.

M. Moinceau has lately urged upon the French Minister of Agriculture and Commerce the importance of forming a professional school in Algeria for the manufacture of Eastern carpets. The Algerian carpets are at present far from having the reputation of those of Turkey and Persia, which are remarkable for the originality of designs, beauty of colours, and solidity of dyes. The velvet is very thick and the tissue excellent. The Algerian carpets are made for use in the country, and there is little effort after progress in workmanship. The Arabs usually weave in the tent for their own requirements, or for sale in a limited district. If a school, or a number of schools, were instituted, where young workmen and workwomen might learn the best methods extant, excellent results might be looked for. This industry appears to be increasingly occupying the Algerian natives. At the Paris Exhibition in 1855, there were 15 exhibitors; in 1867, 35; and in 1878, 79—indicating that the manufacture has, even now, considerable vitality.

The celebrated rosebush at Hildesheim, in Hanover, believed to be 1,000 years old (tradition says it was planted by Charlemagne), never bore so many roses as this season. The shoots grafted on its trunk in recent years are growing admirably. The bush stands at the outer wall of the cathedral crypt. Its branches extend about 3ft. 8in. high, and 3ft. 4in. in width. It is an object of much curiosity.

A new automatic regulator for engines of screw steamers (to prevent the "racing" of the screw when out of water), has been patented by Herr Windemann. From the account in *Dingler's Journal*, we gather that it consists of a bell crank lever with axis at the angle; one end weighted and resting, when the ship is still, on an elastic buffer, the other end connected by chains with the throttle-valve. When the screw rises, the weighted end is raised from its seat, and the chain is loosened, allowing a spring to close the throttle-valve. This closure takes place before the lever-end has completed its rise, and before the screw leaves the water. The return of the lever-end to its seat is retarded by a brake in which a piston acts on water in a cylinder, driving it out.

An interesting telephonic experiment was tried on Tuesday at Malta, according to the *Standard*, during the bombardment of the forts at Alexandria. A telephone was attached at Malta to the Alexandria cable, and connection was made with the other end of the cable on board the *Chiltern*, off Alexandria. It was found that, owing either to the distance, or to the vibration caused by the firing, it was impracticable to send a verbal message, but the firing at Alexandria was distinctly heard, through the telephone, at Malta—a distance of more than a thousand miles.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. PASSMORE EDWARDS.

*** *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

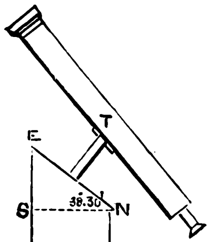
PROFESSOR PICKERING ON THE WEDGE PHOTOMETER — COMET WELLS—SMEATON'S BLOCK—DECIMAL OF THE YEAR—ROTATION OF THE EARTH—THE COMING TRANSIT OF VENUS—WEATHER FORECASTS—THE MOON'S DECLINATION.

[20260.]—AT the meeting of the Royal Astronomical Society, on November 11th, 1881, Professor Pritchard described a contrivance of his own for measuring the relative brightness of stars. (ENGLISH MECHANIC, Vol. XXXIV., p. 250). It consisted, as may be seen by reference to your last volume, of a wedge of coloured glass sliding in front of a diaphragm on the eyepiece of a telescope, such diaphragm being pierced with a small hole to direct the eye. The originality of Dr. Pritchard's device was questioned at the time (somehow it would seem that "some German" had indefensibly anticipated more than one of his previous inventions) without, however, as it appears on this occasion, much warrant. My object in reverting to the matter here is, though, to call attention to the valuable testimony which has been borne to the practical use of the learned Professor's application of the dark wedge, in a paper by Professor Edward Pickering, read before the American Academy of Arts and Sciences, on the 10th of last May, for a copy of which I am indebted to a friend. As may be expected from so thoroughly practical and experienced an observer as Professor Pickering, however, he suggests more than one very obvious improvement in the contrivance itself, and in the mode of using it. One of Professor Pickering's simplifications will be best described in his own words. "It is," he says, "only necessary to insert in the field a bar parallel to the edge of the wedge, and place it at right angles to the diurnal motion, so that a star in its transit across the field will pass behind the bar and then undergo a continually increasing absorption as it passes towards the thicker portion of the wedge. It will thus grow fainter and fainter until it finally disappears. It is now only necessary to measure the interval of time from the passage behind the bar until the star ceases to be visible, to determine the light. Moreover, all stars whether bright or faint, will pass through the same phases, appearing in turn of the 10, 11, 12, &c., magnitude, until they finally become invisible. For stars of the same declination, the variation in the times will be proportioned to the variations in the thickness of the glass. But since the logarithm of the light transmitted varies as the thickness of the glass, and the stellar magnitude varies as the logarithm of the light, it follows that the time will vary as the magnitude. For stars of different declinations, the times of traversing a given distance will be proportional to the secant of the declination." The fundamental constant (A) was determined by Professor Pritchard by the method of limiting apertures. Professor Pickering's simple, and (theoretically) more accurate mode of determining this constant, must be sought in his own paper. I have said "theoretically," because, in practice, Professor Pritchard's results have been found to correspond very closely indeed with those obtained by totally different methods. At all events, Professor Pickering's personal testimony to the efficiency of the Savilian Professor's ingenious adaptation can only tend to inspire additional confidence in it.

I do not think that either your readers, or Mr. Mills himself, can now complain of the reproduction of his excellent and truthful drawing of Comet Wells, which appears in letter 20215 (page 378).

"Smeaton's block," concerning which "J.C.L." puts query 47294 (p. 387), is nothing in the world but a wooden cylinder with its top bevelled at an angle equal to the co-latitude of the place of observation.

If, then, the pillar of the ordinary table-stand of a telescope be screwed into the bevel, and accurately square to it; and if, further, the bevel itself be placed so as to coincide with the plane of the Celestial Equator, we shall have a form of equatorial mounting at once. The annexed figure



shows a Smeaton's block cut for the latitude 51° 30′. The angle E N S = 38° 30′, the co-latitude. N S. is the direction of the meridian, and T is the telescope.

In reply to "J. C. L.'s" next query (47295, p. 387), the decimal of the year is calculated by the very simple process of dividing the number of the day of the year (supposed to begin at noon on January 1st) by 365·242. Thus, what fraction of the year is it at noon on July 14th? July 14th is the 194th day of the year, and 194 divided by 365·242 will be found to be ·5312. Hence, any phenomenon stated to have been observed 1882·5312 must have occurred at noon on July 14th of the present year—and so on.

The answer to query 47314 (p. 388) entirely depends upon the particular body to which "Cymro" refers the Earth's rotation; because while with reference to any fixed star she rotates 366 times on her own axis during the year; as referred to the Sun, she only turns round 365 times. This is, pretty evidently, because she is revolving round the Sun, and that hence the Sun appears to be moving (in the opposite direction) among the infinitely distant fixed stars. When, therefore, any meridian—say that of Greenwich—is synchronously opposite to the Sun and a fixed Star, at apparent noon on any given day, when the terrestrial rotation again brings that star on to the meridian the next day, the Sun will seemingly have moved nearly two of his own diameters to the East, so that the Earth will have that piece more to turn upon her axis before our supposed station again comes up to him. "Cymro" will find this all illustrated and explained at length on p. 595 of your Xth Volume.

With a preliminary protest against the too flattering terms in which "Orderic Vital" refers to me in the final paragraph of letter 20242 (p. 402), I would say that, as soon as I have a little leisure, I shall be happy to do what I can to render intelligible the principles on which the observations of the coming transit of Venus will be made.

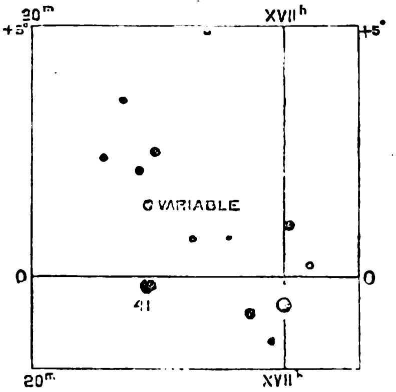
If (as alleged in letter 20249, p. 404) Captain Newton really "has discovered the causes which regulate the wind and weather . . . and that with proper appliances at his disposal, he can correctly forecast the weather, the world over, for years in advance," I can only say that the sooner the Government shuts up the Meteorological Office and subsidises Captain N. to reign in its stead, the better for the interests of the British nation. Unlike most prophets, however, Captain Newton's honour would seem to be confined to his own country; although it seems odd—to say the least of it—that the name and fame of a man possessing the quasi-miraculous powers of prevision asserted for him should be so utterly unknown beyond Newcastle. Mr. Mitchell's claim, though, for this Northern Light, seems to me to partake altogether of the character of what is called, in society slang, "rather a large order." "You may as well," says the schoolboy whose ethics are a little hazy, "tell a good 'un at once!"

To reply to query 47347 (p. 412) in extenso would require a pretty long article, instead of a paragraph at the end of a letter written in the very extremity of haste; but I may just say here that the inclination of the Lunar Orbit to the Earth's Equator is a very material factor in her diurnal change in Declination. To begin with, the mean value of the inclination of the Orbit of the Moon to the Ecliptic is 5° 8′ 42″; but sometimes it will be inclined to our Equator at this angle more than the Obliquity of the Ecliptic, and sometimes at 5° 8′ 42″ *less*. Here is a preliminary source of considerable variation in the total difference in her declination. Then, again, when she is crossing the Equator, her movement in her Orbit tells most in changing her declination; and when she is moving parallel with it obviously has the least effect in doing so. And, further, when she is in perigee, her motion is notably more rapid than when she is in apogee. If, then, we consider that the line of Nodes of the Moon's Orbit is perpetually shifting round on the Ecliptic in the opposite direction to that in which she is travelling (and this, be it noted, at a rate which is not uniform); that her line of apsides (or her perigee and apogee) goes right round the heavens in a little less than nine years, and that the eccentricity of her Orbit is very appreciable, indeed; that, in fact, neglecting further detail, her path in the sky is a most complicated one, consisting of a series of spirals, contained within a zone extending nearly 5° 9′ on each side of the Ecliptic, and varying most materially both in direction and velocity, it will be easily seen that her change both in Right Ascension and Declination must be of a perpetual and most varied character.

A Fellow of the Royal Astronomical Society.

SAWYER'S VARIABLE STAR U OPHIUCHI.

[20261.]—THE very interesting notice of Mr. Chandler's discovery of the short period of Mr. Sawyer's variable D.M. + 1·34·08° leads me to forward to you a small chart, by which it may be easily found by those of your readers who care to look for it. The chart is taken from the "Uranometria Argentina" of Dr. Gould, and as it is the copy of a copy, there may be slight inaccuracies; but it will be correct enough to allow of the star being found easily with the aid of an opera-glass.



The history of this star is very brief. Its variation was suspected by Dr. Gould first, who fixed its limits at half a magnitude 6·0 to 6·5. Its R.A. = 17h. 10m., and its Decl. + 1° 21′ for 1875. Mr. Sawyer, in 1881, found a period for this star. He made its period D. 5 24. Mr. Chandler now gives its period as D. 0·83, as given in your "Scientific News."

I made some observations of this star in May, which led me to believe that the period given by Mr. Sawyer could not be correct. Here are my observations:—

May	14		6·4
„	15		6·8
„	16		fainter.
„	18	11½h.	6·0
„	19	11½h.	5·9
„	21		6·0
„	22		6 6
„	25		6·7

My observations were then necessarily discontinued. These observations were all made with an opera-glass.

The new variable lies 1½° N. of 41 Ophiuchi. This star nearly marks the Equator. It is the second of a delicate curve of five stars, the first of which is β Ophiuchi, while the third is 30, the fourth 23, and the fifth the big star ρ Ophiuchi. Mr. Sawyer's new variable will be U Ophiuchi.

T. E. Espin.

γ VIRGINIS, α VIRGINIS, 70 OPHIUCHI, CASTOR, &c.

[20262.]—VERY few measures of the small and distant *comes* of γ Virginis have ever been made, owing probably to its faintness and present distance from the bright stars, as γ has usually been measured in twilight or daylight. It is an interesting object, however, from the fact that about 200 years ago it and the binary formed a fairly close triple star, though of course none of the telescopes then existing were capable of showing it as such. Sir W. Herschel does not mention it in his observations of γ from 1780 to 1803, though its distance from the bright stars was about 53″ in 1780. It is first noted in Sir John's first Catalogue as a 15*m* star at 90° + 60″ + (1826·2), and is alluded to in his 4th and 7th Catalogues; but, as in the case of the first Catalogue, the data are mere estimations. Smyth also alludes to it in the "Cycle" and "Spec. Hart." H_2 measured the angle (88·5°) in 1832·4 with the 5in. Tulley, and remarks "exceedingly difficult," but he did not measure the distance; Lamont measured the distance (82 5″) in 1838·4 with the 11in. at Munich, but not the angle. The only complete and other measures I know of are β's, 88 0°: 102·78″; 1880 27 (3*n*), magnitude 11·6 Σ; the southern star (B) of the binary pair being taken as the initial point. This faint star has been distinctly seen by Mr. Ward and myself with 3in. aperture. There is a $9\frac{1}{2}^m$ star (Arg. (− 1° 2600) about 280″ *s* a little *p* γ.

α Virginis. In *Monthly Not.* XL. p. 517, Mr. Burnham mentions a faint (12^m Σ) companion to Spica at 32·9° : 144·8″ : (1879·2.) This minute star was discovered by Mr. Ward of Belfast (and independently by myself), in April 1874; both of us using 3in. refractors. It is a much fainter and closer object than Smyth's star at 62° : 360″. Smyth says of Spica, "This beautiful star is in a clear dark field, and, in a manner, insulated, for it has no *comes* nearer than the one described."

70 *Ophiuchi.* This interesting binary has two distant companions, alluded to by Smyth, but first measured by Se. He gives *a* 11^m. (Σ) 215·08° : 87·514″; *b* 12^m (Σ) 67 2° — 1856·627. Se unfortunately omitted to measure the distance of *b*. The only other measures I know of are Hl, *a* 197·84° : 71·304″; *b* 49·59° : 87·209″ : 1878·84. Hl. calls them both about 13^m Σ; but this estimate is certainly too low, as they are both easily visible with a 6½in. reflector. If *a* is fixed, its place in 1878 should have been about 229° : 75″, instead of the observed position. If Se's measures of *a* are correct, and I have no reason to doubt their accuracy, the motion of the small star is very remarkable. It should be carefully observed.

Castor. H and So measured a very distant comparison to Castor on one night in 1823, finding 224·25° : 177·114″, "measures, perhaps, a little inaccurate." Smyth alluded to this as "another very small acolyte at a distance, in the *s.p.* quadrant of the field," to which Mr. Chambers, in his new edition of the "Cycle" adds, "[which, however, appears to have no physical connection with the primary: at least the alteration in angle and distance are so small in half a century as to seem accidental."] I do not remember any measure of this object which could warrant this strange statement. If no change has occurred, the presumption would be that this small star *is* physically connected with Castor. I should be glad to hear of any recent measures of this star.

With regard to some of the stars mentioned in Mr. Perry's interesting and valuable communication (letter 20181, p. 319), I would remark that his distance of Σ 1777 (by a misprint 1772) is considerably too small. Hl. gives 230·10° : 3·450″, 1879·40. In β 224 and 355 the measures attributed to β are De's. De's distance of η Coronæ in 1875 should be 0·86″, and Mr. Perry's distances of ζ Herculis are too small. In 1875, I found a 14^m companion to σ Serpentis (xvi^h 16^m + 1° 19′) at about 40′ distance, which I should be glad if Mr. Perry would kindly measure; about 11′ *n.*, a little *p.* σ, is the lovely pair Σ 2011 (OΣ 308).

H. S.

ζ HERCULIS.

[20263.]—THE distance of ζ Herculis, given in the little list of test objects, on p. 382 of Vol. XXXI., referred to by Mr. Simms (letter 20213, p. 377), was the best and latest I could obtain at the time of writing—viz., β's with the 18½in. at Chicago, 127·0° : 1·51″ : 1878·4 (the distances in the Mt. Hamilton (Lick) Observations are "far from satisfactory"), and knowing that the small star was approaching that part of its orbit in which it would be at its farthest apparent distance from the primary (at which period it had been seen with telescopes of about 3¼in. aperture), I included ζ in my list, placing it, however, as the last, and, therefore, most difficult object among the tests for the dividing and defining powers of a 3¼in. achromatic; and I confess I have not as yet been able to see the "absurdity" of so doing, as asserted by "F.R.A.S.," on page 110 of Vol. XXXII.—the more so as "F.R.A.S." had previously given this very star as a test for this aperture in a list on page 349 of Vol. XXXI. (a list on which I have some remarks on page 380). β's measured distance in 1880 is probably rather too small, one or two more measures would possibly have altered it somewhat, for the *comes* in 1880 had certainly not commenced to approach the principal star, but had, and has, not yet arrived at its farthest point. If Mr. Simms will refer to the measures of OΣ and Da, which were made when the small star was in about the present part of its orbit, he will see this for himself. Of course, a difference of 2-10th of a second is a very small quantity; and measures of a star of this description differ considerably *inter se.* I have before me nearly sixty observations of ζ, made by a most experienced observer, using a very fine 9½in. refractor, armed with a power of 940, and driven by an excellent clock, the measures all being made by daylight or twilight; yet, on one occasion, two sets of measures, taken at an interval of only three weeks, vary from 0 88″ to 1·18″, and on another two sets made within a fortnight of each other vary from 1·10′ to 1·64″. Perhaps it may not be out of place, in connection with this question, to draw attention to a fact which I believe is not generally known—viz., that Σ's so-called "measured" distances below 0·8″ are not measures, strictly speaking, but only careful estimations; "non mensuratæ proprié, sed potius taxatæ," he says. It should not be forgotten that though Da's rule was founded on a very large number of experiments, yet those experiments were made many years ago, and the largest instrument employed in them would be considered of quite a moderate size at the present day. According to his formula the separating power of the Dorpat reflector was 0·48″, yet this telescope on some occasions showed stars only 0·35″ asunder, "disjunctæ lineola subtilissima," and a modern refractor by, say, Alvan Clark, of the same aperture would, I think, be unquestionably finer than the Dorpat.

A short time ago I was reading an account of the performance of a 6in. (French) refractor by MM. Brunner, which has lately been mounted at the Lyons Observatory. This telescope (to quote from the account in the *Comptes Rendus*) "avec un grossissiment de 200 fois dedouble nettement le compagnon de γ d'Andromède." This seems almost incredible, excellent as the telescope appears to be, for β with the 18½in. at Chicago found the distance to be only 0·36″ in 1880·06, while Hall with the 26in. at Washington obtained 0·33″ from three nights' measures at the same epoch; therefore, according to Da's formula, it would require a 13in. aperture, and of course a high power, to separate the components. Yet M. André says he could measure the distance with the Lyons refractor !

H. S.

COMET *a*, 1882 (WELLS).

[20264.]—THOUGH this comet has not been the conspicuous object that, in accordance with theory, it should have been, it has nevertheless been a most interesting object to astronomers. Not only on account of the great difference between its observed and computed brightness, but because its spectrum has differed so considerably from all the comets that have been spectroscopically examined since 1864.

Sodium appears to be one of the chief constituents of this comet; indeed, the D lines have been so conspicuous in its spectrum, that, according to the Greenwich observers, "the comet might almost be said to shine by monochromatic light." From the observations of Dr. Copeland at Dun Echt, and Prof. Vogel at Potsdam, both of whom have succeeded in dividing the D lines, it is evident that the density of the glowing gas must be very great. In fact, there was a sufficient amount of this substance to impart a decidedly yellow tinge to the nucleus; this I particularly noted on May 31st.

From these revelations of the spectroscope, I think we may conclude that it is owing to the presence of sodium that the comet has not proved itself so brilliant an object as it was expected to be.

London, July 9. **B. J. Hopkins.**

PTOLEMÆUS—TESTS FOR 3in. TELESCOPE.

[20265.]—ON July 8th, 12.30 a.m., 3½ hours after last quarter, I had a good view of Ptolemæus with 3in., p. 160.

One of the so-called pits, seen by your correspondent, Mr. A. S. Williams (20236), viz., the one under S. E. wall, appeared as an indistinct ring; but it gave me the impression of a shallow saucer-shaped depression. There appeared to be no trace of shadow, either inside or outside. Just N. of the crater was a similar appearance. The ring of this was more clearly defined than the first, and slightly larger than the crater. Here again there seemed nothing to indicate depth. Another ring, about 4 diameters of the crater S. was by no means so distinct, indeed, scarcely held satisfactorily at all. I fancied they were all getting more distinct as the terminator approached the W. edge of the wall; but clouds interrupted observation for the night, and I saw no more. The ridges, &c., mentioned by Mr. Williams were not seen at all.

Will "F.R.A.S." kindly give me the present distances of the pairs λ Ophiuchi, τ Ophiuchi, and ξ Ursæ. In the case of the two latter I get a clear black line division between the discs with 160; and the first I divided easily last night by screwing off the field lens of 160 eyepiece. Are these sufficient tests for 3in. aperture? I am a beginner, and my telescope is a new one (not a five-pounder by the way), whose performance has pleased me much so far as I am able to judge of it.

E. S. Beaven.

CATALOGUE OF SUSPECTED VARIABLE STARS.—II.

Aries—Auriga—Bootes—Cancer—Canes Venatici—Canes major et minor—Capricornus Cassiopeia.

[20266.]—WE beg to continue our catalogue of suspected variable stars:—

		h. m.	° ′		
	ARIES.				
49.	Arietis	—	—	6·3	Herschel.
50.	25	—	—	5·7	Herschel.
51.	38	2 37	+ 11 51	4·1	Herschel.
52.	47	2 50	+ 20 5	4·8	Herschel.
	AURIGA.				
53.	16 Aurigæ	5 8	+ 33 12	5·	Franks.
54.	υ	40	+ 37 15	4·3 — 5 3	Espin.
55.	π	51	+ 45 55	Var. Col. Mag. Spect.	Secchi.
56.	B. 141	6 9	+ 39 30	6 9 — 8	Birmingham.
57.	65	7 12	+ 37 2	6	Franks.
	BOOTES.				
58.	υ Bootis	13 43	+ 16 26	—	Schmidt.
59.	Arcturus	14 10	+ 19 49	Col. and Spect.	Secchi.
60.	15	17	+ 10 47	—	Herschel.
61.	B 327	18	+ 8 38	6 – 7½ and Col.	Birmingham.
62.	B 328	18	+ 26 15	7½ — 9 and Colour.	Birmingham.
63.	31	31	+ 8 41	5·4	Gould.
64.	LL 27017	43	+ 8 30	6·0 — 7·0	Gould.
	CANCER.				
65.	36 Cancri	—	—	6·4	Herschel.
66.	37	—	—	5·9	Herschel.
67.	ι	8 37	+ 29 12	5·5	Dembowski.
68.	52	—	—	6·7	Herschel; Gore.
69.	B 211	8 48	+ 17 41	6½ — 8½ Var. Col.	Birmingham.
	CANES VENATICI.				
70.	60 B. Can. Ven	12 39	+ 46 9	6·	Schmidt.
71.	B. A. C. 4632	13 45	+ 35 11	5·	Franks.
	CANIS MAJOR.				
72.	ν^1 Can. Maj.	6 29	— 18 32	4·7	Herschel.
73.	ν^2	31	— 19 8	4·0	Herschel.
74.	ν^3	31	— 18 6	4·2	Herschel.
75.	L 2470	45	— 27 11	6·0 — 7·0	Gould.
76.	θ	47	— 11 51	4·5	Espin.
77.	ε	53	— 28 48	2·6	Herschel.
78.	σ	56	— 27 45	3.6	Gould.
79.	8	7 3	— 26 12	2·9	Herschel.
80.	27	8	— 26 7	4½ — 6½	Gore.
81.	30	13	— 24 24	5 3	Herschel.
	CANIS MINOR.				
82.	β Can. Min.	7 20	+ 8 32	3·9	Herschel.
83.	δ^2	26	+ 3 35	5·2	Herschel.
84.	9	27	+ 3 41	5·2	Herschel.
85.		34	+ 8 39	6·8	Baxendell.
86.	4414970	35	+ 3 54	6·3 — 7·0	Gould.
	CAPRICORNUS.				
87.	48381 Capric.	20 7	— 27 24	6 — 2	Gould.
88.	V	9	— 21 42	6 — 8	Gore and Secchi.
89.	Anon	23	— 12 38	6¾ — 8½	Gould.
90.	29	21 7	— 15 47	6	Franks.
91.	Pxxi. 87	14	— 23 18	7	Franks.
92.	41	33	— 23 56	6	Franks.
93.	46	37	— 9 46	5	Franks.
	CASSIOPEIA.				
94.	ε Cassiopeiæ	1 45	+ 63 5	4·1	Herschel.
95.	54	—	—	5·4	Herschel.
96.	B 658 Cassiopeiæ	23 55	+ 59 41	7 — 9	Birmingham.

T. E. Espin.
W. H. Gage.
T. Read.

(*To be continued.*)

RAILWAY-SIGNALS.

[20267.]—RAILWAY-SIGNALS are things on which a great deal depends, and on which no misapprehension should exist; and yet, when we come to examine the arms at different places, we find many different angles are shown for what is intended to be the same signal. Be this as it may, steps are now being taken by one of the large companies to make every signal work uniformly, and to establish a rule by which this uniformity may be brought about; and, for all that I know, other companies may be doing the same. The reason for submitting this question to your readers is to see if they approve of the following angles for the various signals:—

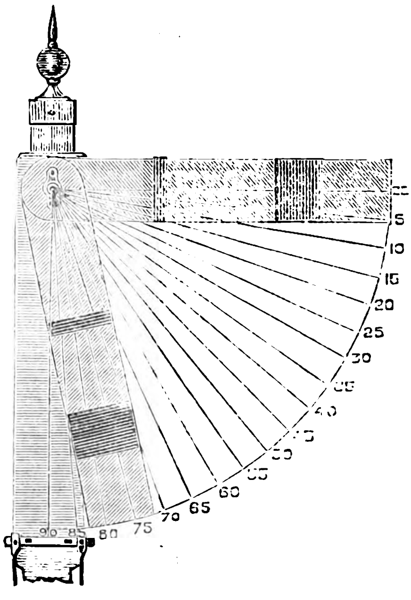
Danger.—Arm to be horizontal; but to be taken as a danger-signal 5° above or 5° below that position. From 5° to 45° to be treated as a "Doubtful signal," and worked on as "Danger."

Clear. — Arm-in-arm position between 45° and 85°.

No Signal.—Arm down into post, and obscured from view—85° to 90°—to be treated as "Danger" signal, if it should occur after the arm has been brought into use.

If anyone disapproves of these angles, will he be so good as to say so, as by doing this assistance will be rendered in settling a somewhat important question? Some controversy also exists as to how the quadrant is to be taken—i.e., whether the degree should be opposite the centre of the arm or the bottom. This latter may seem ludicrous, but a sketch in my possession (just received from an authority) shows the bottom of the arm cutting the degree intended, and not a line drawn from the axle through the centre of the arm. The line is, however, taken from the same centre in the former instance, but the arm is drawn as stated.

The inclosed tracing shows the arm at zero, that point being opposite its centre; and the arm as shown for 85° by the authority in question. I see, on perusal, that I have drawn this second arm about 2° too far to the right—friends will note this correction—and then say what they think of it for 85°!



H. Stooke.

THE BERLINER VIOLIN.

[20268.]—To see one's efforts and experiments appreciated by the approval of experienced critics should be the first consideration to every inventor, hence I feel grateful for the most encouraging words of "Fiddler" in his critique on the violin which I sent to the Editor of this paper. But I would consider the battle only half won if I could not soon draw from my worthy critic further concessions, particularly in reference to his doubt, that first-class made instruments are not improved by the resonator. Permit me to state that, since I sent the violin, I have made a further step ahead, and I soon will take pleasure to ship to our friend "Fiddler" an instrument illustrating the improvement. I agree with him in that portion of his remarks which refers to the distribution of pressure, and his assertion that the treble strings gain more than the lower ones; but I can meet this with my latest resonator, which is all of metal, cast in one piece, and on which the hole where the bass is attached lies lower, proportionally, than the others. I am unable to judge the result of the resonator on a violin without a post, but hope to have occasion to see the results of "Fiddler's" studies on double soundboards. In the mean time I expect to prove that, whatever weak points may occur in the beginning of a new departure, they are subject to, and capable of, correction. Until then, I intend to withhold the sale of resonators, as I mean to put the invention on sale only after I am fully satisfied with it.

Boston, U.S.A., June 27. **E. Berliner.**

[20269.]—In reference to this modified violin, I have made the addition to an indifferent instrument which I possess, after the published drawings of Mr. Berliner. It is beyond contest that the bass, the two strings D and G, are improved. I cannot, however, say the same for the treble, the two strings E and A. With the particular instrument which I experimented upon, the treble was not improved, though modified. This being the case, I cut away the end of the soundboard to free the E and A strings, and strung them up, as usual, upon the tail-piece, and allowed the other two strings alone to have the soundboard to themselves. This results in the instrument being permanently improved; but the tone on this common instrument certainly falls short of the tone which I have heard and got out of good instruments made in the usual way without any addition; but this particular violin is certainly improved. **B. Warwick.**

Highbury, N.

A NEW FORM OF STEAM-ENGINE.

[20270.]—I have pleasure in handing you a description of a new form of steam-engine designed and patented by Robinson and Heath, engineers, West Bromwich, which I have inspected by permission.

The principle claimed for this engine is that it has two moving parts, the cylinder moving and performing a stroke as well as the piston, each operating on the same crank-shaft, and dividing or distributing the force applied to the crank in the same manner as is usually effected by a pair of cylinders.

The cylinder is so contrived as to move or slide between guides or motion bars in the same manner as the crosshead of the piston moves, and has a pair of connecting-rods coupled to cranks on the shaft which are set at an angular distance from the piston-crank on the same shaft, to equalise the motion and overcome the dead points.

The slide-valve and ports are on the cylinder as usual; but the steam-pipe has a telescopic joint with a stuffing-box, so as to vary its length to accommodate the stroke of the cylinder.

The steam being admitted, drives the cylinder and piston in opposite directions, alternately separating and bringing them together again, each moving half the distance that the piston would have to travel if the cylinder were fixed; these half-strokes are, in fact, the strokes of the cylinder and piston respectively as applied to the cranks, the whole distance moved between cylinder and piston being a double stroke or revolution. This arrangement produces a near approximation to a uniform rotary motion.

The advantages possessed by the moving cylinder over a fixed cylinder engine are very apparent, for, in all cases where two cylinders are placed side by side, as in the locomotive, or in other position with respect to each other, for the purpose of dividing the force applied to the crank-shaft and overcoming the dead points, this engine effects the same object with its one moving cylinder.

The test of an engine on this principle clearly demonstrates the great freedom with which this kind of engine works, the friction and vibration being reduced to a minimum, and in consequence of the shortness of the stroke the gearing is stiff and compact.

There appears to be also an advantage in the admission of the steam between the two yielding surfaces of cylinder and piston, its elastic force coming more directly into action, and the recoil and back pressure being considerably reduced.

One of these engines has been tested against an ordinary engine of the following dimensions, both being new engines:—

Robinson's.—Diameter of cylinder, 16½in.; area, 204·21ft.; stroke, 30in.; double, 5ft.; steam pipes, 3in. diameter; area of ports, 8 sq. in.; pressure in boilers, 25lb.; flywheel, 7ft. 6in. diameter; weight of flywheel, 1·1 ton; weight of cylinder C, 9 cwt. moving. Force to move is 9lb. per stroke.

Ordinary.—Diameter of cylinder, 16in.; area, 201; stroke, 36in.; double, 6ft.; steam pipes, 4in. diameter; area of ports, 12 sq. in.; pressure in boilers, 25lb.; flywheel, 9ft. diameter; weight of flywheel, 3 tons; cylinder fixed. Force to move is 9lb. per stroke.

$204\cdot21 \times 25 \times 5 = 25526\cdot25$, working 54 revolutions during experiment; $\frac{54 \times 25526\cdot25}{33,000} = 42$ H.P.

$201 \times 25 \times 6 = 30150$, working 40 revolutions during experiment; $\frac{40 \times 30150}{33,000} = 36\cdot5$ H.P.

Each engine was tested by means of a brake and lever attached.

Each engine had a 4ft. pulley, and these were used as brake wheels; the levers were of timber, the fulcrum 6in., and the leverage was 13·5 to 1, the friction band consisted of a leather driving-band.

Leverage, 13·5 to 1 on 4ft. pulley; weight of lever, 59·5lb. $\frac{59\cdot5 \times 13\cdot5}{2} = 401$ constant weight to be added in each case for lever.

Robinson's Engines.	
79·5lb. on lever	78lb. on lever
$79\cdot5 \times 13\cdot5 = 1073\cdot25$	$78 \times 13\cdot5 = 1053$
Lever 401	Lever 401
1474·25	1454
Speed, 54 revolutions.	40 revolutions.
$54 \times 5 \times 1474\cdot25 = 398018$	$40 \times 6 \times 1454 = 348960$

But these are over a brake 4ft. diameter, which is nearly 12·5 circumference.

$\frac{398048 \times 12\cdot5}{5} =$	$\frac{348960 \times 12\cdot5}{6} =$
995120 ft. lb.	872400 ft. lb.
$\frac{995120}{33000} = 31\frac{1}{2}$ H.P.	$\frac{872400}{33000} = 26\frac{1}{2}$ H.P.

Extra weights were added to pull up the engines, and it was accomplished by—

1st weight 79·5	1st weight 78
2nd " 57·0	2nd " 29·5
136·5	107·5 lb.

showing a difference of 29lb., or ¼·7 more work, being over 27 per cent. in favour of Robinson's engine in pulling up, and running with the load Robinson's shows 20 per cent. more h.p.

Robinson's engine, while possessing all the advantages afforded by a pair of cylinders, occupies only half the space, and it is evident that there is only half the friction, and the usual rigid foundation required for a fixed cylinder would be unnecessary for this engine. **George H. Wood.**

West Bromwich.

THE WILLANS ENGINE.

[20271.]—It would be interesting to know what are Mr. W. Trathern's objections to the above engines (letter 20202, June 23rd). They have proved so very successful in launches, tugs, &c., that any scientific criticism would interest greatly your readers. Considerable credit, I think, is due to Mr. Willans for his judicious abolition of slide-valves, eccentrics, and link motions in launches, together with the attendant noise and irritation. I know of no engine which makes so little noise and requires so little attention. **Octurus.**

MR. JEFFREY'S TRICYCLE SEAT.

[20272.]—Perhaps Mr. Jeffrey will permit me to suggest that a more appropriate name than the one he has used for his new tricycle seat would be to christen it the "Blood" seat, after the inventor (see "E. M.," No. 865, Oct. 21, 1881); or the "Dublin" seat, after the tricycle on which it was first used. All I have done is to describe it and advocate its great merit.

Here it may be well to state that the "Dublin" seat, to be fully appreciated, should be used on a machine having a more or less forward thrust. It is not so well suited to tricycles with vertical action. These latter would appear to necessitate a saddle.

July 8th. **W. H. Stacpoole Westropp.**

STONEHENGE AND SUN-WORSHIP.

[20273.]—It may be probable, as "Neo" states, that the stones in question are connected with sun-worship: we will grant him that they are; but we must, of course, work on assumption when speaking of a structure set up in such remote ages. At any rate, I am certainly of opinion that the stones were connected with astronomical observations, and that they were put into position to register the point at which the sun stood at a certain time, that time being the date of earliest sun-rising. This was, perhaps, the only measure they had of the year, and it is very probable that the formation of a yearly register was the chief object of the stones pointing towards the sun. Be this as it may, it will be admitted that no inconsiderable amount of observation must have been made to ascertain the earliest point of sun-rising in those ages. The two stones were perhaps put into position at first so as to point at what was supposed to be the earliest rising, and this reading might have then been corrected during the next year. No little trouble must have been experienced by the performers of the task. "Neo" states, we "must date back to a time long before astronomy, as a science, was thought of." But I cannot agree with him, seeing that astronomy had to be studied, however limited that study might have been, before the stones could be put into position. I mean the particular stones directed towards the sun. The other large stones arranged in circles might have supported a roof of wickerwork or skins, or both combined; but the probability is that they formed some mysterious circle connected with religious rites.

I see no grounds for assuming that these gigantic stones were erected in the Neolithic or Palæolithic ages, for they weigh from ten to twelve tons each, and there is no similar material to be found for a very considerable distance off, and how they were conveyed to their destination is a mystery. But this is not so mysterious as the hewing, and the forming of the mortice and tenon, which keeps the horizontal stones in position. Could this be done with pieces of flint? These horizontal stones also have to be raised some 15ft. or 20ft. All these feats seem in advance of the Neolithic or more advanced Palæolithic age.

Again, because flints have been found on Salisbury Plain which formerly constituted weapons, it does not follow that Stonehenge was erected during their age—a man might die to-morrow in a cave full of these flints, and in twenty years hence we might see advertised in bold letters—"Discovery of a Wonderfully complete Skeleton of Neolithic Man," together with extenuated accounts of his accompanying weapons. To sum up, I should fix the time of the erection of Stonehenge as that in which the Druids held sway in England. Even at this advanced date, the mystery of erection does not, to my mind, appear clear.

Paddington, July 6th. **H. Stooke.**

GAS-ENGINE EXPLOSIVES.

[20274.]—With regard to the power that can be developed by explosions of a mixture of gas and air (letter 20221), it is not difficult to calculate what will be the limit of the power developed. If we burn one gramme of hydrogen with sufficient oxygen to form water, we develop about 34,000 (gramme degree centigrade) units of heat.

Now, by Joule's experiments on the mechanical equivalent of heat, 1 gramme degree unit of heat is equal to $4\cdot156 \times 10^7$ ergs (an erg being the unit of work, in gramme centimetre second units). One foot-pound is equivalent to $1\cdot356 \times 10^7$ ergs.

To find the value in foot-pounds of the combustion of one gramme of hydrogen, we have—

$$\frac{4\cdot156 \times 10^7 \times 34000}{1\cdot356 \times 10^7} = 104,200 \text{ foot-lb.}$$

Now, whether the gas be burned explosively or quietly, with or without compression, we can never get more than 104,200 foot-lb. out of 1 gramme of hydrogen by its combination with oxygen. I do not say that in practice we do not utilise more of the power by previous compression; but whether we utilise it or not, that amount is developed.

Again, with regard to the explosion of chloride of nitrogen, this could not be calculated by the ordinary methods of combustion, since it is due to the decomposition of the compound into its elements, not to the combination with fresh elements.

It seems to me, however, though perhaps I am mistaken, that it is possible to calculate the power developed by the explosion of nitrogen chloride, in the following manner:

Suppose we take its composition to be NCl_3, though this is not certain, the atomic weight of $N = 14$, $Cl = 35\cdot5$; therefore, $NCl_3 = 14 + (35\cdot5 \times 3) = 120\cdot5$.

Taking grammes, 14 grammes nitrogen occupy 11·2 litres, and 35·5 grammes Cl occupy 11·2 litres; therefore, if we convert 120·5 grammes NCl_3 into its elements, nitrogen and chlorine, we get $4 \times 11\cdot2 = 44\cdot8$ litres, at normal pressure and temperature.

$44\cdot8$ litres $= \frac{(44\cdot8 \times 61\cdot02)}{1728} = 1\cdot58$ c. ft. Suppose the nitrogen chloride to have been in a cylinder having a frictionless piston 1 sq. ft. area, and neglecting the volume occupied by the nitrogen chloride as a solid or liquid when it decomposes, it will lift the piston 1·58 ft. high; that is, till its pressure equals that of the atmosphere. Now, in doing this, the work done is to lift the piston against the pressure of the air, which is $15 \times 144 = 2160$lb. on the piston of 1ft. area (since 15lb. = pressure of air on square inch, and 144 is the number of square inches), through a distance of 1·58ft., the work in foot-lb. is 2160 × 1·58 = 3434ft.-lb. This is done by 120·5 grammes, so 1 gramme will do $\frac{3434}{120\cdot5} =$ 27, about, foot-pounds of work.

This seems very little considering the tremendous violence of the explosion; but we must remember that gunpowder, which in small grains would burst a gun, in large cubes can be used safely, owing to its having time to communicate motion to the projectile, the only difference being the rapidity of combustion. So also it may be with the chloride.

I shall like to hear the opinions of other correspondents on these points, which are of great interest, and I am glad that J. H. Huxley has started the subject. **Ll.B.A.**

THE FOREGROUND IN SKETCHING—SCIENCE FOR ARTISTS.

[20275.]—In landscape paintings I have frequently been struck with the singular treatment not only of the immediate foreground, but of what is supposed to lie beyond it. Some artists would seem to forget that the laws of perspective apply to distinctness as well as to mere size; for I have seen pictures representing views which only a man with telescopically adaptable eyes could possibly see—a flowery hedgerow, perhaps, with a whole field intervening, painted in true proportion, but in as perfect detail as if it were only distant a couple of feet. The difficulty of your correspondent (query 47282) is a natural enough one, but he answers his own question when he says, "No one sketching a (distant) scene sees the detailed leafage at his feet." No one looking at the sketch is supposed to see it either. It is there merely to indicate, what could not otherwise be known, that the scene *is* distant. Suppose I sketched a castle, standing on a knoll, distant, say, a mile, and put in the knoll only, without any of the intervening ground. My picture would represent a knoll without detailed herbage, and an equally indistinct castle on it; and every person who saw it would consider it a very bad attempt to sketch a *near* view. It is only the presence of the foreground, and the unconscious comparison between it and what is beyond that leads us to the perception of distance in a picture at all. There is no reason, to be sure, why a sketch with the immediate foreground wanting could not be made: but the effect of it would only be that of a complete picture with a piece at the foot cut off.

I believe I am right in saying that too many artists affect to despise the aid of science in their work. Perspective is, of course, a *sine quâ non* of success in landscape painting; but physical science is also a great help. I have seen a preposterous sky put into a picture for the sake of an "effect" of colouring. The clouds certainly can assume a great many shades and tints under certain known conditions; but some tints they can't assume, even to please artists. Distant hills, again, are often given the most remarkable tints in sheer defiance of nature. Rainbows are turned outside in, moons put in impossible attitudes, and so on, all through ignorance, or the most culpable carelessness. Surely there is enough variety of scene in nature as she is to satisfy artists. When she is exhausted it will be time enough to begin making variations in her.

As no branch of science is of greater importance to landscape painters than meteorology, I hope by and by (and with the Editor's permission) to have something to say on "Meteorology for Artists."

J. A. Westwood Oliver.

Belle Vue, Springburn, Glasgow, July 1.

COLOUR.

[20276.]—It may, probably, be of little use to explain to your correspondent, S. Calton, where his mistake lies, since it appears from his letter that the explanation has already been given to him—Sir John Lubbock having most courteously replied to his letters asking for information to be found in any scientific treatise on optics. But a word or two of explanation may not be wasted in case any of your readers who have not paid attention to the subject should be misled by the statements of your correspondent.

Although Sir John Lubbock had explained that two differently-coloured lights—blue and yellow, for example—could not be compounded by superposing blue and yellow glass, your correspondent, treating Sir John's explanations with the same contempt with which he seems to regard all scientific conclusions, straightway places his coloured glasses together, since he "contends that two colours must give invariably the same result, however compounded."

It is a popular belief that blue and yellow, when mixed together, produce green. This is, no doubt, true in many cases of mixing blue and yellow pigments, or of superposing blue and yellow glass: it is altogether untrue of mixing blue and yellow light. If anyone doubts this, let him make the following simple experiment. Choose blue (not cobalt blue) and yellow glass, which, when superposed, give a fine green. Construct a wooden wheel, having a rim connected to the centre by six spokes (as narrow as possible), and have the wheel so mounted that it can be put in rapid rotation by winding a piece of string round it, and then spinning it after the fashion of a top. Now fill up the six spaces between the radii alternately with the blue and yellow glass. Let a strong beam of light fall through a small round hole through one of the coloured glass divisions of the wheel on to a white screen, and set the wheel slowly rotating. The spot on the screen will be seen to be alternately blue and yellow. Now set the wheel revolving rapidly, so that the eye no longer perceives the separate colours, but receives the impression of the single tint, due to the mixture of blue and yellow light. It will be found that this compound colour is not green, and has no tinge of green about it.

I need not offer instructions to your correspondent, who is an artist, on the methods of experimenting with mixtures of coloured pigments; but if he wishes to experiment on the effect of mixing variously-coloured light, he must adopt some other mode than that explained in his letter. There are plenty of books which give instructions on this point. One of the easiest is Mayer's "Light" in "Nature" series. **X. N. X.**

THE APERTOMETER—LANTERN OBJECTIVES.

[20277.]—It may perhaps lend additional interest to the reply of "Akakai," p. 309, June 2nd, as to a difficulty raised, p. 262, May 26, in my paper on Microscope Power, if I detail the result of the experiment which he suggested. His explanation seems to me the most concise and intelligible as regards the basis of this aperture question, which has yet appeared in your paper, or any other, and deserves the best thanks of all "brass and glass" men, like myself.

I have had the opportunity of trying the measurement of one of Powell and Lealand's wide-angled oil immersion eighths, and the process confirmed "Akakia's" prediction to a nicety. (1.) Focussed *dry* on the central silver ring of the apertometer, the reading of the pointers was just 1·00 N.A.; I could not make it less. (2). Then, on the interposition of a drop of water, the field brightened amazingly, and the pointers had to be widened to precisely the 1·25 N.A. he mentions. (3.) Lastly, oil being substituted for water, the pointers had to be removed further than the glass semi-disc of the apertometer could accommodate them; it is only graduated to 1·4 N.A., and the numerical aperture of this lens certainly exceeds that quantity.

On the other hand, trying the same experiment with an immersion one-sixth by another maker, the *dry* reading was 1·00 as before; but with *water*, the pointers stood at 1·20 only; and with *oil at the same point*. The full aperture of which the lens is capable, having already, as demonstrated by "Akakia," been measured in water.

Does this indicate that it is useless to make oil immersion lenses unless their N.A. is greater than can be obtained with lenses constructed for water immersion? It would be of assistance to many of us if "Akakia" would kindly say a little more on the subject, and especially give some instructions as to the use of the apertometer, which is comparatively a new instrument. Its description is to be found in the volume for 1878 of the R.M.S. *Journal*, but it does not seem to have yet been honoured by a place in your pages.

By examination with a Browning's table spectroscope, I find the refractive index of the glass of the apertometer used for this measurement is 1·527 for the "D" line, and 1·533 for "F." Perhaps "Akakia" will say which of these should be taken. Also, I find that the refractive index of cedar-wood oil is 1·51 (not more) for the "D" line, and the sulph. carb. zinc in glycerine is 1·50. But the calculations for N.A. homogeneous immersion given on the cover of the R.M.S. *Journal* are based on 1·52, as there stated. This makes some difference, though not much. For instance, a balsam angle of 117° 31′ comes out 1·29 N.A., with refractive index of 1·51, instead of 1·30 exactly, with index 1·52, as tabulated.

There is another way of estimating "aperture"—viz., by measuring the diameter of the apparent field of light transmitted by the objective, as viewed by placing the auxiliary lens between the objective and an eyepiece carrying a Jackson's eyepiece micrometer. But by this method my results were not so accordant as they should be. Taking the same o.g. brought to focus upon a slide, with the several interposing media in turn, the apparent diameters of field were:—The one-eighth, with air, 60 divisions of e.p. micr.; one-eighth, with water, 78 divisions of e.p. micr.; one-eighth, with oil, 89 divisions of e.p. micr.; one-sixth, with air, 63 divisions of e.p. micr.; one-sixth, with water, 71·5 divisions of e.p. micr.; one-sixth, with oil, 71·5.

The one-sixth gave the same reading with both water and oil, as it should do from what precedes; but why it should read more when "dry" than the one-eighth does under similar circumstances is not clear. The measurement was confirmed by another microscope, which gave diameters in the same proportion as the above.

By the way, May I ask Mr. Shrubsole (page 284, Vol. XXXIV.) if he found my description of lantern objectives (pages 236, 308, same vol.) of any service? **Antares.**

IS GOLD AN ELEMENTARY SUBSTANCE?

[20278.]—The interesting article in your issue of the 7th inst., on "Artificial Forms of Silica resembling Agate," reminds me of a letter I recently read in the *Mining Review*, an American journal, by Dr. D. P. Kayner, in which the writer states that while experimenting in California upon the sands and quartz for the separation of gold, he came to the conclusion that gold was not an elementary substance.

Acting upon this conclusion, he made a metal resembling gold in every respect. His *modus operandi* was as follows, in his own words: "Experiment we did; and taking certain proportions of the three baser metals, combining them with such other substances as would represent as near as possible nature's alchemy, luting the whole together in a French clay crucible and encasing that in a black-lead crucible all closely covered and luted to represent the confined state of minerals and gases in the earth. The whole was placed in a Chilton furnace and kept at its highest heat for several hours, when the contents of the crucible were poured out, resulting in a nugget of metal having all the characteristics of pure gold—viz., colour, malleability, and resistance to acids." Dr. Kayner further states that what is true of gold he has no doubt is also true of some of the other metals.

The discovery has little commercial value, as it appears to cost three times as much to make as pure gold; but as a chemical problem it is of the deepest interest, if we could only ascertain for certain that which Dr. Kayner states is absolutely true. Judging from his letter above, no doubt whatever could be raised on that score.

Worthing, July 10th. **C. H. Romanes.**

THE EXPANSION OF IRON IN THEORY AND PRACTICE.

[20279.]—In letter (20259), the writer mentions as an example a stretched cord expanding when moistened. I should have thought it was generally known that the reverse would happen. It seems a pity that such a slight mistake should have been made, and I should be sorry to see it left uncorrected.

Edward F. Carter.

Temple-Balsall, Warwickshire.

FULLER'S MERCURY BICHROMATE BATTERY.

[20280.]—The sulphate form of battery, after twenty-three years' use, has been partially—I might say almost entirely—superseded by the battery about which I write. Inquiries from time to time, made in one corner and another, have induced me to compile this letter. The makers write:—

"This battery possesses the most valuable essentials of a telegraph battery—economy of maintenance with constancy, and a potential double that of the sulphate form. Its internal resistance is very low—a valuable condition for working open lines, on which the insulation varies with every shower of rain. For instance, twenty-four cells give unvarying good signals on circuits, where, with 70 ordinary cells, the signals are either weak or strong, according to the weather. An examination of the conditions of the two forms of battery will explain this. The ordinary sulphate battery has an internal resistance of 10 units per cell, or, say, 700 units for the 70 cells; consequently, the quantitative force is very low, and the potential high. The 24 mercury-bichromate cells, having a resistance of only 48 units, yield a large volume of quantity, and consequently are capable of putting into motion a force of sufficient capacity to supply the leakage occurring at the insulators, and at the same time give an unvarying force to the instrument.

"The conduction of an exposed line wire in cold and wet weather becomes more complete, and the necessity for increasing the battery power, as it is usually done, is not in any way needed; but the maintenance of quantitative force is absolutely necessary."

Quantitative force is maintained by Fuller's battery to a marked degree, and its maintenance is cheaper than many other forms of battery. They are used by nearly all railway companies in England, and by the P. O. Telegraphs, &c.

The battery consists of an outer glass or porcelain jar, and an inner porous cell. Zinc is element in porous pot, and the carbon is placed in the glass jar. Bichromate of potass crystals (3oz.) must be put in outer jar. Mercury is put in with zinc, also sulphuric acid; a little acid also goes in outer jar. Fill with water, and battery is ready for use. Further particulars to any querists.

H. Stooke.

HOW TO MAKE A FLAT FOR A NEWTONIAN REFLECTOR.

(*Continued from p.* 351.)

[20281.]—It would be well before commencing to smooth the surface, especially if the disc has been "shanked" round, to grind the edge to a clean circle. This is easily managed if the screw bosses of tools are of the same size and thread as the lathe mandril. The tool on which the disc is cemented may be screwed on the lathe, and a piece of thin sheet-iron or ordinary tinned iron is bent to fit loosely half the circle; No. 90 hole emery mixed with water must be used with this grinder—the latter needs holding up to the edge of glass with the hand only, if the disc is chipped nicely round. If this has not been accomplished, a "jigger," on the construction described in my letters on Specula Working, will bring a most unshapely disc to a circle. I may here state that the surface should be ground down as fine as it is possible in the last smoothing emery. This is of more importance in flat work than in specula working, for in the latter case the surface must be altered in figuring from the nearest approach to spherical that is obtained in the smoothing to a parabolic form. With the flat all processes must tend to keep up the one form. The amateur worker will I have no doubt get, when he has smoothed his flat, our old enemy the depressed ring due to capillary attraction. If he has had no practice in polishing on paper, the method I now describe will serve him better. I cannot think that pitch is a good substance to use for *flat* polishing, the elastic property, so useful in parabolising, in my experience causing a lot of trouble in flat work. Rigidity, not elasticity, seems to be wanted in producing a plane; I have, however, used pitch for large speculum metal flats on account of its *polishing* properties for metal. The polisher should be made of lead ½in. thick and 3in. diameter. If our operator can turn up in one piece a leaden holder as sketched (Fig. 1) it is best, but a wooden handle can be substituted for the leaden knob. In that case a male-thread must be cut on the leaden plate, as shown at A, Fig 1. The face may be roughened with a sharp point, so that the mixture forming the polishing-face will hold well—melt and strain through cambric a mixture of 1 part rosin to 12 parts good bees-wax, incorporate with this mixture, when in a fluid state, as much fine putty-powder as will bring it to the consistency of treacle, while heated—a very little of this mixture is needed, as the depth of 3-16in. is enough for this surface. Paste a rim of note-paper round the edge of holder ½in. deep, warm the holder, set it level, and pour the mixture in to a depth of ⅜in., taking care to stir the mixture well, the putty-powder, being of such weight, will instantly sink if this is not carefully done, the result being a mottled or patchy surface. When the mixture has set, cool down well in cold water, and strip off the notepaper ring; chuck the holder in the lathe and take a cut across the face of the mixture, and trim the edge true, then turn in V-shaped grooves ¼in. wide, and leaving a ¼in. surface, a groove and surface ring alternately, as shown at Fig. 2. Turn a conical hole in centre ⅜in. at top, and with a pen-knife cut across gutters, taking care that all grooves and gutters intercommunicate. Now rub the polisher on tool No. 3, and note where it fits. It is very likely that a raised burr will be found at the edges of each surface-ring; these must be lightly trimmed down, as the tool will show, by discolouring the surface of the mixture, where it touches. The discoloured parts must be lightly scraped down until a general system of patches, very close together, are seen to cover the whole of the surface-rings. Have ready a paste of putty-powder and water, and "work in" the polisher by rubbing with elliptic strokes, first on No. 3 tool; then cleanse by washing, screw down on the bench-screw the tool No. 1, with disc attached, and feeding the polisher again with the putty-powder paste, work with elliptic short strokes for 10 minutes. It is well at this point to see how "we take," i.e., how the polish is starting: a good "take" would show at least 1½in. in the centre affected by the polisher, and say ⅛in. at the edge. This would tell us that our old enemy, which I will in the future call the *c. a* ring, has been fairly attacked.

FIG. 1.

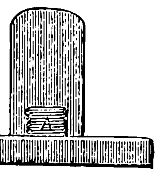
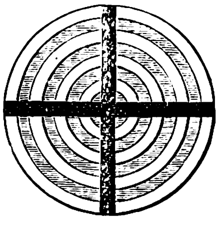
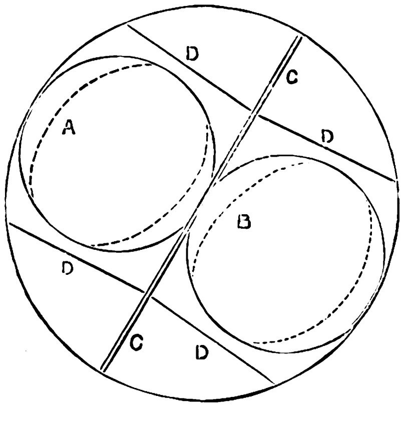


FIG. 2



It is well in polishing to alternate elliptic strokes with straight ones across the centre. As our amateur worker is not supposed to have a perfect test-plate by him, to test his working as he proceeds, in the manner described by our clever and generous friend Mr. Brashear, which test, by the way, is an old friend put to finer uses, I have thought how well our amateur may make his surface-test itself: this is the old way. Take one part of a flat surface to test another by the "colour test." I have never, however, seen the colour test depended upon finally, and rather think I should like to try my flat in front of a telescope o.g. afterwards to make sure. As I, perhaps, do not know the *refinement* of the colour test, perhaps Mr. Brashear will step in with a few hints to help us all, should this meet his eye. I will give my experience. Polishing should not take more than three hours: if a satisfactory polish is got in one hour it is better, as the "roll back" on marginal error increases with polishing. When sufficiently polished, hold a spirit-lamp under the tool No. 1, warming evenly all round, push off the disc, stand on edge till cold, then soak off the cement by placing it in a saucer of spirit of turpentine. It is best to mark the back surface with a diamond, or scratch it with a three-square scraper, so that we are not mistaken in the sides. Then make a cardboard circle 2in. diameter, and mark off with soap two circles, A and B, Fig. 3. Mark off the major axis of each ellipse in the direction of the dotted lines on the back surface. This will insure the cutting away of marginal error. Now cut the disc in halves, down the line CC, with a diamond. after dividing the disc, cut off each end as marked at DDDD, and "shank" out the two circles, leaving the soap-marked rings inside the chipped edge.

FIG. 3.



I hope to conclude in my next on this subject with colour-testing, and finally edging up the flats correctly.

Prismatique.

(*To be continued.*)

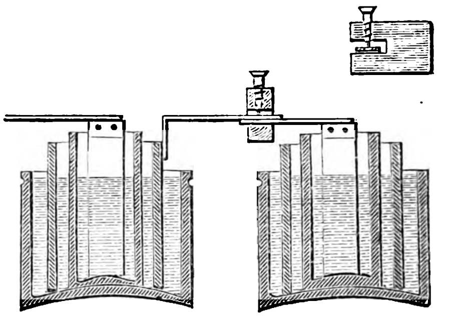
CONNECTION OF BATTERY CARBON.

[20282.]—Referring to letter 20234, the method of carbon connection suggested is faulty—the saving of ½oz. of lead at 2d. per lb., is false economy. The correspondent himself indicates the faultiness of his arrangement, as he states the lead contracts and loosens in the hole when cold. What can be worse than loose connections, allowing room for dirt, &c.? Now, by the Silvertown Co.'s plan of casting lead *outside* the plate of carbon, it tightens in cooling, and forms the best of connections—beating all your electro-depositing or platinum clip binding screws.

Electra.

CHEAP BUNSEN BATTERY—COPPERING CARBONS.

[20283.]—We have been making a Bunsen battery lately, and have found the following plan a good one for connecting the carbons. Prepare a depositing solution of 3 pints saturated solution of copper sulphate to 1 part dilute sulphuric acid (1 part acid to 10 parts water.) Place this solution in a jam-pot, with a piece of sheet-copper dipping into it. Attach a wire to this copper, and lead it to the copper of a Daniell cell. Place three of your carbons in a wooden clamp, with a thin strip of copper between the carbons and the wood. From this strip lead a wire to the zinc of your battery. Before placing the carbons in the depositing solution, paint a band of paraffin round the carbon, ¾in. wide and ½in. from the end, to prevent the copper from depositing too high up. Now place the ends of the carbons in the depositing solution, and attach the battery and leave for two hours and a half. Unclamp the carbons and wash the coppered ends; dry, and drill two holes through the coppered end of the carbon; pour hot water through these holes, to dissolve out any sulphate of copper which may have soaked in; dry thoroughly in the oven; now place in the vice, and with a soldering-iron tin the top. Attach a copper strip ⅜in. wide, by soldering. When this is completed, stand the coppered end of the carbon in melted paraffin, deep enough to just cover the holes. Allow to stand until the paraffin has soaked up the carbon about an inch. Take out and allow to set. Paint over the copper and copper strip with melted paraffin. This paraffin prevents the nitric acid from creeping up the carbons and attacking the copper and spoiling the connections. A simple form of clamp is shown in the sketch, which we found perfectly efficient and very inexpensive. Oak is a very good wood to make them of.



Holmes Bros.

MEDICAL REPLIES.

[20284.]—Taking Cold (47297).—Refer back to a former reply of mine on this subject. Otherwise your query is ineligible for answer, and you must get some local medical man to examine and advise you.

Contracted Fingers (47302).—Querist suffers from a contraction of the fingers, which is sometimes due to contraction of the tendons—sometimes to contraction of the fascia around the tendons. The diagnosis on this point can only be settled by personal examination. In either case the remedy is subcutaneous division of the contracted fibres.

Inflamed Throat (47308).—Not eligible for useful reply.

Deafness (47239).—The advice given by Mr. Dalby is excellent. But Mr. Ollard will discover, on again perusing my note, that his case is one of perforation or absence of the *membrana tympani*, Otherwise fluids or air could not be forced through the ear from the mouth and nose. The cases for which I wrote do not include such as his, all of which need discriminating diagnosis and personal advice. As to ear-trumpets, &c., they merely act by collecting large areas of sound-waves and concentrating them upon the ear. Practical trial of the various contrivances is the only guide which I can here indicate, and that which one hears most comfortably with will be the best.

Abscess in Groin (47322).—Probably glandular, and to be treated like other glandular abscesses, for which refer back to a former reply of mine. Poultice when inflamed or tender. Rest. Improve general health by careful diet and regimen, such as previously described.

Drowsiness (47333).—Not eligible for useful reply.

Stiffness in Foot (47334); Lameness (47339); and Rheumatism (47343).—Not eligible for useful reply; must have personal examination.

Excessive Perspiration (47355).—I have seen similar cases, but they are very rare. Probably due to some disease of the sympathetic nerves. Treatment would be conjectural, and not even conjecturable except upon personal examination.

Stammering (47366).—This is due to a want of due co-ordination of the complicated muscles by which speech is produced. It is easily acquired when young by nervous children who are with nurses, servants, and other persons who stutter. The habit when established is very difficult to cure. Drugs have no effect upon the habit, but it becomes worse if the health deteriorates or the child is worried and made nervous. With such children, keep up the general health by careful feeding, early going to bed, and avoid noticing or hurrying the child when it hesitates in its speech. The more the child is noticed or hurried the worse it will stutter. Let everyone about the child speak slowly and distinctly, and make the child read aloud with extreme slowness and distinctness for a quarter of an hour four hours a day to some one who is very gentle, and with whom it is quite at home. Such reading is the only method of cure, and this, if adopted early, and duly persevered with, will re-establish deliberate well co-ordinated action of the muscles, and after that is established, speed should come gradually.

James Edmunds, M D., &c.

Grafton-street, Bond-street.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[46635.]—**Imitation Marble (U.Q.)**—Probably, this can be made with Portland cement, but the colour would be decidedly objectionable. The usual process is with plaster, which should be of the finest description. This is gauged with lukewarm water, in which is dissolved size, isinglass, or gum-arabic to fill up the pores, and render the composition of a texture capable of being polished. If various tints are required, the colours are dissolved in the size-water. (Scagliola is formed with a great number of splinters [*scagliole*] of marble in the plaster.) The different colours are produced by metallic oxides: as blue, oxide or carbonate of copper; red, litharge; yellow, the yellow oxide of lead; or for green, by green enamel; grey, by ashes; brown, ashes and cement mixed; and black, by forge ashes. In best works, it is usual to mix with the plaster pounded Carrara marble. The mixture is worked together, in the form of a very damp paste, until the whole is homogeneous. When perfectly dry, the surface is rubbed with a very fine-grained grit-stone, washing and cleaning it with a sponge in the same way as marble is polished; it is then rubbed, with a linen rubber, with moistened tripoli powder and chalk: it is finished with a felt rubber, charged with oil, and very fine tripoli powder; and, finally, a rubber with oil only. The above is extracted from Burnell's "Treatise on Limes, Cements, &c.," published in Weale's rudimentary series.—DITTON.

[46744.]—**Marble (U.Q.)**—Bethersden and Purbeck marble, both from the same (Wealden) formation, are very dark green, almost black, and filled with small shells, the general effect being a very dark grey. I know of no work specially devoted to the marbles of the United Kingdom; but the following list, taken from the "National Cyclopædia," will probably satisfy "Murano." No doubt, further information could be readily obtained from any marble or stone-merchant. **Black marbles**: Ashford in Derbyshire; Dent (Yorks), Crickhowell; Tenby; Kilkenny, &c. **White**: Skye, Inverary, Assynt, Blair Athol, &c. **Ash and Grey Marble**: Orleton, in Shropshire. **Brown and red**: Buxton and Betham Fell, near Milnthorpe. **Green**: Irish green. **Black, variegated with other colours**: Ashburton and Torbay, Devon. **White, variegated with other colours**: Near Plymouth, at Killarney, &c. **Green, variegated with other colours**: Mona, Anglesey. **Marbles containing shells, corals, &c.**: Plymouth, Ashburton, and other Devonian limestones; the Crinoidal marbles of Flint, Derby, and Garsdale (Yorks); the shell marbles of Buckingham, Whichwood Forest, Stamford, and Yeovil, from the Oolite; and Purbeck and Petwork (similar to Bethersden), from the Wealden.—DITTON.

[46859.]—**Indigo Blue Dyeing.**—S. J. Simpson, on p. 383, gives a brief description of indigo dyeing by Holliday and Sons' process, and asserts that the only difference from the old woad vats is simply that Holliday's is worked with bisulphate of soda, zinc dust, and lime. The writer displays ignorance of the two methods of indigo dyeing, or he would have been able to have given a fuller and more correct description than he has done. In the first place, lime is used in both cases: in fact, it is the lime that keeps the old woad vat, and it is more essential to use it than in Holliday's process, and the indigo by their process is specially prepared known only to, or at least done so by, the patentee), whereas with the woad vats it is the pure indigo that is used. I may add that the process of indigo dyeing by Holliday's process is far superior to any yet discovered, and will ultimately supersede all other methods of blue dyeing. It is a superior colour, it is less expensive in cleaning, and is equally as durable. It will stand washing and the atmosphere better than other systems, and will dye double the quantity of wool, yarn, or cloth, in any given time. Having worked both systems for a number of years, I can testify to the above, and would recommend any party beginning indigo dyeing, to adopt Holliday's process.—J. ORMISTON.

[47039.]—**Clock Query.**—Set the "fly" so that it revolves slower; perhaps it is loose on its spindle.—ST. LUKE.

[47043.]—**Camera.**—To MR. LANCASTER.—In reply to yours on p. 359, my objective has:—1st, an achromatic lens, 31 mill., with shutter; 2nd, a conical piece, with a set of two lenses (double convex and meniscus, separated by a ring), 38 mill. and diaphragm, 5 mill.; 3rd, a separate piece, with convex lens, 21 mill., a diaphragm 8 mill., and shutter. 2 and 3 can be screwed on 1.—A DUTCH SUBSCRIBER.

[47045.]—**Wire Harness for Weaving.**—I believe the machine for making wire heddles is an American invention; but are they much used in this country?—C. K. J.

[47048.]—**Greenhouse.**—The vine would, of course, cover the roof, and so exclude much of the light the flowers would require; but if you do not intend to "force," you may have a vine and flowers too. It would be better to utilise the wall for, say, peaches and nectarines; but the best thing to do would be to call in a practical gardener to see the place, and ask his advice.—ESSAR.

[47049.]—**Gilding Book-Edges.**—As the "receipts" referred to were, in all probability, taken from this paper, they are no doubt correct. At any rate, the method of applying gold-leaf to book-edges has been frequently described. Look in p. 550, Vol. XXXIV., for instance. "J. K. B." has, probably, allowed the glair to get thoroughly dry, or has attempted to burnish before the gold was fixed. If he tries again, he will, no doubt, succeed.—E. G. M.

[47052.]—**Paint on Mowing-Machines.**—Is it possible that "Daylight" means he has seen some galvanised iron? Try it with a knife.—T. P.

[47057.]—**Glaze or Enamel on Iron.**—Would the querist say what temperature will suit?—then, possibly, he may get a reply. As it is, his reference is incorrect, and it is impossible to know what recipes he refers to. He will obtain nothing more fusible then a common glass having a large percentage of lead, and perhaps that won't adhere to the iron. There are many recipes in the back volumes, including the present one, for the enamelled iron tablets.—VIDEO.

[47059.]—**Iron Chimney Rusting.**—Cover it well with Brunswick black when it is thoroughly cleaned. Of course, you mean it is the outside that rusts.—G. T.

[47060.]—**Atmospheric Nitrogen.**—See Angus Smith's "Air and Rain." The quantity of nitric acid found in rain varies with the locality. In parts per million he gives Runcorn ·278, Liverpool ·582, Manchester 1·179, Glasgow 2·436.—S. R.

[47066.]—**Scissors and Razor-Grinding Machine.**—Surely, you can take a hint from one of the ordinary travelling grinder's wheels. Many of them have only one treadle, which works direct to a flywheel, and that has a band driving a pulley on the grinding spindle.—E. H.

[47081.]—**Polishing Granite.**—Is it granite or concrete that has to be polished? At any rate, it is done by taking a lump of granite, some sharp sand and water, and then with plenty of elbow-grease you will get a surface. Finer qualities of sand are used until the polish is brought up.—E. G. M.

[47081.]—**Polishing Granite.**—After the surface is tooled as truly as possible, rub down with an iron or wood muller and wet sand, and then with a lead muller and emery; next rub with hard pumice-stone, keep constantly wet with water only, then with rouge under a linen pad. To finish, well wash the surface, and when perfectly dry, polish with a linen pad, moist with water, and powder of calcined tin of the finest sort, and finally with a pad of dry rags, carefully removing first any grit that might scratch the surface; the above is from Spon's "Workshop Receipts."—DITTON.

[47082.]—**Hardening Leather.**—Choose good pieces, bark-tanned, soak in water until thoroughly mellow, and then hammer thoroughly. If you can get the use of a hydraulic press, by all means get a die and a plunger, and compress the leathers as much as you can.—E. C.

[47143.]—**Aluminium.**—"Zelia Naien" will find it very difficult to separate the Zn from the Al economically and perfectly. On the other hand, the alloy will probably have advantages, as it will most likely take solder, hitherto a matter of the greatest difficulty with pure aluminium. If "Zelia Naien" will send me his address, I think I can help him.—C. WOODHEAD, The Woodlands, Hitchin.

[47143.]—**Aluminium.**—In the production of aluminium, "Zelia Naien" asks for a method of separating the zinc from an alloy he has obtained. He has received in reply a very "deserved snub" from Mr. Grey (page 361), as Mr. Allen calls it (page 404). I concur in the same opinion. Nevertheless, I will give "Zelia Naien" some useful information about his research. I have extracted also very easily an impure alloy from a mineral ore sent to me from Spain; its technical name is "Ghanite," a proper aluminate of zinc, whose chemical formula is Al_2O_3ZnO. How to purify the extracted alloy? I will not say my own experiments—they were a failure. But I will kindly tell "Zelia Naien" that, in the factory of Nanterre, near Paris, erected in 1858, by M. Deville and M. Morin, they have employed every means of scientific purification. When the alloy is melted at the temperature of volatilisation of zinc, a portion of the zinc burns up and vanishes away as a vaporous oxide in the form of a flocculent powder—the "pompholix" of the ancient chemists. In trying to increase again the temperature in a crucible of plumbago, the volatilisation of zinc goes on, but the aluminium oxidises in the atmosphere of carbonic oxide produced by the carbon of the crucible. The quantity of metallic aluminium left is quite insignificant. The process is very wasteful. A crucible of wrought iron, instead of plumbago, sets up a triple alloy—aluminium, zinc, and iron. M. Morin has tried many other methods of purification. In spite of his long practical experience, every new process for the production of aluminium has proved a failure.—SPANIARD.

[47145.]—**Oil.**—Into a tin pan, 3ft. square and 1ft. deep, set on ground, pour three or four gallons of linseed-oil, to which throw in a quarter of a pound of coarse litharge to each gallon; stir this every day for a fortnight, and take care to agitate it well. At the expiration of the term the oil will have acquired a good drying quality—will be equal to boiled oil—and will have suffered no loss, as heat was not employed in the process. The resultant oil is also white and limpid.—H. STOOKE.

[47160.]—**Recovery of Silver.**—I think you are wandering under a delusion. Because lead has favourably replaced the silver plate in your battery, it must not be assumed that the lead contains silver. Any two metals in the following table will give off a current; and the farther they are apart in the order given the greater will be the power given off. The deduction, therefore, is that you have formed a couple which is as much to your satisfaction as the one previously in use. You do not say what metal you used with the silver and lead. Table of metals evolving voltaic electricity:—

1. Aluminium
2. Manganese
3. Zinc
4. Iron
5. Nickel
6. Lead
7. Tin
8. Copper
9. Mercury
10. Silver
11. Platinum
12. Carbon

These might be added to.—H. STOOKE.

[47168.]—**Trimming Copper Sheets.**—Many thanks to "Mide" for his answer on the above. Perhaps he will have the kindness to inform me how to keep one side of the burnished sheets bright whilst the other side is being trimmed, or how best to restore it to its brightness again?—and oblige—COPPERY.

[47174.]—**Pedal Reeds.**—From the description you give of your intended instrument, I should consider it wise to leave out the reeds of 32ft. pitch, and add one of 16ft. pitch, which will make in all two rows of 16ft. and one of 8ft. pitch. Let one of the 16ft. rows be voiced soft, and the other 16ft. row a little more reedy. This will be far better than having a 32ft. set, which is not required in an instrument of the size you describe. Any further advice if asked for.—G. FRYER.

[47174.]—**32ft. Pedal Reeds.**—"Ariel" can procure 16ft. sets of pedal reeds from any of the warehouses where those things are kept. They are known in trade as "small Bourdons." As to 32ft. reeds giving the actual 32ft. tone, I suspect he will have to give an order for them. The lowest reed will be from 8in. to 10in. long, according to scale adopted. If "Ariel" wants addresses he must look in the "Musical Directory," as makers and sellers rarely advertise, being well known in the trade. There will be a difficulty about the speech, but the patient workman will remedy that. It is simply impossible to give any directions, or even to show how it is done, for it depends almost entirely on the setting of the reed—the vibrator. You may have a reed that speaks slowly, and you press the vibrator further into the block only to find that it won't speak at all, say; then you lift the vibrator higher so that it stands well above the block—then perhaps you find it stutters and splutters. You try again, and lo, it speaks the instant the key is depressed. You may defy anyone to tell you why, or to explain what there is in the last position of the vibrator which makes the difference. Mr. Huxley, on page 385, recommends an old and abandoned dodge, which he will find, I believe, in a patent of Debain's, taken out in 1870. Debain also (see p. 61, No. 315) patented curving the reed, filing a hollow across the block, &c., all of which allow the wind to pass, and induce the reed to go with it. That was for his aspirophone, which was built on the plan of the American organ. Mr. Huxley should have stated that what he calls the "American twist" did not improve the speech because it was done by somebody who did not understand it. A reed properly set and twisted, speaks directly without any filing of the block, which is ruination in parts of the scale.—S. MAYER.

[47196.]—**Electricity v. Gas.**—I should not intrude further but that the question is important, and is bound to come to an issue some day. When we ask a question, it is to know the reason why, or why not, a thing can be done, not to be told to go and find out ourselves, as though the thing was impossible. When I saw an installation of the electric light the engine was a 20-h.p., working up to 50-h.p. to supply 16 lamps; also a 4-h.p. engine up to 7-h.p., to supply 3 lamps, the cost of small engine £100. I saw at once that the process was not economical. Considering this, I am glad to read of available small dynamo machines (p. 405) as these, if effective, are a step towards universal adoption. But Mr. Lancaster has been persistent in condemning such small machinery and also small batteries, presuming that from nothing, or next to nothing, nothing will come. But when we see hydrogen, an invisible and almost imponderable substance, possessing such enormous powers, it makes us think with the ancient Paul, "that things which are seen were not made of things that do appear." I am aware that we have to do with facts, but we do not know what remains to be found out. I cannot experiment myself, as my violin and "cello" takes up all my spare time; but "N. Z." has advanced the subject one stage by declaring the hydrogen incandescent gas lamp (with electrical action) to be a fact. So we have two ways of making an incandescent light with almost the same materials—the gas lamp with one jar, the electric lamp with many jars. With the object of reducing the number of elements, I wish to ask another question,—Cannot hydrogen gas be burnt with the electric light? Forgive me for supposing that hydrogen gas is a large component of electricity; this is only my idea, electricity has yet to be analysed. If it is a part, then the escape of hydrogen should be prevented or made use of.—FIDDLER.

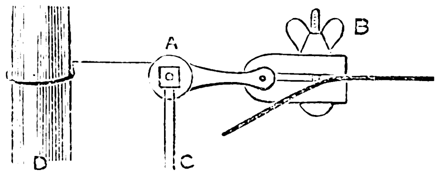
[47226.]—**Picture-Frame Making.**—Frame-making, especially when using the cheap foreign article, requires considerable practice to make a good job of it, and therefore I will give a few more "wrinkles," which are the result of my experience. I don't approve of "Cotswold's" plan (see page 409), because he leaves the glue to soak in first, which will bring out the end grain, and thus prevent the plaster edges from coming together. Then he does not give any method of holding the two pieces together until the glue is dried sufficiently to stand the nailing. The first requisite is to have the plane "flat" on its cutting edge (and this is not very easy for an amateur to accomplish), and, of course, very sharp. The next important memo. is, that you must not alter the set of the plane-iron whilst doing the eight mitres of any frame, or you will require to do them "all" over again. Then, bear in mind that, by shooting, say, the end of a long piece, with the gilt side uppermost, and the corresponding end of the short piece, with the gilt side downwards, that any slight errors will be compensated. Grip the largest piece in the vice, with the gilt facing your left hand; hold the companion piece so that your forefinger is feeling that the mitred edges are together. Now raise it up ⅛in., and bore with sprig-bit through the top one ½in. into the other (have your sprig-bit very sharp, and don't use it as a turnscrew, &c.); procure nice delicate sprigs, not the horrid rough and blunt articles commonly sold as cut nails. Have your glue thick, and just put one "dab" towards the back of the mitre, in with your sprig, and tap gently down, as "O. J. L." recommends, being guided by the feel, in conjunction with the eyes, and if not quite right, a sprig in the opposite side will probably make matters right. I have not tried any of the cramps, but am certain that, with anyone used to the job, the whole frame could be done ere one corner could be accurately cramped up for nailing. Memo: these cheap mouldings are often very crooked, and in driving the sprigs to keep the back-boards in place, don't use a hammer, or your glass will often come to grief; but use the edge of, say, an 8in. flat file.—J. J. A., Liverpool.

[47228.]—**Telephone.**—A hundred yards.—H. STOOKE.

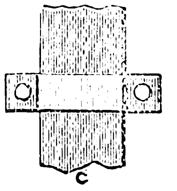
[47238.] — **Astronomical Telescope.** — To "ALDEBARAN."—Artificial tests for definition, such as small print, &c., are never to be depended upon. It often happens that a telescope, perfectly useless for stellar work, will define such objects remarkably well. A simple and, at the same time, a very certain test for both object-glasses and specula, is to remove the eye-tube, and to place a white screen at the focus of some bright object, such as a gas-flame or an artificial star, obtained by placing around the flame a sheet of bent tin, with a ⅛in. hole just in front. A piece of cardboard about 6in. square, with a similar hole punched in the middle should then be held close to the outside of, we will say, the object-glass, and the hole moved across its surface in every direction. There should be one particular position where the image should be perfectly steady, whatever may be the movement of the perforated card. If there is no such position, the figure of the object-glass is imperfect, and a blurring or nebulosity (not to be confounded with the effects of irradiation) would be present at the edges of any bright image. This blurring would not, perhaps, affect the definition of terrestrial objects, or even lunar detail; but it would render the telescope utterly useless for separating close doubles, or for showing planetary markings. Its definition may, however, be much improved, and sometimes rendered perfect, by stopping off the faulty portions of the object-glass. This may be determined by noting at which zone of the object-glass the hole was opposite when the motion of the image was most distinct. It will not be necessary to give tests for achromatism, because any shortcomings in that direction will be sufficiently obvious, and I do not suppose "J. L." will, in such a case, be curious to know whether his lenses are too much or too little corrected. A "rough-and-ready" way of estimating the magnifying power is to divide the focus (in inches) of the object-glass by one-half that of the field-lens, supposing it to be a Huyghenian eyepiece. Thus, if the former be 36in. and latter 1in., the power would be 72 diameters. For hints on eyepieces, see page 337 of the current volume. I may also mention that I have received some very excellent and cheap secondhand eyepieces from Mr. Caplatzi.—ALDEBARAN.

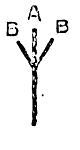
[47245.]—**Electric Bells.**—Dust in switch perhaps.—H. STOOKE.

[47246.]—**Private Telegraph Wires.**—The wires are strained by a "draw-vice," and when sufficiently tight are placed into the groove of the insulator, and bound in with No. 16 *g. i.* wire. The nearness to wall of outdoor wires affects them not, if they do not actually touch it; but only their insulators. However, if they are just within 4 inches of wall accidents occur, for when the wind blows contacts occur, and spiders in fine weather spin their webs between the wire and wall, which after a shower, open up a path for a considerable amount of leakage. I must apologise for my rough sketch of the "draw-vice." D is a pole, and A drum of vice, which works on an axle governed by the key C. The jaw B clips wire to be strained. On turning C, the wire fixed to D is wound on to A, and the distance between vice and pole shortened, and, therefore, B is strained in proportion thereto.—H. STOOKE.



[47264.] — **Lightning Conductors.** — These generally consist of a stranded copper rope, from ¼in. up to ½in. diameter, which is fastened down to the wall of the chimney, &c., by means of staples. Formerly the conductor was insulated from the wall, but as the efficiency thereof depends upon its capability for opening up a ready path for the charge, this course was beneficially abolished. When the conductor is not insulated from the stack, the chimney itself assists the discharge to earth. The copper wire is fixed to a platinum-tipped iron or copper rod at the top of the chimney, and at the bottom must be appended to a good earth plate, or some other good earth connection. The rods are often forked, as shown in the figures, but BB are certainly superfluous, as if the "flash" approaches and strikes the chimney, it is a natural circumstance that the current will find the path of least resistance—the main conductor — without these expense-increasing platinum points. The earth-plate, formerly mentioned, may be 2ft. square, and should consist of galvanised iron or of copper. If the soil is dry, a few bushels of coke around it will improve the earth. Any old iron, &c., may be beneficially buried around the earth-plate. A very good conductor may be made of a half-inch wide strip of ⅛in. copper fitted to wall, as shown at C. It is simpler and cheaper than a stranded construction. The brackets (if they may be so termed) which hold the copper strip down to the wall, are easily cut out and bent into shape from thin sheet copper, and after the holes have been punched are fixed down by clout nails. Thus we see that the conductor should leak all the way down, and the more it leaks at every point, the more efficient it will prove, because, as before stated, that efficiency depends on its earth-conducting power. Conductors should be frequently examined, as they corrode, and connection from top to bottom gets impaired. If you have a galvanometer, get a battery cell, and connect to top of conductor through galvanometer; the result should then be a full deflection, say 90°. Now try for deflection at bottom. Say you get 80°. The conclusion can then be drawn that 10° of the current are carried off to earth through the brickwork and 80° through the conductor. When the weather is wet more current will go through the damp chimney; tests should, therefore, be made in dry weather for comparative results. Should the deflection from the top fall off, you may depend something is wrong, and that the wire wants looking to. Of course, the deflection at the bottom of the conductor will also be reduced by deterioration; but it must be remembered that the weather must, for testing these uninsulated lines, be fine, as dampness affects the lower deflection.—H. STOOKE.



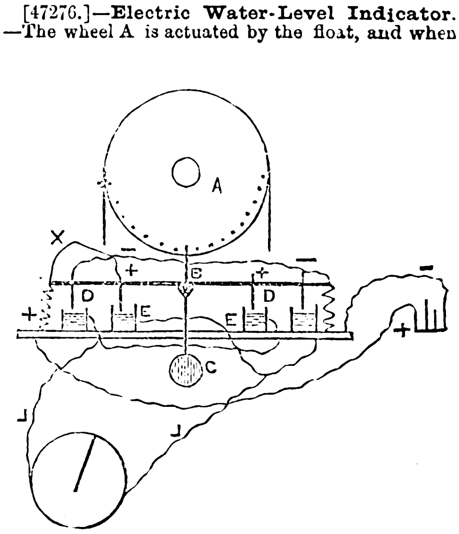


[47274.] — **Illuminating Clock.** — Paint the dial with the new luminous paint, saving gas, &c. A piece of wood, painted two coats, was found to yield sufficient light to get gunpowder out of a dark magazine. See "Scientific News" column of this journal a week or so ago.—ELECTRA.

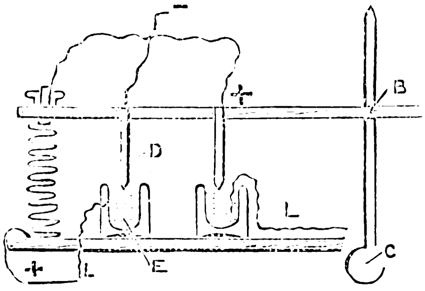
[47274.]—**Illuminating Clock.**—You can have the source of illumination in the room, and have mirrors to reflect it on to the face of clock, but you would lose about one-third of the light at each reflection. The better way is to have the light below the face of the clock, and just in front, then looking-glasses on each side, and in the front, would help to illuminate the clock. I have often thought that a good clock might be made for night use, having two rotating discs with a hole in each, long and narrow, the one disc serving the purpose of minute-hand, the other hour hand; then a circle of round discs outside in place of figures, the light to be at the back of the dial. Such a clock could be seen ten times further away than now, and would be most valuable at night. The light, of course, would illuminate the whole of the figure spaces, and the holes in minute and hour discs, which would rotate. This would be a novelty worth the making.—W. J. LANCASTER.

[47275.]—**Electrical Indicator.**—I do not see how you can arrange this without going in for a very expensive contrivance. The company under which I serve have to pay £15 to £20 for an apparatus simply to show when tank is full, which I will describe if you wish for it. The apparatus might be modified to show when the tank was empty also; but to show intermediate positions would, I should say, be useless. Write again.—H. STOOKE.

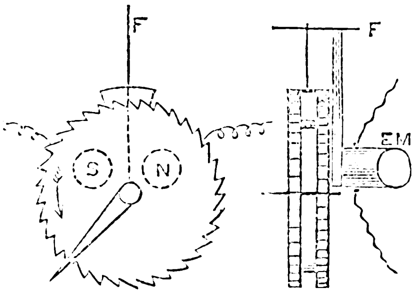
[47276.]—**Electric Water-Level Indicator.**—The wheel A is actuated by the float, and when revolving causes the bar carrying the contact-pins to rock on its centre B, and so producing a circuit on one side or the other by immersing the pins D in the mercury C, the pendulum C bringing the bar into its normal position. I have shown pins in a line for the sake of clearness, but they can be placed anyhow so long as they dip together. By using mercury I think you will make a great deal better contact than you can with solid metals, but the pins on the bar and the connections must be well insulated. For the recording instrument you will require a couple of ratchet wheels of equal



size, but fastened together a little apart, and mounted on a common centre. You must have as many teeth on them as your float-wheel has pins, and the teeth must be cut in an opposite direction



to one another, so that when the electro-magnet attracts the armature, and escapement F toward the pole marked S, the wheel at the back revolves



in the direction of the arrow (and with it the wheel and index that are shown), the reverse action takes place when armature, &c., is drawn toward N; there are several disadvantages in this plan—viz., the necessity of having the batteries at the reservoir, the liability of instrument to get out of step, and the continuous action if the pins on float-wheel should happen to hold the bar down; but all I have seen are not free from these defects. If this does not suit write again.—Wallington.

[47279.]—**Spoilt Glass Shelves**.—I presume that no acid is about the place where you stored them, as that occasionally injures glass.—H. Stooke.

[47279.]—**Spoilt Glass Shelves.**—The easiest way to remove the stains is to repolish the glass. Make a pad with thick cloth on a flat piece of wood, with a handle on the other side; then get some of the finest putty-powder, and commence to polish with the powder and a little water, and work until all the stains are removed, then finish polishing with dry powder. Take care you do not get any grit on the glass.—W. J. Lancaster.

[47281.]—**Tricycles**.—The power obtained by the lever and rotary motions is about equal, provided the stroke is of the same length. The reason why the rotary motion is so much used, is that most people consider the motion more pleasant and less tiring. It also has the advantages of enabling the wheels to run faster or slower than the pedals, according as the lower cogwheel is larger or smaller than the upper one, and it admits of the use of "balance gear," for double driving. This, I consider a great point, for I consider "balance-gear" very much superior to any ratchets or clutches, and the enormous number of "balanced-geared" machines which have appeared this season shows that the makers think so too. Levers are easier to construct, for chains entail a very great deal of work. There are, however, several patented methods of communicating the rotary motion to the wheels, some of which are rather superior to chains.—G. R. T.

[47281.]—**Tricycles.**—I have used almost every kind of tricycle, and can find nothing superior to the chain. The lever machines I would not use. I can with the chain climb any hill, although it is not always well to attempt to climb a steep hill; more energy is used up than would be required to push the machine up the same hill. I have no preference for a double-driver; can do quite as much with a single geared well, and can turn corners much more easily and quickly with single-driver. I have seen some nasty spills with double-drivers in turning corners at all sharp. I should most decidedly recommend a back-steerer single-geared machine, of not more than 44in. diameter. With such a machine you can go 12 miles an hour, and if you will, can keep your seat all day. I rode 19 miles in an hour and three-quarters the other day on a Swallow without the least fatigue, and after eight o'clock at night, several long hills being on the road. This is, I think, as much as one would care to do on any machine. There is one part of the tricycle that needs a lot of improvement, and that is the saddle, or seat. I should like to see a dished saddle, very much like the half of a washing-bowl, and fitted on springs working only in a forward vertical motion. Such a seat would be most valuable.—W. J. Lancaster.

[47287.]—**Magneto-Electric Machine.**—Put the bobbin in a lathe and guide the wire with your hand. The change of polarity must be made at the point where the poles stand (or rather just before they stand) NN, SS, as no motion would be the result if a continual NS NS condition was not kept up.—H. Stooke.

[47287.]—**Magneto-Electric Machine.**—Leave out 2in. of wire in commencing to wind your spool, fill up each, connect the two bottom wires (cleaned) together, have shaft between spools bright, wind four folds of finishing end round, braze fast to shaft (from one spool only). Observe, should your shaft have a broken connection, and the pinion working in the step between magnets be inserted with guttapercha, then fasten the other end of spool wire to the pinion, apart from the shaft. The other question is of no use. In putting the machine together, do not let spools bear upon magnet, and if tin spring bears upon framework, you throw back the current, gently bear your spool spring upon flats not too stiff. Notice your pole wire connection has a drop of oil, and I think it will work.—Tom B.

[47288].—**Drying-Racks for Dry-Plates.**—According to my experience, there is not much to choose between the vertical and horizontal positions. In the former case a space of at least half an inch should be left between the plates; and in the latter they should not be laid flat upon any cold material, such as glass; but supported on strips of cardboard or wood, so as to allow the air to circulate underneath.—W. Robinson, Junr.

[47288.]—**Drying-Racks for Dry-Plates.**—The racks are bad because there is not a sufficient current of air between them. You could easily make a circular drying frame to hold, say, a dozen quarter-plates, the outer edge of each to be 2in. apart, then they would dry much more rapidly than in the usual rack. The drying circle could be made of tin directly; have a tube in the centre, say 2in. in diameter, then around this have the one series of tin grooves soldered; then for the outer circle a tin band with another series of grooves would be all that would be required.—W. J. Lancaster.

[47292.]—**Bunsen Battery Connections.**—See my letter elsewhere, in reply to "Beetle Crushers," letter 20234, on carbon connections.—Electra.

[47292.]—**Bunsen Battery Connections.**—Read letter 20234, from "Beetle Crushers." You can deposit copper by placing the end of carbon in sulphate solution of that metal and passing an electric current through it. The carbon is connected to the — pole and the plate of copper (which must be put in solution opposite the plate of carbon) is connected to the positive pole of the battery. The little spirits necessary for the soldering may be entirely overlooked. I may say that it is very convenient to have all carbons provided with terminals, as in case of removals, renewals, or when cleansing the batteries, they can be easily removed.—H. Stooke.

[47298.]—**Examination of Malt.**—Infusion of malt cannot be filtered through filter-paper without pressure, but a piece of clean calico answers very well. The heat at which the infusion has been prepared makes a good deal of difference to the filtration. An extract of suitable strength may be prepared by adding 50 grammes of ground malt to 250 cubic centimetres of water at 145°, raising the infusion to this point, and keeping it there for 1½ hour, afterwards heating it to 180° for half an hour, filtering as above, and rinsing with enough hot water to make up to 500 cubic centimetres. This will give a proportion of 10 to 1, from which the results for acidity, &c., can be easily calculated. If the heat of the infusion is too high to begin with, the "goods will set," as a brewer would say, and it will be very difficult to get the extract off. Further particulars if wished.—E. S. Beaven.

[47298.]—**Examination of Malt.**—I have found the best way to get a clear and rapid filtration is to allow mash to stand in beaker long enough to allow grains to settle to bottom, leaving wort at top, and then to carefully pour, without disturbing grains, on to a sponge, or loose plug of cotton wool inserted lightly in a funnel, returning first drainings on to filter if not clear. Have found this the best way of very many practical trials through filter papers.—J. W. East, Louth, Lincolnshire.

[47299.]—**Lantern Optics.**—You can get a true disc when the light is either within, at, or beyond the equivalent focus of condenser, by using discs of varying aperture over the opposite side of condenser, just cutting off the marginal rays. The equivalent focus of the condenser will be a point nearer to the condenser than you have evidently taken, but even if the light is at this exact spot you must cut off at least one-tenth of the diameter of outer lens to get a clear-edged disc. With a single lens condenser the effect will be different.—W. J. Lancaster.

[47301.]—**Vacuum Tubes and Coil.**—You have a leakage somewhere, most probably a soldered connection broken. Go carefully over every connection, and then get the spark between the two points of a discharger, and notice whether there is a continuous run of sparks, or if there is a spark only, and then a rest; then a succession of sparks, and another rest; if so, then if connections are right, the insulation is wrong. Let me know the size of coil when you write again.—W. J. Lancaster.

[47303.]—**Rusty Water-Pipes.**—I see no alternative for "Puzzled" but to replace the iron water-pipes by lead, as the water passing through the iron pipes affects the same so much as would, no doubt, in time prevent any water passing at all by reason of the amount of rust in the pipes.—Ditton.

[47305.]—**Photography.**—To Mr. Parkinson.—No doubt the white spots are caused by air-bubbles in the developer. Remedy: To each pint of oxalate solution add 2oz. of lump sugar; this has a double advantage, as it greatly improves the tone of the enlargement. If this should not be a perfect remedy, send specimen, showing defect, and I will do my utmost to assist you. Spot out with Indian ink cooled down with indigo. Of course you must match the tone with that of your enlargement. Spot silver prints with sepia. I find the glycerine developer suitable for all kinds of plates, if you give long exposures and slow development; but if rapid exposures are necessary, use any of the standard formulas, or that supplied with the plates.—James Parkinson.

[47309.]—**Clarionet.**—The position of the holes in this instrument is a compromise between the theoretical correct position and the most convenient for human fingers. Obtain an organ pipe scale, and compare it with your clarionet, and you will see at once what I mean. Do not make the bore any larger because you wish to have the instrument flatter, as if you do the upper notes will be difficult to obtain. I should like to assist "Old Blow-hard," if possible, and perhaps "Vulcanite" or Edwin Morgan will help him.—Hampstead.

[47313.]—**Tests for Bicarbonate of Soda and Tartaric Acid.**—Commercial bicarbonate of soda generally contains a proportion of carbonate. To a clear solution of the bicarbonate in cold water in a wine-glass, add a few drops of solution of sulphate of magnesia (Epsom salts); if carbonate of soda be present a precipitate will be formed. Tartaric acid sometimes contains lime and potash as impurities. On heating a little of the acid in a spoon over a flame, it should melt, carbonise, give a smell of burnt sugar, and on stronger heating, burn off without leaving any residue. Does "Novillo" mix the two salts together before they are actually wanted to be used? If so, there is sure to be some loss of carbon dioxide. On the other hand, when they are used, they should be thoroughly mixed together in the flour, and in the right proportions—viz., 13 by weight of acid to 16 of bicarbonate. If "Novillo" will send small samples by post (in wooden pill-boxes), I will test them, and let him know the amount of impurities they contain.—E. S. Beaven, Warminster.

[47315.]—**Harmonium Pan.**—Anyone capable of handling tools in a workmanlike manner, and possessed of the requisite appliances, can make a pan for a harmonium, whether it is for one or seven rows of reeds, which shall be quite as good as the majority of those that can be purchased. Whether, considering the time necessary, it is worth while to make is another matter, and one that must be left to the discretion of the individual. It need only be mentioned, then, that the price for a really good 2½ row pan is about 25s. (not more), before proceeding to tell "Gotha" how he may make one. It will simplify matters if the making of a one row is fully described, because many of the operations have to be simply repeated in constructing larger affairs. It would be easier to refer the querist to back numbers, where full details have been given more than once; but as I take the insertion of the query to mean that those numbers are out of print, and I happily possess every number of the English Mechanic, it may be of service if I make a réchauffé, guided to some extent by my own experience. First, we require to make a channel frame having 60 pieces of thin wood across it, so as to make 61 divisions, each of which must be blocked off into suitable lengths for the different reeds. To make this take a piece of ¼in. yellow pine, 34in. long by 1¼in. broad; make a mark ¾in. from each end, and then space off the remaining 32½in. into 61 equal divisions. The easiest way to do this is to have the keyboard you intend to use, and mark the centres of each key on a strip of wood; then placing the strip against the piece of pine, mark off the channels, taking care that the centres of the keys will fall directly over the centres of the channels. Thus you will have 60 pencil marks, at which you cut a groove ⅛in. deep by the same width. Now draw a line diagonally along the strip, starting just about ¼in, from the edge, and cut through; then you have two pieces 1⅜in. deep at one end, and ⅛in. at the other, and the next thing is to fit them with ends; these should be of ¾in. pine, and 5½in. long: then if the side pieces with the grooves are tongued into them, we have an oblong frame 32½in. long, 4½in. wide, 1⅜in. deep at one end, and ⅛in. at the other, all inside measurements. The depth is not exact, because the saw has taken a bit of the 1½in., but no matter. One end piece will be 1⅜in. deep, the other ⅛in. Now take some stuff just thick enough, when planed up, to fit into the grooves, and cut it up into lengths of bare 4¾in., the width, or depth, decreasing as you go from the thick to the thin end of the frame. As you are a workman all those little channels (rabbets) you cut are perfectly square one with another, and you now glue in the pieces of thin stuff so as to make a channel-frame, having 61 divisions. For the lowest bass-note, 8ft. C, you require the channel to be the full 4½in. long; but as you proceed towards the treble the length must shorten gradually. So you put in little blocks of wood with glue, and you put them in so that there will be no difficulty in planing the thing on both sides to as perfect a level as your skill will enable you to do. The lengths will be as follows:—Bottom C (i.e. first channel) 4½in., 2nd C (i.e. 13th channel) 4in., 3rd C, 3½in., 4th C, 2½in., 5th C, 1¼in., and 6th C, ⅝in. These lengths will indicate the line of the blocks, which need not commence till about the 9th channel from the bass or deep end. You will understand that the square side of the channel-frame is the pallet-side, and you will consequently arrange your blocks so that the pallet-holes will be on the further side from you as you hold the frame in proper position—consequently, the blocks are to be put in by commencing at the nearest end of the channel. Having blocked off the channels to your satisfaction, procure some beech ⅛in. thick when planed, or if you can't get that, use sycamore, and cut out two pieces 34in. long by 5½in. wide. Invert the channel-frame on one of these, and keeping all edges flush (pin the pieces), mark the width of the channels and the end close up against the side-pieces. That's for the pallet veneer. Fair in the centre of the marks, and just within the mark that indicates the end of the channel, cut the pallet-holes 1⅛in. long at bass-end, and 9-16in. at treble-end—bare quarter wide at bass, and bare 3-16in. at treble. The frame is then reversed on to the other or reed veneer, and the widths again marked just inside the blocks. The reed apertures must then be cut so that the tongue of the reed shall play as closely as possible to the block—the bass-end being 1½in. long, and the top C ⅝in.—the width being full-quarter at bass and bare at treble—but, *sub rosâ*, it won't matter if you make all the same width; however, if broad-reeds are to be used, give plenty of room. The two veneers being ready, plane up the square side (pallet) of the channel-frame; get the glue ready; a couple of pieces of thick wood, one of which you should make as hot as you can; glue veneer all over, and with the pin holes as guides put in place; clap on the hot piece of wood, the other underneath, and put on the cramps; then dry. Serve the other side ditto (but plane the treble end down until you nearly touch the veneer), and the pan is complete so far. To make it suitable for an instrument, you mount it in a frame of ¾ stuff 2½in. deep. The only reason for using beech as veneer is because the reed screws hold better. Possibly, however, you would prefer to cut a pan out of solid beech; if so, make channels with drills to the dimensions above given, and put on a pallet veneer to cover them. To make a two-row you clap a 16ft. scale pan alongside, the two pallet-holes being brought close together, and when you draw that out on a piece of paper you will see that by shifting the dead space where the blocking cuts off the channels there is room for more than a half-row of reeds extra in the treble part of the instrument; but you will then have three pallet holes to cover. The scale for 16ft. may be ⅛in. longer than that of the 8ft. in all octaves, but the channels must also be deeper, say 1 3-8in. at the bass end, and ½in. at top end, whereas in the 8ft. the depth at top C is practically nothing more than the thickness of the two veneers. I have given you a scale which answers well, but if you will keep the proportions in view, you may alter it to the extent of ⅛in. in length either way, and goodness knows how much in depth, bearing this in mind that, other things being equal, the shallower the pan the reedier the reeds; and the deeper, the rounder the tone, and also the sluggisher the speech. If the querist or anybody else wants to know more, or to have something explained, if he will indicate the difficulty in these columns I will endeavour to help him over—especially if he will put his difficulties in clear and unmistakable language. Sketches are, I think, unnecessary, for they would occupy space, and as any one who intends making will of course draw the parts to the measurements given, those interested will be able to make their own sketches.—S. MAYER.

[47319.]—**Ordnance Datum.**—The Ordnance Datum is the approximate mean water level at Liverpool, and is the Datum line from which all levels on the maps issued by the Ordnance Office are calculated; this has nothing whatever to do with the level of water in water-bearing strata, which varies within the widest limit, according to the nature of the various geological formations of any particular district—DITTON.

[47319.]—**Ordnance Datum.**—The datum for Great Britain is the level of mean tide at Liverpool, as determined by the Royal Engineers of the Ordnance Department, and from this all levels throughout the survey are measured. On many of the Ordnance maps the elevations of salient points are marked; but the "sea level" of any broad arrow bench-mark can be ascertained by proper application to headquarters at Southampton.—ANTARES.

[47324.]—**Sketching Stool.**—The legs of the stool are joined at their middle points with a triangular bolt; the section of each leg being the sector of a circle, angle 120°, with the inside corner sufficiently rounded off to allow of the stool opening.—GAMMA.

[47324.]—**Sketching Stool.**—The legs are held by a three-armed iron joint. As all the legs move at once they make room for each other, but unless they are left rather slack on their respective pins they will have to be notched near the middle to allow them to open sufficiently. It is not a very strong kind of stool, but if a piece of brass curved to fit is screwed on each leg at the joint and with the iron pin of the joint coming through it in the middle, it will strengthen it considerably. If the bottom ends of the legs are fastened with string at a little less than the right width when open it will add to its strength.—E. F. C.

[47325.]—**Street Medical Coil.**—To MR. LANCASTER.—I shall be very pleased to give you the information. Let me know whether you want to make only the coil, or the coil rotator, bells, &c., usually on the base board in street coils; also let me know whether you want to make the battery as well, and I will give you all the necessary instruction.—W. J. LANCASTER.

[47326.]—**Traction-Engine.**—First, see that the bearings from the crosshead to the crank, also the two bearings of the shaft, do not shake, because that will often cause a noise at both ends of the stroke apparently proceeding from the cylinder. Should this not be the case, the fault lies with the slide-valve. First take off valve-box cover, and put reversing-lever over to one end of stroke; then try round for lead, which should, in an ordinary-sized engine, be 1-16in.; try both ends of stroke with each end of reversing-quadrant. Should the lead be right, there may be too much outside lap, which you can try by marking a wooden slip by the ports on cylinder slide-face, and comparing them with slide-valve edges, for, probably, there is too little inside lap. Allowing for no cushioning at end of stroke, this does not so much matter for engines running at an ordinary speed if there is sufficient lead. The remedy for insufficient lead is to advance both eccentrics until the required amount is given at one end of the stroke; then try round and equalise. If too much outside lap, file off until the required lead and cut-off is obtained. If too little inside lap, pin a brass or iron slip upon the inner edges of valve, and file off until sufficient cushioning is obtained.—FRED. WALKER.

[47329.]—**Boat-Building.**—I am afraid £20 would go a very little way indeed towards carrying out "A Would-be Jack Salt's" ideas in fitting out such a boat with the conveniences required for living on board. Six times that amount (at a moderate estimate) would hardly cover it, and this without allowing for rigging and canvas, both very expensive items. As to steam power, even if you could spare the room, a 4-horse engine would be of no use. "A Would-be Jack Salt" does not say if he has had any practical experience in the art of sailing. If he has not, he may take my word for it that he will find himself in a very dangerous position if he relies upon himself to navigate a boat (however small) at sea. Why not go to some seaport town with a good tidal harbour well sheltered from wind and wave (there are plenty such on the South Coast), where you can live cheaply and get a boat suitable for your purpose for a very moderate sum? I shall be happy to send any further hints which may be useful.—ARIEL.

[47335.]—**Packing.**—I have tried the packing you mention, and, indeed, nearly every kind of self-lubricating packing extant, for piston-rods and slide-rods, and find that, although they do not cut the rods, it conduces to the life of the packing to oil the rods while in motion occasionally. I have also remarked that in cases where water has dropped upon the rods while working, they have remained bright and surfaced for many years, irrespective of packing—old hemp and patent wove being tried with equal success.—F. WALKER.

[47337.]—**G.E.R. Loco.**—Eight-wheel tank engines on G E.R., built about 1866, were of following dimensions:—Cylinders, 15in. diam., 22in. stroke; leading and trailing-wheels, 3ft. 7in.; coupled-wheels, 5ft. 9in.; boiler barrel, 3ft. 11in. diam., and 13ft. 6in. long; tubes 143 in number, 1⅞in. diam., and 13ft. 9¼in. long; heating surface, 977 5 sq. ft.; Firebox, 64·6 sq. ft.; total heating surface, 1,042·1 sq. ft.; weight, 38 tons; ditto on coupled-wheels, 21 tons; working pressure, 130lb. per sq. inch. Is not L.B. and S.C. "Beaconsfield" same as "Richmond," "Hartington," "Devonshire," &c., with leading and driving-wheels, 6ft. 6in. diam., and trailing-wheels 4ft. 6in., cylinders 17¼in. by 26in.? "Caen," "Genoa," and "Naples" seem to be similar build, with the difference that the wheels are not so large—only about 5ft. 6in.—CARSTAIRS, London, S.E.

[47338.]—**Leclanche Battery.**—You have four of Grenet's cells; however, no doubt they will require a thorough clean; take them to pieces, clean out all the small particles and dust out of bags, then put in again with a few extra pieces of manganese; get new zinc rods. You should use porous cells if the canvas bags are too much worn.—W. J. LANCASTER.

[47348.]—**Bending Copper Tubes.**—Has "Salop" tried filling his tubes with melted lead or rosin where he wants to bend them. Of course he must wait till the lead or rosin is cold.—G. I. C. E.

[47348.]—**Bending Copper Pipes.**—Fill the pipe with lead, and you will bend it without a buckle; fill it with rosin, and you will do the same when you have acquired a little skill. The rosin is more easily melted out.—T. P.

[47348.]—**Bending Copper Tubes.**—The method we adopt, and I think it is almost universally adopted, is to fill the tubes with solder, then turn a groove in a chuck, same radius as required bend; then bend tube round this, and melt out the solder. You can make a perfect bend in this way.—W. J. LANCASTER.

[47348.]—**Bending Copper Tubes.**—"Salop" cannot bend copper tube (unless stout), without ribbing inside. With a sharp radius it is best to fill with lead or rosin. If he has to make a coil similar in shape to a hairspring of watch, he had best use rosin, being easier to employ. I have been making one last week of one-inch copper tube, ten ounces per foot, and was obliged to hammer out ribs with round-face hammer when charged.—T. W. G.

[47349.]—**Dry-Plate Queries.**—(*a*) If the object of the querist is to be able to compound a developer which will answer under all circumstances, I am afraid he will be disappointed, as the character of an emulsion and the quality of the plates prepared with it depend upon many conditions. As a rule, a slow plate requires a stronger developer, with more ammonia than a quick one; but a good deal depends upon the exposure. If that were relatively increased, it is quite possible that a weak developer, such as would be right for a quick plate, would answer equally well for the slow. (*b*) Potassic oxalate is required in excess in order to dissolve and keep in solution the ferrous oxalate, which would otherwise be precipitated as a fine yellow powder on the surface of the plate. The principal effect of dilution is to render the development slower.—W. ROBINSON, JUNR.

[47351.]—**Mathematical.**—The following solution is extracted from Todhunter's "Key to Algebra," p. 124:—"These results are easily established by induction. For simplicity, it is well to take a particular value of r; it would be found that the reasoning would apply to any other value of r. We may show, then, by actual multiplication that the laws which are stated hold when $n = 2$, or when $n = 3$. Assume that they hold for any assigned value of n. Let $r = 3$, and suppose that $(1 + x + x^2 + x^3)^n = a_0 + a_1x + a_2x^2$

$$+ \ldots\ldots a_{3r-1}x^{3r-1} + a_{3r}x^{3r}.$$

Multiply both sides by $1 + x + x^2 + x^3$; then $(1 + x + x^2 + x^3)^{n+1} = a_0 + (a_1 + a_0)x + (a_2 + a_1 + a_0)x^2 + (a_3 + a_2 + a_1 + a_0)x^3 + (a_4 + a_3 + a_2 + a_1)x^4 + \ldots\ldots$ Then we see that the coefficient of x^4 is greater than that of x^3, if a_4 is greater than a_0; and this is the case by supposition, and so on."—J. H. M. JACOBY.

[47351.]—**Mathematical.**—Write the explanation as follows:—$(1 - x^{r+1})^n (1 - x)^{-n}$. Put in the first factor, $x^{r+1} = y$. Now we may disregard the latter factor, as every term in the first must be multiplied by every term in the latter. We have only to consider $(1 - y)^n$. In Todhunter, Art. 508, the first part is proved. By Art. 510 the greatest coefficient is $\frac{\underline{|n}}{\left\{\underline{|\frac{n}{2}}\right\}^2}$ or

$$\frac{\underline{|n}}{\underline{|\frac{n-1}{2}}\;\underline{|\frac{n+1}{2}}}$$ according as n is even or odd.

By the formula the coefficient middle term, or of two middle terms, according as n is even or odd, are $\frac{\underline{|n}}{\left\{\underline{|\frac{n}{2}}\right\}^r}$ or $\frac{\underline{|n}}{\underline{|\frac{n-1}{2}}\;\underline{|\frac{n+1}{2}}}$ hence is seen the second part. Obviously, by the binomial theorem, the third part holds. I must request "A. B." to carefully consider the remarks in the beginning. Does he consider them legal?—AN ENGINEER'S SON.

[47353.] — **Gelatine Plates.** — Use a little greater excess of soluble bromide, and do not cook the emulsion quite so much.—W. ROBINSON, JUN.

[47353.]—**Gelatine Plates.**—I believe that damp, after the plates are dried, will cause green fog. I think the gelatine has a lot to do with it as well, as the first lot of emulsion I made had green fog so bad that I could not use it, and thinking it might be bad gelatine I got some of Nelson's No.1, and have had no trouble since with either fog or frilling. I use about half a grain of chrome alum in five or six ounces of emulsion, which may have something to do with absence of frilling. I think making the emulsion is the easiest part of the process, coating the plates being my greatest difficulty.—E. F. C.

[47354.]—**Green Stains for Deal and Other Woods.**—Any respectable chemist could supply you with what you require. Verdigris and water is quite unsuitable, and does not constitute a stain. There is too much pigment in it.—G. FRYER.

[47355.]—**Excessive Perspiration.**—I should advise "Sudor" to try the following: Put 10 drops of dilute phosphoric acid in half a tumblerful of water, and take one dessert-spoonful every 4 hours. If not better in a month, I shall be happy to make further inquiries into his case.—DOCTOR.

[47357.]— **Malleable Castings.** — Put 2oz. fluoric acid, 1oz. nitric acid, and 1oz. of saltpetre to 10lb. of metal. When the metal is melted, add the solution. It can be made in a brass furnace. When you have cast off patterns, the castings want keeping at a red-heat for three or four days in iron boxes in a furnace.—T. S. H.

[47358.]—**Shocking Coil.**—Let the core be ¾in. diameter, then well insulate it, and use for primary 6oz. of No. 18—this will give you two layers; then well insulate, and put on as secondary ½lb. No. 30, this will give as much current as any ordinary person will care to take. The secondary will give you about 10 layers, and of course you must insulate each of the layers from the others.—W. J. LANCASTER.

[47361.]—**Watch - Construction.**—When a watch loses time, the balance-spring requires taking up or shortening. Unpin the spring at the outer coil, and remove the balance from the watch. Then, with a pointed tool, turn the brass collet, to which the spring is attached, in the required direction, and replace in watch, taking care to set the spring so that the watch is in beat. The spring must be set flat, and perfectly free throughout its length, except, of course, where it passes the curb-pins in regulator. Between these it should have just perceptible freedom. I would warn Mr. Fryer that this is a rather delicate operation for anyone with such a limited acquaintance with watchwork as his queries would indicate he possesses.—J. E. FLOYD.

[47361.]—**Watch Construction.**—To make the watch go faster, you must "take up" the hairspring if it is not a lever watch. You must first make the wheels secure, then remove the cock-plate, or bar; next prise out the little pin which holds the hairspring; turn the balance round until the hairspring is free; then remove the balance; next put the point of a small drill, or something similar, into the opening of the brass collet which holds the inner coil of the hairspring, and prise open the collet. Now you will be able to turn the collet the same way as the outside end of the hairspring is pointing. If you want it to go slower, you turn the reverse; now replace balance and put watch in beat. If you had stated what kind of watch you have, it would have been much easier to answer the query.—A FELLOW-WORKMAN.

[47361-2.]—**Watch Construction.—Watch-Dials.**—If your watch loses time, you must take up the spring a little by unpinning it at the cock-stud, and drawing it through; a very little may suffice. This has the effect of shortening the action of the spring, and so making the watch to go faster. The reverse alteration makes it go slower. If the spring plays freely between the regulating-pin and curb, you may make the watch gain several minutes a day by simply bending the hairspring nearer the pin of the regulator, thus lessening the "play." If you take the spring up you will have to reset the watch on beat. This is done by easing the collet round until the hairspring-stud rests exactly over a small drill-mark upon the cylinder-wheel. If it is a Geneve watch that you are altering, it can invariably be got on beat correctly in this way. Occasionally, when a new cylinder has been put, the position of the drill-mark is altered, so it would not in every case be a correct guide to a correct beat. In, I may say, 90 cases out of a 100, you would be right in doing so. If the watch is a verge follow the instructions given in a recent letter of mine. Enamelled watch-dials are fixed in a variety of ways. In most English watches, the dials have two or more feet soldered to them, and are pierced with small holes at their ends to receive pins, which are inserted after the dials have been placed on the plates or frames. Geneve dials are generally secured by "crescent" screws and slotted dial-feet, or drilled feet and pins, as in the English work. I do not speak of metal dials, which are attached differently in many cases. American dials are sometimes secured with pins like the English, and in many instances with screws, which are set on the edges of the plates, and are screwed up against the dial-feet. If you intend to replace the cream-coloured dial with a white one, send the present one as a pattern to the material dealer for the size and shape of the new one, at the same time sending the bottom or pillar-plate, or the frame, if fitted with one.—ALFOJOE.

[47362.]—**Watch - Dials.**—English dials are usually secured by pins passing through feet attached to the dial. The ends of these feet and the pins may easily be seen near the edge of the bottom or pillar-plate. To get a new dial, take the watch to pieces, and send pillar-plate, together with dial-rim, if there is one, to a dial maker, who will make one with feet, holes, &c., in proper position. It then only remains to drill pin-holes in feet, and enlarge holes in dial to free hands.—J. E. FLOYD.

[47362.]—**Watch-Dials.**—Remove the movements from the case; next the hands; you will find the dial pinned to the inside of the pillar-plate; remove these pins, and send the old dial to J. Stockall, 6 and 8, Clerkenwell-road, London, with 8d. in stamps, and instructions; when you get new dial, fit it in its place; mark the stumps, and drill little holes for pins, same as old dial.—A FELLOW WORKMAN.

[47363.]—**Watch Cylinder.**—File up a plug which will go two-thirds up the inside of the cylinder; now fit a rose on the end of the plug, so that about two-thirds of the plug protrudes beyond the rose; file this two-thirds down, to about half the size of the plug; now cut off the plug, put it into the cylinder, and file up your pivot. I shall give full instructions in a week or two, with drawings.—A FELLOW-WORKMAN.

[47364.] — **Silver Filagree Brooches.** — A simple and effective method to clean silver brooches is to wash them carefully with clean soap and water.—G. FRYER.

[47364-5.]—**Silver Filagree Brooches—Gold Coins.**—Should it prove, on examination, that the filagree work has not been soft-soldered in any way, you may impart to them a beautiful frosted appearance by thoroughly washing them in hot soda-water (weak), to remove dirt or grease, and then, after making almost a red heat by the flame of a spirit-lamp or gas, with a blowpipe, laying the articles in a solution of vitriol—water two parts, vitriol one. The water must be pure rain or distilled. Let the articles remain in the solution for a couple of hours or so, then swill in clear water and dry. Do not use any cleaning powders, leathers, or brushes. The articles should come out a pure dead white. Cyanide of potassium is equally efficacious for the work, but is rather more dangerous in its nature, if you unwittingly get it on your person. If you are going to solder good-quality wires to the coins, say 18 carat, you may use a little common gold in lieu of solder, say 9 carat. If you use 9-carat wires, you must have solder specially prepared to run at a low heat, and to be obtained of any material dealer. These remarks apply also to rings. The articles may be freed from discoloration by immersing them in diluted aquafortis, or even in the vitriol solution, swilling them in water afterwards. If iron wire is used for binding, all traces of it must be removed previously. 9-carat gold can seldom be got up to a good colour, owing to the base metal forming the alloy. Polishing by rouge, &c., is the only plan you can adopt. Re-colouring is seldom or never done to any lower quality of gold than 12 carat. 9-carat gold, when of a rich yellow colour, would be gilt only. It is not necessary to gild the rings after soldering, if you polish them up well, unless you wish for the rich effect of "parcel gilding," as the partly gilt, partly bright work is called.—ALFOJOE.

[47367.]—**Heating Apparatus for Greenhouses.**—There is a mistake in this query. Instead of 20ft. of 2in. pipes it should be 60ft. of 2in. pipes.—R. H.

[47371.]—**Photographic.**—For cause and cure of "oystershell" markings, see my reply to query 46574, p. 137. The free iodine liberated from iodide of lithium could probably be driven off by heat, or absorbed from solution by a strip of clean zinc; but, in either case, I do not think the result would be as satisfactory as using fresh iodide.—W. ROBINSON, JUN.

[47372.]—**Lens.**—Assuming that your lens is a biconvex, or its two radii are 1½in. by 1½in., then grind a concave 1½in. by 4in.; this will give you a lens, when the two 1½in. surfaces are cemented, of 5in. focus, within a very small amount. The crossed concave should be made out of flint.—W. J. LANCASTER.

[47373.]—**Removing Old Varnish.**—The best thing to use to remove old varnish from globes will depend on the nature of the varnish; but the two commonest solvents are turpentine and alcohol (methylated free from gum will do). Try the alcohol by wetting the surface of the globe and applying a piece of blotting-paper when the varnish appears to be attacked.—T. P.

[47375.] — **Lightning Conductors.** — Undoubtedly the arrangement given by W. Clark is dangerous: — the conductor should be taken straight down, and connected with earth, as given by "Derbyshire" in reply to 47264—page 409.—DITTON.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

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47076.	Bunsen Battery, 294.
47078.	G.W. Engines, 294.
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USEFUL AND SCIENTIFIC NOTES.

The Quickest Railway Run.—According to the *Engineer*, a Great Northern train, with an 8ft. single driver outside cylinder engine, which recently took the Duke of Edinburgh from Leeds to London on the Great Northern Railway, did the journey, 186¾ miles, in exactly three hours. One stop was made at Grantham. The actual speed, therefore, was over 62 miles per hour. This is, we fancy, the quickest run of the stated length on record.

THE largest sailing vessel afloat was launched last week from the shipbuilding yard of Messrs. Harland, Wolff, and Company, of Belfast. She is named the Walter H. Wilson, after one of the partners of the firm of builders, and is for Mr. Samuel Lawther, J.P., Belfast. Her measurement is 300ft. by 42½ft., by 25ft. She will be classed 100 A 1 at Lloyd's. She is built of iron, has four masts, three of which are square rigged, and is capable of carrying 4,000 tons dead weight.

QUERIES.

[47376.]—**Bone Calcination.**—Will some reader of "ours" favour me with a few hints on the calcination of bones? A description of furnace and title of a good book on the subject will be very acceptable.—BONE.

[47377.]—**Casting Small Articles in White Metal.**—Will some correspondent inform me how best to succeed in casting small articles in white or Britannia metal, such as valves for dry gasmeters, valves and valve-boxes of wet meters, and various other non-corrosive fittings?—METAL.

[47378.]—**Legal.**—To MR. WETHERFIELD.—I am saddled with a wife who constantly gets drunk, assaults me, and damages my furniture. Will you say what I can do? I am a professional man, and do not want an exposure.—M. B.

[47379.]—**Model.**—Would some fellow-reader give the exact proportions of port-ways, crank-shaft, working-gear, &c., for a cylinder 1in. bore and 2in. stroke?—MECHANIC.

[47380.]—**Clark's Process for Softening Water.**—To "NUN DOR."—Kindly give particulars of the above (referred to in your reply to 46929, p. 381), especially as to quantity of lime required, say, per gallon of water?—H. J. NOLAN, 3, Clifton Villas, W.

[47381.]—**Wildbad and Its Cures.**—Perhaps Dr. Royston Pigott would supplement his interesting account of the above spa. Kindly give invalids some information as to the best, or rather easiest way to travel to the Black Forest, and what the probable expense of the journey, and a sojourn there for a month would be for persons of but moderate means?—H. J. NOLAN, 3, Clifton Villas, N.

[47382.]—**Engine Query.**—Will some of "ours" say what lead the valves of a pair of condensing engines should have of the following descriptions?—Diam. of cyls. 20in., length of stroke 4ft., and running at 33 revs. per min., boiler-pressure 75lb. Also, say what part of stroke steam should be cut off at? I should mention that the load, or one-half of load, is knocked off every five minutes.—YOUNG BEGINNER.

[47383.]—**Hardening.**—Will some of our practical turners or forgers kindly give a proper method of hardening a carriage-axle? I have tried, but failed. I put one handful of charred bones and one handful of charred leather in a piece of 3in. hot-water pipe, and put in the axle, and sealed up both ends with clay, and heated 2½ hours in a smith's fire, then knocked box off and immersed in salt water, but it did not harden a bit; so I hardened with prussiate of potash, which makes a cankered mess of it after being got up smooth in lathe. A practical amateur will greatly oblige a—NOVICE.

[47384.]—**Coil.**—To MR. FRED. WALKER.—I have made a medical coil, the same as you described in the "E. M." on June 9th, 1882, only I have made mine ¾lb. of wire, and the shock is weak. Also the contact-breaker works but very little. I think that there is something wrong in the contact-breaker that prevents me from getting a better shock. I have a Bunsen battery and a wire core. If you will kindly assist me I shall be obliged.—G. TOPS.

[47385.]—**Spectacles.**—To MR. LANCASTER OR OTHER OPTICIAN.—I am near-sighted—the furthest distance for reading ordinary print being about 6in. I find this a great impediment in music, and the best spectacles I seem able to get do not make me see like other people. What I want to know is, if it is possible to buy, or have made, glasses that would enable me to read music comfortably at 2 or 3ft. from a music-stand, and which would not have any tendency to injure the sight?—KURZSICHT.

[47386.]—**Riveting Ship's Kelsons.**—I should be much obliged for a sketch of the best riveting machine for riveting ship's kelsons. There is 3in. by 3in. between flange of frame and kelson lug. What kind of a jaw would be required to get on the rivet between frame and kelson? Any hints on shipyard rieveting machines and what they are qualified to do, and how to fix them for different jobs, will be very thankfully received. I think deck stringers might be done with them.—A. RUTT.

[47387.]—**To "Aldebaran."**—I have bought a second-hand telescope, 3½in. in diam., and fear I have been taken in. Shows small stars very distinctly, but they seem to have rays or wings, whereas I am told that in a good telescope they ought to show a small disc. It answers very well for sunspots, and shows the lunar mountains very clearly. I have not tried it on the planets. I have taken out the o.g., and notice that the glasses are not cemented together. Should they be? and if so, which would be the best way to set about it.—GEORGE TOWNSON.

[47388.]—**Cold-Water Soap.**—There is now extensively sold a yellowish hard soap, with the words "Cold water soap," and "Sinclair, London," stamped on each of the bars. As it has a rather peculiar appearance, I should like to know more about it. Could Mr. Allen indicate the composition of that soap?—A TEN YEARS' SUBSCRIBER.

[47389.]—**Engine and Carriage-spring Furnace.**—Can any of your reader inform me what is the best form for economy of an engine and carriage-spring furnace? My longest spring is 5ft. long. Is there any economy gained by the arrangement of bringing the smoke over furnace-hearth before getting away to chimney? I saw one worked some time ago by wind from blast fanner, but with what results I cannot say. Please describe construction of furnace, with sizes, and also height of chimney.—HOMBRE.

[47390.]—**Foundry.**—Could "Foundry," "Cast-Iron," or some other of your correspondents, give me some particulars as to how the mixtures of cast-iron and steel are made? And if cupola is of the same construction as is used for ordinary iron-founding? I, myself, have made a trial of mixing cast-iron and steel in an open cupola, but sorry to say, got nothing out better than common iron after all my trouble in getting the different classes of iron and weighing of the old steel rails, &c., &c. What I want to get at is a chilled wheel for a narrow gauge railway that could be depended on without breaking, as the common cast-iron ones generally do. The Americans put very good wheels, and all chilled, under their railway plant.—HOMBRE.

[47391.]—**Portable Lounge Chair.**—Would some reader kindly give dimensions, with sketch, of one of those hammock or lounge-chairs, something on the plan of the Yankee hammock-chair, or one like those used on board of the Trans-Atlantic steamers, the frame to be of oak, and to fold up when not in use?—AN AMATEUR M.

[47392.]—**Perfumed Pastilles.**—Would some reader tell me how to make them?—AN AMATEUR M.

[47393.]—**Cocoanut Oil.**—We have a large cocoanut plantation in Singapore. The price of oil at present being very low, it hardly pays us to make it. Can anyone suggest some profitable manufacture from the oil, so as to make it pay? Our oil is very clear and sweet, as it is not pressed.—SINGAPORE.

[47394.]—**Combustion of Coal.**—Having followed the replies to the queries on the "Combustion of Coal" with considerable interest, I shall feel extremely obliged if Mr. Kanthack would tell me how to calculate (as simple as possible) the weight of air required for complete combustion into cubic feet.—IGNORANT.

[47395.]—**Large Tank.**—I have just taken down a tank 15ft. long, 5ft. wide, 4ft deep, flanged, and put together with bolts and nuts. I find the joints were made with iron borings, each joint being about ½in. apart. Will some of "ours" kindly tell me the proper way to put the same together—whether I am to put all the bolts in, and then make the joints, or how, and how much sulphur and sal-ammoniac to one lot of borings?—J. T. H.

[47396.]—**Simple Rotary Engine.**—Will some kind reader kindly tell me the best form of the above for steam at, say, 30lb. of steam, to drive a 3in. Britannia lathe at the ordinary speed for wood-turning: this to be made by myself, so ease of making is one object in view? Please to give all particulars available, with dimensioned sketch, and oblige—ROTHER.

[47397.]—**Engraving Machine.**—I read description of engraving machine with considerable interest, but failed to understand how the drill was moved backwards and forwards, so as to form the letters or figures. Would it be asking too much of you to explain more fully the movements of machine in question to me? I could only see that the drill has the usual rotary motion; but how it is made to follow the lines of any design, I fail to see either from the woodcuts or description. This is a thing that would interest great numbers of our readers I should imagine. I thought engraving could not be touched by machinery; but I find I am mistaken. Your correspondent, N. S. Heinecken, speaks of the "elaborate and effective engraving machines of various makers being known to your readers" I should be very glad to see an account in the columns of "E. M." of these machines.—SCRATCHER.

[47398.]—**Lewis' Incandescent Gas-lamp.**—To "SIGMA."—Will you kindly say whether this lamp can compare in economy with the gas-burner at present in use, say Sugg's or Silber's, using the gas now supplied?—PAUGUL.

[47399.]—**Condensing Exhaust Steam.**—What is the most efficient method, consistent with economy, of condensing the exhaust steam of 12-i.h.p. engine, so as to reduce back-pressure, water to be afterwards injected into boiler? Kindly state cooling surface of condenser, and quantity of water per hour required. Would a circulation of water through condenser and double pipes to an open tank on roof be sufficient, and what should be the size of roof-tank? Water is very expensive.—P.

[47400.]—**Electric Light for Workshop.**—Will some correspondent kindly say which would be the best system to employ for lighting workshops where 200ft. of gas per hour are now burnt in common burners, and approximate power necessary for same? At least, six lamps would be required. Kindly give a hint of the cost of apparatus, and of the comparative economy in working the gas and electricity, neglecting the power.—P.

[47401.]—**Coil.**—To T. N. ANDREWS, Plymouth.—In your description of coil in the MECHANIC, March 10th, 1882, p. 15, you say nothing about the ends of the paper tube being fixed into the reel ends, and you also seem to have put the paper tube between the primary and secondary wire instead of being round the wire bundle and inside of the primary, as surely it ought to be. More information will oblige.—W. R. C.

[47402.]—**Summer-House.**—Will any of our subscribers help me? I wish to make a summerhouse 7ft. wide and about the usual height. What size and quantity of materials shall I require, as I wish to buy all at once? The shape I wish is hexagonal, with cone roof.—SECONDS.

[47403.]—**Lawn Tennis Court.**—I wish to make a lawn tennis court (not turf), in as effective and cheap a manner as possible. Can you tell me the best way to proceed—asphalte, cement, cinders, or what? The ground at present is ordinary garden ground.—G. T. S. GILL.

[47404.]—**Railway-Carriage Lamps.**—Can any reader interested in carriage lighting tell me how it is that there are so many lamps on our line all with about 1lb. of oil run over into bottom of glass globes? There is certainly a fault somewhere. Is it in the construction of lamps, or in trimming of same?—HOMBRE.

[47405.]—**Locomotive.**—Will some fellow-reader kindly help me out of the following difficulty?—In taking out a copper firebox to put in a new tube-plate, I find in the outside casing plates all round about the taper holes where the copper stays pass through, more than half the thickness of plate eaten away: all the rest of plate in good condition. Is there a galvanic action formed between the iron plates and the copper stays, or is it bad copper with too much arsenic? Having discussed the matter over with several parties, but all seem to have different opinions. I should like to hear the opinion of some of our readers. What is the opinion of W. J. Lancaster?—HOMBRE.

[47406.]—**Dew-caps.**—Can any of your readers kindly inform me of an easy and effectual method of constructing for oneself a dew-cap for a 3in. refracting telescope?—TYRO.

[47407.]—**Concave Lenses.**—Will Mr. Lancaster, or some other gentleman, kindly instruct me how to cut and finish the grooves on the edge of oval concave-lenses for spectacles with the invisible frames?—C. R. D.

[47408.]—**Fish Glue.**—Is glue manufactured from fish-skins—not bladders—anywhere in Europe?—where? And can the process be given in a general way?—AMERICA.

[47409.]—**Circular Bead-cutter.**—I have large quantities of small round beads to make, exactly same size as an ordinary lead pencil. I use thousands of feet of this beading, but should like to know if it is possible to cut them with a revolving cutter at once running through. My idea was to fix a cutter in some manner to a short revolving hollow shaft, pass a piece of square yellow pine just cut from the circular saw through a square aperture to keep it from turning round with motion of cutter, then through hollow shaft containing cutter, and come out finished at the opposite side. It would require to be quite smooth, even if two cutters had to be used. It would be driven from a gas-engine, with small pulley on the hollow shaft. What number of revolutions ought the cutter to have per minute to work efficiently? It would be required to cut any lengths, from 2ft. to 20ft.—BEAD.

[47410.]—**Dry-Plate Intensifier.**—What is the chemical reaction on the addition of a haloid salt, such as ammonium chloride or bromide, or potassium bromide or iodide, to mercuric chloride solution? Some photographers recommend a solution of mercuric chloride alone. Does the addition of one of the above-mentioned salts increase or modify the action of the mercury? If so, in what way? Have any of your readers tried copper bromide, followed by silver nitrate, as a dry-plate intensifier? I have, with good effect. It is recommended by Abney for wet plates, but I have never read of its being used with dry plates.—W. H. S. W.

[47411.]—**Throwing the Hammer.**—In the exercise of throwing the hammer I have broken half a dozen shafts. Hammer is sixteen pounds weight, shaft 4ft. long, regulation length. Is there any mode of seasoning the handles? The break occurs from just at the ball to about a foot from it, and takes place when the hammer lands on the ground. My shafts have been pretty thick, and of ash and hickory. Perhaps some one of your correspondents could help me out of my difficulty?—SCOTTICE.

[47412.]—**Coulomb's Law of Electro-Statics.**—At line 5, on p. 191, of Prof. Thompson's "Elementary Lessons on Electricity," the force exerted between two charges of electricity is said to be inversely proportional to the distance between them. But the formula given lower down in the same page makes the proportion inversely as the square of the distance. Which is correct?—H. E. A.

[47413.]—**Marble.**—A month ago I brought home a Carrara marble figure from Pisa. I now find that spots or blotches of a very pale buff colour are appearing all over it. I am told that this is a common fault with white marble. I have tried plastering on a coat of thin stucco, leaving 24 hours and then washing off; but this does not seem to be effectual. Can any correspondent give advice, or help me to the best method of cure?—VULCANITE.

[47414.]—**Substitute for Leather Disc.**—I have a small machine in which I use a metal disc to turn a leather disc instead of a pair of bevel-wheels: but I find that the leather wears very soon. Could any reader inform me of a paste or composition with which to coat the leather so as to protect it?—A DOWN MECHANIC.

[47415.]—**Organ Stops.**—Will Mr. Dresser or other of our organ correspondents kindly give me a few hints how to voice the pipes of a clarabella stop? Several pipes I have tried have always a chiffing, and in others a quivering whenever they speak. How can this be overcome? I should also like to know if the inside of the cap ought to be hollowed as in Fig. 25, No. 8 of Mr. Dresser's articles, or like Fig. 22? Also, the nicking: ought it to be straight, or should it run obliquely across the block? I may say that the pressure is 2in., and the pipes are cut 2-7, and the lips left thin. Any information will oblige.—L. G.

[47416.]—**Aluminium—Mellogen.**—I thank Mr. E. Sellon and will communicate with him. I am obliged to Mr. Alfred H. Allen for his wish to disabuse my mind: but had he carefully read my communications, he would have learnt that it was no "hopeful method," but a thing actually accomplished. As he is so interested in aluminium, he may extend his interest to other like apparently difficultly reducible metals, and will be pleased to hear that I find no difficulty in reducing magnesium and other metals by a process of my own, and without the aid of sodium. Thanks for the answer to my query "Mellogen." I really wished for the chemical formula of action. Given C and H_2O, how does the electric current produce $C_{11}H_2O_4$? I have a theory, but at present only a theory, and I should be glad to learn from one who knows.—ZELIA NAIEN.

[47417.]—**Varnishes.**—1. What is the best work on the making and properties of the various painter's and coachmaker's varnishes, and who are the publishers? 2. Does copal gum possess any special properties for making varnishes not to be found in other gums, and what are they? 3. What is "prepared painters' copal"?—T. MACKENZIE.

[47418.]—**Refrigerator.**—Would it be possible to construct one on the compressed-air principle, of moderate cost, and to be worked by hand, so as to be available for domestic use?—ARIEL.

[47419.]—**Riveting China, &c.**—Can any reader of the "E. M." inform me as to the process in riveting broken china, &c., or if there is any published work giving such information?—JOBBER.

[47420.]—**Steinheil's Eyepieces (page 397, "E. M."**—How are they constructed? Will some correspondent kindly give diagram?—ZETA.

[47421.]—**Transparent Gum.**—Can any of "ours" tell me how to increase the transparency of dissolved gum? I have had the best gum-Arabic, which, although white, is not transparent, and when dissolved has a slightly starchy appearance. Can it not be made in its liquid state to appear almost as transparent as pure water?—SOLUTION.

[47422.]—**Stamping Notepaper.**—Having some notepaper to stamp with in white colour, I find the colour I use (flake white and stamping varnish) turns a grey colour. Would any of your numerous correspondents kindly inform me if there is any other varnish or compound to be used with a steel die that would keep the colour pure white?—ONE IN A FIX.

[47423.]—**Diabetes.**—Will Dr. Edmunds kindly give a simple test for sugar in urine? A friend of mine who has lost two children through this disease (although attended by good doctors) wishes to keep a check on it, and to know of its presence before it is so far gone. Is there any diet to be recommended to anyone who is supposed to be diabetic, and what would be the best thing to do if sugar were detected by the test? Local doctors seem to know very little about this disease.—E. F. C.

[47424.]—**Crystallising Vessels for Epsom and Glauber's Salts.**—Can any of your readers practically acquainted with making the above salts say what is the best kind of vessel for cooling and crystallising them? I am much troubled with some iron ones, each time emptying of the salts, those lying close to the iron bring away a dirty brown discolouration, causing much loss, having to be separated from the rest and worked over again. What could I coat the pans with to remedy this? Ordinary paint seems to have no effect.—ANXIOUS.

[47425.]—**Electrical Measurement.**—Would someone give me information respecting the following?—Equal deflections on the same galvanometer always equal the same "current." Does the same deflection on the same galvanometer always equal the same "electromotive force," and the same with "resistance"?—STUDENT.

[47426.]—**Reynard Incandescent Light.**—I have endeavoured to obtain this light by following the directions given in *Nature* of June 1st: with petroleum I obtained no light at all; with benzoline I get a blue flame, but fail after repeated attempts to make the platinum gauze incandescent. No doubt there are many readers of the "E. M." who have tried the light. Will some of them suggest any cause for my failure?—S.

[47427.]—**Calculating Strains in Boiler.**—Will "M.I.C.E." tell me why the following sum should be multiplied by 2?—A boiler 6ft. diam., 50lb. pressure and ⅜in. plates. First, 6 × 50 × 3 ÷ 8 = 112·5 for strain on circumferential seams; secondly, 6 × 50 × 3 × 2 ÷ 8 = 225 for strain on longitudinal seams. Why multiply by 2 in second case? What is resisting strain of same? Will "M.I.C.E." also notice query 47291, p. 387?—JOHN.

[47428.]—**Etching.**—To "R. B."—I am much obliged to "R. B." for his answer to my former query, and for kindly offering further assistance, of which I now wish to take advantage. Not understanding anything about chemists' weights, &c., I find rather a difficulty in finding the right proportions for mordant. Will "R. B." tell me whether the following are right?—I have troy weights, decimal system; taking ·032151 troy oz. to = 1 gramme, then taking three figures of the decimal to be near enough, gives for the mordant, hydrochloric acid 3·215, chlorate of potash ·643, water 28·292, or for smaller quantity take one-eighth of each. Is there a simpler method than weighing for getting proportions? What proportion of beeswax to turps is best? Is Japan varnish the same as Japan black sold at 1s. per bottle? I purchased the "Handbook" and other necessary articles. They give every satisfaction, but the ground seems too thick with two coats for the point to get through easily. What is the advantage of smoking? This ground seems to be a different mixture, smelling of ether.—ROGATOR.

[47429.]—**Electro-gilding.**—In gold-plating brooches I never can get the plating to cover the solder. How can it be done?—A AMATURE.

[47430.]—**Instantaneous Photography.**—To MR. W. ROBINSON, JUN.—I am much obliged for your reply. I have since used some other plates, and the results are better, but not quite satisfactory. The centre of the picture is very good, but at the ends of the plate there is scarcely anything to be seen, and then in developing they become so very thin, and the hypo. clears it nearly all off the glass; in fact, if I left them in the fixing as long as the many books I have read recommend, there would be nothing but clear glass. With regard to the lens I use, there is only one stop, which is described as an f_8 stop.—TYRO.

[47431.]—**Speed.**—Would some one kindly work out the following:—Two trains approaching each other, one is 30 yards long, running at 50 miles per hour; the other is 36 yards long, running at 40 miles per hour. What time elapses from when the engines meet until the brake-vans are clear?—S. W. J.

[47432.]—**Locomotive Boiler.**—To "E. L. P.," OR OTHERS.—Shall be obliged to any reader for answer. I wish to know if coppersmiths understand the making of model boilers fitted with tubes, and having a proper-made firebox to burn coal or charcoal? Also, how is the starting valve made that turns steam on or off inside of boiler? Should the dome be placed over the joint of valve, and how is it possible to get at it to repair if the dome is riveted on to boiler? Should the supply-pipe in boiler be placed high up, so that it is clear of water? Would a boiler 19in. long by 5in. diam. supply steam to a pair of cylinders of 1¼in. long?—W. RICHARDS.

[47433.]—**Portland Cement Floors in India.**—In India the floors of houses are usually made of either brick and mortar concrete well rammed, and then plastered with lime plaster of a more or less fine quality, or else of brick set on edge in mortar and then plastered as above. It has lately been found a great improvement to lay on this a fine layer of about ¼in. thickness of Portland cement, as the cement sets much harder than the chunam (lime). My difficulty is, that the Portland cement almost invariably cracks all over the floor after being down for a short time, and in some instances separates from the floor beneath and shells off. Is this the fault of the cement, and is there any means of remedying this defect? The cement is usually mixed 1 to 1 of fine sharp sand, and the floor kept under water for sometimes a month to properly harden it.—A MELTING MECHANIC.

CHESS.

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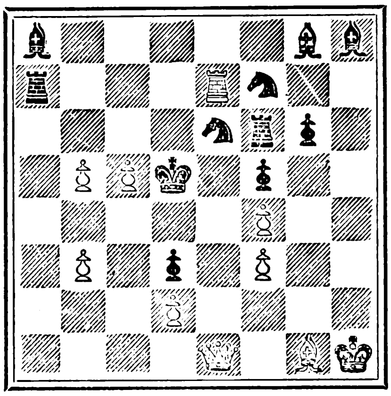
ALL Communications for this department must be addressed to the Chess Editor, at the office of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCLXIII.—By J. W. ABBOTT.

Black.



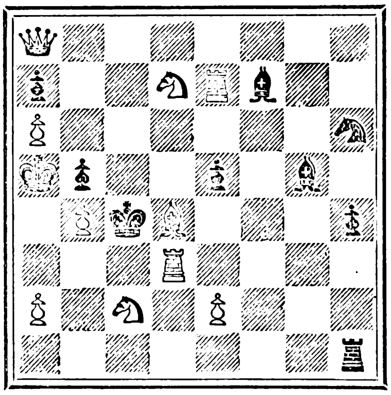
White.

White to play and mate in three moves.

PROBLEM DCCLXIV.—By C. A. GILBERG.

From *Brentano*.

Black.



White.

White to play and sui-mate in three moves.

SOLUTION TO 759.

White.	*Black.*
1. Q to Q R 7	1. Kt to K Kt 3
2. Q to K Kt sq	2. Anything
	(a) 1. Kt to K B 2 (b)
2. K takes Kt	2. Anything
3. Mates	
	(b) 1. Kt at K B 8 moves
2. Q to Q 4 (ch)	2. K takes Q
3. Mates	

SOLUTION TO 760.

White	*Black.*
1. R to K R 2	1. P takes P (a)
2. R to Q Kt 3 (ch)	2. P takes R
3. B to K B 2	3. P mates
	(a) 1. P moves
2. Q R to K Kt 2	2. P moves
3. B to K B 2	3. P mates

NOTICES TO CORRESPONDENTS.

IN problem 757 the Kt at K Kt 3 should be at K B 2, and a P should be placed at K Kt 4, in order to avoid a second solution.

SCHMUCKE.—You have hit 760, but have missed the point of 759; there is no mate if $1.\ \frac{\quad}{\text{Kt to K Kt 3}}$ $2.\ \frac{\text{Q to Q 4 (ch)}}{\text{K takes Q}}$ $3.\ \frac{\text{B to K B 6 (ch)}}{\text{Kt covers}}$.

"CHESS STRATEGY," BY S. LOYD.

AT last the long-looked for volume by Mr. S. Loyd has appeared, and we think that in interest and value it must far exceed any one's expectations, though no doubt they were high, owing to the great reputation of the author. In fact, it is not too much to say that no collection of problems hitherto published comes anything near the present one, and that because we not only have 500 of the writer's best compositions, but (what is perhaps of equal value) his own views on the various subjects in connection with the art. These views are not laid down in any precise or formal way, but in a delightful, gossiping style which makes the book as attractive as a good novel. The fault or weakness of previous collections (if we may except Klett's and Kohtz and Kocklehorn's) is that the problems have been published simply in order of moves, without note or comment: so that there was no connection between them, and nothing to interest except their own intrinsic merits; but here, if the author does not take us into his workshop, he does what is better: goes thoroughly into every point (to use his own words) "upon the defects as well as the beauties of the art, showing his way of composing and solving, how to get new ideas, and how to judge of their relative merits." Accordingly, we have pregnant remarks, with illustrations, on such subjects as "crowded positions," "economy of force," "end games," "key moves," "neatness," "old style problems," "problem solving," "surprise moves," "suggestive problems," "two movers," "problem building," "sacrifices." Thus, every page is interesting; and although we expect a good deal that the author lays down will be questioned (especially with regard to his definition of "problem" and his views about two movers), it is none the less valuable on that account. We intend shortly to give a few problems extracted from the work. Copies may be obtained from J. Watkinson, Esq., Fairfield, Huddersfield, at 12s. each, post free.

ANSWERS TO CORRESPONDENTS.

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⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6 Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, July 12, and unacknowledged elsewhere:—

THURSO MECHANICS' INSTITUTE.—Starley Bros.—J. Hagger.—G. Hudson.—J. Francis.—F. A. Millar.—R. Murray.—A. M. Read.—J. Gillott, Jun.—W. F. Stanley.—G. Calver.—G. Plant and Son.—Cunliffe and Croom.—A. MacNab.—G. J. Hewson.—E. Bryce.—W. R. Hicks.—Etna.—W. B.—B. B.—W. M. Gardner.—C. J. Little.—Miner.—J. Smith.—W. R. H. R.—Rigel.—New Querist.—Spelter.—E. B. Fenessey.—Tourist.—A Mongeril.—E. M.—G. Tolman.—Deh.—H. B. C., Lambeth.

FIXUS LECTOR. (What sort of a book do you want? "Marine Engineering" applies to many branches. If the "Marine Steam Engine," see Sennett's work with that title, published by Longmans.)—CORNUBIA. (Native alum is found in the shape of a potash alum on alum-slate in a few parts of Britain. The alum of commerce is manufactured from alum-schists, or clay, and is, we should say, a profitable undertaking.)—C. ADAMES. (If you refer, you will see that the article is quoted. The Fig. is a diagram, and the part that has puzzled you is merely to show how the supply-pipe is attached. It need not taper smaller, and you can use either steam or air.)—DRAUGHTSMAN. (You will find the rule in p. 259, No. 812, or with diagram in p. 457, No. 851; also p. 599, No. 883.)—G. I. C. E. (Yes, it will do. Run it through some melted paraffin wax, if you like.)—M. OLLINER. (1. Nothing serious. 2. It is a very useful book, if that is what you mean. 3. It does not treat of personal health, but of sanitary arrangements.)—JAS. CALVESBERT. (Dissolve shellac in pure methylated alcohol; add lampblack and, if you wish for a jet black, a little prussian blue.)—ONE ANXIOUS. (We do not know; it is a trade secret. There are, however, several processes.)—E. H. (For boomerang see p. 124, No. 313.)—H. H. (It acts as an indicator of a change in the weight of the atmosphere in its locality, but is scarcely a barometer. It is, however, a useful prognosticator of the weather, and is not more often adopted because the water evaporates and becomes dusty and dirty. If some coloured solution made with boiled water is used, and the apparatus is protected from dust, it will be found useful as a weather-glass, but it can never take the place of a barometer.)—H. S. T. BISCOE. (Your idea is quite correct.)—A. FRASER. (See p. 100, No. 836. You must serve an apprenticeship or work in the engine-room.)—R. H. S. (Many recipes in back numbers—p. 111, No. 863, for instance.)—A SAILOR G. H. (Clock-springs will do, but we believe they are to be bought ready cut. File the tip to sharpen; near the screw to flatten.)—D. J. (You mean the "agglomerate." Peroxide of manganese, gas-carbon, and rosin, moulded under great pressure.)—PAINFUL. (Bunions, apparently; but examination necessary.)—G. W. (Both recipes have been given several times, but the colour of the last is a trade secret.

Brunswick black is made by dissolving asphaltum in boiling oil, and thinning with turpentine. A common kind is made from pitch.)—R. W. (We doubt if there is such a book.)—J. TEMPLAR. (Too much of such a drink would not be beneficial; a tablespoonful of oatmeal to a pint of cold water, makes a wholesome and satisfying drink, and weak cold tea, with a slice or two of lemon squeezed into it, is palatable and thirst-quenching.)—SEMPER FIDELIS. (Diluted nitric acid will remove it: use carefully.)—SY. SMITH. (The filtering medium is choked up, and the water is really not filtered at all. You will have to send it to the maker to be refitted, but the best advice we can give is to discard it altogether, and buy a filter with a removable top, so that you can clean the charcoal block once a week, and substitute a fresh one when worn out.)—PAUGUL. (Received; but in this instance we had not room for reproduction.)—ONE IN A FIX. (You can obtain a copy at Somerset House, for a small charge.)—R. F. (You had better give up smoking; it does probably induce dyspepsia in some men, and you seem one of them.)—NOVICE. (They do not require any artificial heat at all now. You will find a recipe for making them into wine in No. 345, p. 179; but such grapes are wasted in wine. To make a preserve, treat in same way as other fruit. Grapes ripened in a house should, however, be eaten as they are. You can preserve by cutting the bunches with long stems and putting them in bottles of water.)—DE'RING. (We have given many recipes for graphs. Use more glue if it is too soft. Good clear glue—not Nelson's gelatine, which is wasted on such things. Dissolve aniline violet in alcohol, and dilute with water.)—A AMATURE. (It is lacquer, which you must clean off, and pickle the metal in nitric acid; then relacquer. It is an art requiring much skill, to be acquired only by practice.)—WATER-GLASS. (1. Answered directly or indirectly in every volume—see pp. 9, 80, 172, present volume, for instance. For the other question see some of the text-books and the *Nautical Almanac.*)—VIOLINIST. (Spohr's book is considered one of the best; but lessons from a teacher are more necessary with the violin than any other instrument. There are some useful hints on p. 94, No. 784.)—ONE UNSETTLED. (See p. 47, No. 652. For particulars apply to Mr. W. C. Burnet, 10, Blomfield-street, Finsbury-circus, E.C.)—GEO. SMITH. (In type.)

Every Workman connected with the Building Trades requiring a situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden London, W.C.

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Drilling Stand. made of 2in, iron, 4ft. 6in. high, with jib 1ft. long, swing brace with 36 best steel drills, with screw for feed. Offers of anything useful invited.—219, Walton-road, Liverpool. ½cwt. of slide-rest tools, all best cast steel. Offers as above.

Thirty-four Vols. "**English Mechanic,**" bound, complete and clean. Wanted cottage piano, or offers.—J. WOOD, 189, West-terrace, Burley-Wharfedale, near Leeds.

76 **Microscope Slides** for Exchange. Also Microscope Turn-table —LINTIN, 170, Freedom-road, Sheffield.

Good Norwich yellow cock **Canary.** Exchange.—WILLIAM RIGBY, Walmer Bridge, near Preston.

¼ dry-plate **Tourist's Camera,** complete; for Lantern Slides.—SHEERMAN, 147, Clarence-road, Lower Clapton.

Two **Lathe Heads,** 6½in. centre, 4 chucks, socket, and two T-rests. Exchange.—C BLANCHARD, 4A, Little Church-street, Edgware-road.

Clarionet Stop of Organ Pipes, 42 notes, from tenor C, spotted metal, London made and voiced, nearly new. Offers wanted.—HAVARD and STEVENSON, 103, Byrdsley Park-road, Birmingham.

Seventeen 2s. numbers of "**Cassell's History of** ENGLAND," unsoiled. Also quarter-plate Camera. with dark slide, focussing lens, and instructions, cost 33s. 6d. Wanted, Slide-rest, or other engineer's tools, in exchange.—HARDY. Newtown, Yeovil, Somerset.

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What offers for Gem **Sewing-Machine** on beautiful stand, oscillating treadle motion. Photographic Dark Tent, Quarter Dry Plate Camera and Lens?—E. SCOTT, Patrington, Hull.

Wanted to exchange, Watchmaker's **Balance** WHEEL-CUTTING ENGINE 6 cutters, 35s, or other goods; for good Telescope, with day and night eyepieces.—E. SCOTT.

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To Amateur Mechanics.—Small **Steam Engine,** 1in. bore, 3in. stroke, vertical. Wants slides for crosshead fixing up. Also Vol. XXI., XXII., XXIII, ENGLISH MECHANIC, clean, unbound. What offers? Small bench lathe or bicycle parts.—FRANK DYSON, Delph, Saddleworth, near Manchester.

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THE SIXPENNY SALE COLUMN.

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"**Engineer,**" from May, 1880, to July, 1882, 113 clean copies, 25s.—R., 36, High-street, Welshpool.

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Diamond Pencils, for writing and sketching on glass, stone, &c., 3s. Real diamond guaranteed.—GEORGE TEMPEST, 3, Canova-street, Liverpool.

Lathe, 4in. back gear; bargain. Tools, chucks carpenter's bench and tools. Complete list on application.—Address, LATHE, 1, Addington crescent, York-road, Lambeth, S.E.

Volvox Globator, tube 9d:; small tube 4d.—M. C. P., Bisham Vicarage, Gt Marlow.

Iron Indiarubber **Stamp-making Press,** cost 16s., used twice, 10s.—M. C. P., Bisham Vicarage, Marlow.

Metallic "A" and "E" **Violin Strings,** Acknowledged success. Six, post free, 1s—JOHN ELARCO, 36, Kelvin-grove, Liverpool.

Air-Cane (breechloading), shot and bullet barrels, perfect, price £3 10s.—R. STIRLING, 14, S. Hamilton-street, Kilmarnock.

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Remington **Type Writer,** nearly new, cost £20, £9 —FRANCIS, Rochford, Essex.

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Astronomical Telescopes.—3in. Tulley, £8. 4½in. Browning, £8. 5¼in. Gregorian £6. Second hand. Property of an amateur.—Onvah House, Stodart-road, Anerley.

Pair of **Telephones.** Switches, and Bells, cheap. Send for particulars.—E. A, 20, Malden-road, Kentish Town.

A pair **Engines, Boiler, and Tanks,** suitable for yacht Good as new. Cheap—JENKINS, Waterson, Milford.

An **Invention** that will realise a large capital.—Apply, W. T. BRAHAM, 392, Stretford road, Manchester.

A perfectly constructed **Ten-cell Grove's.** with special ebonite cells, grooved to steady the power cells. Platinum points to all the binding screws.—F. HARVEY, Bushey Heath, Herts.

A delicate **Balance and Weights,** Griffin make. F. HARVEY, Bushey Heath, Herts.

Patterns of Weston's Pulley Blocks, all ready fit up, complete, new, cheap.—W., 19, Atkinson-street, Stockton-on-Tees.

Sewing Machine, the Improved Perfection Shuttle Lock-stitch, 60s.—BROWN, 93, Leyton-road, Stratford, E.

Microscopic Objects, prepared ready for use, 12 packets, 1s. 1d, post free—W. WHITE, Warden-place, Nottingham.

Fret Machinery, parts for fitting to wood framing for steam power, cuts 4in.

Bicycle, 52in, by Hillman and Herbert, only used twice, £8 10s. Painted—J. HERBERT, Engineer, 8, Southampton-street, Fitzroy-square, W.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, JULY 21, 1882.

EXPERIMENTS WITH THE ELECTRIC ARC.

A FEW weeks ago MM. Jamin and Maneuvrier, in the Paris Academy, described some instructive experiments in which the electric arc was maintained between various "electropyres" (to use a recently-coined word), by action of a Gramme machine with alternating currents. With two quite similar carbons as electropyres, there is no deflection of a galvanometer in the circuit, the two rapidly-successive contrary currents neutralising each other. But, with one carbon thick, the other thin, there is permanent deflection (as though a battery were inserted in the circuit); the current from the large carbon to the small dominating over the other, and giving a differential current. There is also a differential current where the electropyres are a mass of metal and a carbon point. With lead a deflection of 29° was had; with iron 30°; with carbon 31°; with copper 60°; with mercury 70°. In the case of zinc, the current, at first as strong as with copper, falls off, probably owing to formation of oxide.

The electromotive force of the differential current is small, and about the same, for lead, iron, and carbon. For copper it is equivalent to 50 Bunsens, for zinc (at first) to 66, while mercury shows 103·7. It is proved that the first three substances offer the greatest resistance, while copper and mercury offer the least.

The differential current can only be explained in two ways: by a difference in the resistance, or by an inequality in the inverse reactions of the arc in one direction or the other. As no difference of resistance was observed with change of direction, it is concluded that the current in question is due to a particular property of alternating currents.

Whatever the explanation, it is clear that, the arc once produced with mercury, the differential current quite alters the action of the machine. One system of currents is, if not extinguished, considerably weakened, and the other constituted by excessive currents of greater intensity and duration. The commutator by which alternating-current machines, like those of Nollet and Meritens, are rendered available for chemical operations, might be replaced automatically by one or several arcs formed between a bath of mercury and a carbon point. It remains to ascertain the economic conditions of this transformation.

The effects obtained from the Gramme machine, with alternating currents in the electric egg, are remarkable. The two currents contribute equally (say the authors) to the phenomenon, which is that of Geissler tubes, but which assumes incomparable brilliancy, owing to the considerable quantity of electricity which passes and rapidly modifies the appearances observed. The carbons get heated, redden, and reach a pale white, not only at their extremity, but throughout their length; then they are rapidly volatilised by the combined effect of heating and of the currents. Whatever the cause of this volatilisation, it is certain that a carbonaceous matter spreads in the state of vapour. The globe gets filled with a blue gas, like vapour of iodine, deepening in hue to indigo. The vapour is abundantly condensed on the glass, rendering it opaque. The authors avoided this termination by using instead of single carbons two bundles of crayons, diverging from the rheophores, conewise, towards each other. Here the currents are divided into a large number of effluves, less intense than the single effluve; all the carbons are illuminated at once, and less the more numerous they are. The volatilisation is nearly *nil*. A still brighter effect was obtained with copper rods.

In a more recent paper, MM. Jamin and Maneuvrier have described some striking modifications of the arc when sulphide of carbon vapour is introduced into the vacuous space. The carbons in these experiments were parallel—fixed at the base, and separable at the top by a simple mechanism. With a vacuum as complete as possible in the receiver, the arc, of course, does not form; there is the Geissler tube phenomenon: but when a few drops of sulphide of carbon are introduced, increasing the pressure about 0·05m. or 0·06m., one sees the arc between the points, and it persists as they are separated. At this moment there is, as it were, an explosion of light, so bright as to be unbearable, incomparably superior to the usual brilliancy of the arc. Looking through coloured glass, one observes the arc to be of horseshoe form, or like a large Omega, resting with its two ends on the carbon points, and about 0·05m. in height. A long flame rises vertically from it. The points of the carbons seem red and very brilliant, but the arc is pale-green, and, as this colour dominates, the whole room is as if illuminated by a Bengal flame with copper in it. The brilliancy increases with increase of tension of the vapour; but, the resistance also increasing, the arc may go out and have to be started again and again.

The spectrum of the light is formed of four channelled spaces in the red, the yellow, the green, and the violet, very similar in appearance, though the green is the most luminous. They probably obey the same harmonic law, which remains to be discovered.

While these appearances are in progress, a chemical action takes place. If air have remained in the receiver, the sulphide of carbon burns incompletely; a cloud of sulphur fills the space, and is deposited on the glass; the carbon burns alone. If the air have been well removed these clouds do not form; a brown deposit is produced on the glass, and becomes black. This deposit is volatile. Its odour recalls that of sulphur. "It is evidently a compound of sulphide and carbon; perhaps a protosulphide corresponding to carbonic oxide, perhaps an isomeric combination of ordinary sulphur. One finds, indeed, neither a deposit of sulphur nor one of carbon, and the crayons have neither lost nor gained. It is probable that the sulphide of carbon is dissociated, the sulphur volatilised, the carbon in vapour disseminated in the arc, and that this carbon and this sulphur recombine in the flame to reconstitute a combination under different conditions; but this is merely a conjecture, no analysis having yet been made. *En résumé*, this experiment is remarkable for the extraordinary quantity of light produced, for the size of the arc, for its colour, for the composition of its spectrum, and for the chemical actions which take place. It is not probable that it could ever be turned to advantage for illumination, on account of the colour, unless for lighthouses and signalling at a distance."

CONTINUOUS RAILWAY BRAKES.*

IN the preface to this work, Mr. Michael Reynolds tells us he has endeavoured to explain what, according to his experience, a continuous brake should be capable of doing, and when it is found most useful. The key-note of his remarks may be found in his statement that even the worst continuous brake is a marvel of improvement on the old system of separate and independent brakes under the control of driver and guards, and worked by the primitive mode of "turning handles." By turning handles, the author obviously means the gymnastic feats which can still be witnessed on too many of our lines, when the stoker and the guards, in order to bring a train up to a station, are compelled to revolve a lever many times in order to screw down the brakes. The question of continuous brakes was first brought prominently into public notice by the celebrated Newark trials, which were made in 1875, just seven years ago; and the competition which has gone on since then amongst the rival brakes has left the railway companies in much the same condition: that is, they have found nothing better than the brake that was then offered for their acceptance, and shown to be an efficient train stopper and a valuable safety appliance. Readers of these columns must be well acquainted with the recent history of the question: they are aware that while some companies have taken every advantage of modern inventions, others have pursued a policy of "shilly-shallying," apparently waiting for something to turn up, while at least one boldly declared that continuous brakes should be used only in emergencies, and that the brake in use on their particular line was the best in the world—an opinion which has since been unconditionally surrendered. As the whole question is not unlikely to come before the Legislature, —it would probably have been brought forward before now, but for a press of other more important matters—this work, in which Mr. Reynolds has given a popular explanation of the different brakes, will be of great assistance in forming public opinion, and it might be studied with benefit by those who took upon themselves to burk the Bill that was introduced this session in the House of Lords. The brake question may be considered as a difference of opinion concerning the relative merits of two principles—viz., compressed air and exhaust,—the latter utilising a portion of the pressure due to the atmosphere. One ingenious and, under certain conditions, efficient system, utilises the hydraulic principle; but the fact that the conditions necessary for its proper working are not always present will prevent its general adoption in this country. Amongst the brakes described by Mr. Reynolds are the Steel McInnes and Westinghouse, both of which employ compressed air, and the Aspinall, the Eames, the Hardy, the Sanders, and the Smith, all of which utilise the atmospheric pressure, and some of which are automatic in action. Barker's hydraulic brake, as it deserves, has a chapter devoted to it, but no description of the Heberlein is given, the scope of the work covering only those brakes which are in use in the United Kingdom. In his introduction, Mr. Reynolds has some rather scathing remarks, which may go home to those who "manage" railways; for, speaking of the old-time practice, when the driver was supposed to be gifted with prevision, and was always to shut off steam in time, it was only reasonable, he says, to expect that the efficient heads of his company would likewise possess foresight, and would place all the brake-power in the hands of the individual who could, in almost all cases, see the danger in front of him, or would be first to find out that he had kept steam on too long. Even at the present day there are railway authorities who object to providing drivers with the means of quickly stopping, and when the means is provided, they object to the driver having full control over it. It is only fair, however, to say that the great majority of railway authorities have recognised the importance of placing all the available brake power within reach of the driver, and not a few have gone further and adopted arrangements which place the control of the brakes primarily in the hands of the man who is responsible for the safe piloting of the train. It will form one of the most remarkable pages in the history of railways (says Mr. Reynolds) that the whole, or nearly the whole, of the improvements which have been made are the fruit of human sacrifices, and not the result of man's long-sightedness. So far as some companies are concerned, that remark will be applicable to their present conduct when the history of the battle of the brakes comes to be written. Years ago, when the companies found that accidents continued to happen through the simple but dangerous fault of over-running stations, instead of increasing the brake power in the hands of the driver, the distant signals were put further out, so that there should be a greater distance in which to pull up the trains; but since it became evident that signals of themselves would not arrest a train the engine of which, for instance, had left the metals, the importance of brake power has been generally recognised, and since 1875 the battle of the brakes has been waged without the companies determining upon the united action which would obviously be for their benefit as much as for that of the public.

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*Continuous Railway Brakes. By MICHAEL REYNOLDS. London: Crosby Lockwood and Co.

The inventor of the first brake used upon vehicles running on rails appears to have been Le Caan, of Llanelly, who applied a heavy cast-iron block resting on nearly half the perimeter of the wheel, but it was employed only for carts. The inventor of the first steam brake was undoubtedly Robert Stephenson, for in a patent dated October 7, 1833, he describes a method of applying steam to raise a small piston, which, attached by a rod to a small walking beam, lifted a connecting-rod, which straightened a toggle-joint and pressed a couple of blocks against the tires of adjoining wheels. That brake was so far a failure that it was not adopted, and the reason, as given by Mr. Reynolds, is a very simple one; for Stephenson applied it only on one side of the engine. The little cylinder was mounted on the framing by the side of the firebox, and if Stephenson thought of connecting it to both sides of the locomotive, he doubtless found considerable difficulty in carrying out the arrangement, which was, however, abandoned for the familiar screw brake applied by hand. The coupling arrangements in those days were, as may be surmised, of the crudest; but the shaking-up of the passengers at every stop led, in 1835, to the adoption of the screw coupling, an invention of Mr. Booth's, the secretary of the Liverpool and Manchester Railway, which, with sundry modifications, is in use to the present day. Mr. Booth also patented a contrivance for checking the speed of a train by throttling the exhaust, so that a heavy back pressure was brought to bear upon the pistons. In this connection Mr. Reynolds has some remarks which are not very clear, for he says, "The steam brake should have been applied to both sides of the engine, and it should have been put in the power of the driver to have locked the wheel with it. In fact, it is a mistake to place a brake in the driver's hands that can lock the wheels." Probably it is only a printer's error, the meaning being that it should have been "out of the power of the driver to have locked the wheel," but we put that forward merely as a suggested explanation, for we learn from a note that the text has been "revised" by Mr. D. K. Clark. In his chapter on the "conditions of a perfect brake," Mr. Reynolds enforces, by recounting several accidents, the importance of placing the brake-power within reach of the driver, and also of rendering the brakes automatic, so that in the event of the train separating, each coach contains within itself its own stopper, so to speak. A thoroughly good continuous brake will also act as its own tell-tale, for it is of as much importance to have a brake always in good order as to have a brake at all; in fact it is safer to be without one than to have a contrivance liable to get out of order, and to be useless just when it is most required. Besides that, simplicity of working, as distinguished from simplicity of construction, is an essential feature of a good brake, for a second lost when danger is discerned may make all the difference between disaster and safety. The familiar screw-brake with which the majority of locomotives are fitted was, at the time of its invention, a great improvement, but the gymnastics necessary to put it on, and even the labour that is required to take it off, are out of place in these days of mechanical invention. It seems absurd that, with the power of a thousand giants at his elbow, a stoker should have to waste precious seconds and exert his comparatively feeble strength in turning a lever handle round, in order to bring blocks against the wheels which could be applied much more quickly and more forcibly by a modification of even the simple arrangement which Robert Stephenson patented nearly half a century ago. Well may Mr. Reynolds say that the operation is barbarous and out of place in these advanced times, when an ounce of steam can do the same thing, and do it better. The cardinal error made by the early managers of railways was in dividing the responsibility for the safe conduct of the train between the driver and the guards. At one time, the head guard was perched up on the top of his brake, or carriage, immediately behind the engine, with the idea that he was to see along the road in front, and warn the driver; but the guard in that position was in worse state than the driver, even when the latter had no protecting-plate or cab, for his eyes were blinded by the sparks and fragments of coke from the engine, and in winter he was pierced through and through by the biting blasts of the icy wind. Nowadays, the guard is at least protected from the weather, and the driver has a spectacle-plate, or a sort of half-cab, which, we believe, is preferred by the men themselves to the more elaborate arrangement generally adopted in America. The divided responsibility for the brakes still, however, remains on many lines, but there are signs that at last the boards of directors are beginning to see that the position is illogical and not conducive to safety. That change in opinion has been mainly brought about by the introduction of continuous brakes; but the continuous screw brake and the chain brake are comparatively old inventions, which are now rapidly passing into the limbo of history with the advent of the new views that the driver should have full control of the braking as he has of the motive power, and that the system of brakes throughout a train should be automatic in action if any accident should happen to either the apparatus or the train. In Mr. Reynolds' book we have all the best-known brakes fully explained with the aid of numerous large plates, while smaller diagrams serve to illustrate the details; and the attentive reader who carefully follows the explanations will have little difficulty in deciding which is the better of the two principles we have mentioned above. For some reason, several of our largest railway companies have adopted systems which are radically wrong, as they work on the exhaust principle, the extreme pressure in which must of necessity be something less than 14lb. on the square inch. To obtain the requisite amount of brake-power with these systems, it is necessary to have the collapsing sacks of large surface, or, to put it another way, the portions actuating the brakes must have a large area simply because they cannot have high pressures, and the consequence is that they are slow in action, and waste a great deal of steam. The weak points of the vacuum-brakes have, however, been so ably pointed out in our columns by Mr. Stretton, that we need do no more here than say that Mr. Reynolds, who speaks from practical experience on the foot-plate, condemns them, and ventures to say he is convinced that if the Midland abolished the use of the steam-brake on the engine, they would have a "serious accident in less than a week." As appendices to the work, we have Mr. Harrison's famous report, Captain Galton's experiments, and a description of the Westinghouse speed indicator. The celebrated Newark trials are embodied in the text, so that the reader will find in this book a clear exposition of the brake question as it relates to the rival systems; if, after reading it, he can understand the action of certain railway companies, he will comprehend why the best appliances are not always adopted, and will also speak tenderly of the want of foresight exhibited by the managers of railways in the early stages of their existence.

THE ACHROMATIC OBJECT-GLASS.—VI.

By W. BRADBURY.

(*Continued from page* 419.)

WE have previously seen that the uncorrected equation for spherical error in a double object-glass is $A = a\,\delta\,.\,\eta$. But as F, one of the values from which δ is found, is in this case double its former amount, instead of δ we shall have 2δ: and introducing the correcting factor as before, $A = a\,.\,2\,\delta\,.\,\eta^2\sqrt{\eta}$.

By this equation, we can make the aberration of each convex equal to that of the concave lens. In a triplet, it is more convenient to assume the curves of the flint lens; and, for the sake of simplicity, we will take it as an equi-concave.

In the previous example, the correcting factor was ·578; in this case, it will be double the amount, or 1·156. Also, focus of the convex was 8·64: therefore, each convex will now be 17·28. Focus flint, as before, is 12·13. Computing the curves by the formula before given, we find each is 13·91. The value of q is 1, which, being introduced in the equation, gives 5-3 as the value of a. Multiplying this by 1·156, we get 1·927 as the value of A. The root of the equation which satisfies this value is 1·34; so that $R : r :: 1·34 : 1$ in each convex lens.

$$R = 17·28 \times ·528 \times 2·34 = 21·34. \quad r = 21·34 \div 1·34 = 15·93.$$

Here we have:—

First lens ..	21·34	Second lens	13·91
Bi-convex..	15·93	Equi-concave..	13·91
Third lens	15·93		
Bi-convex	21·34		
Compound focus	30.		

The first and third lenses are thus arranged in opposing positions, and to some extent correct each other.*

I have not met with an account of the curves used in any triplet of Tulley's make. If they were based on the foregoing process of selection, their arrangement was very different from that of Dollond. Instead of making the two convexes of equal foci and similar in form, Dollond appears to have preferred the second convex of shorter focus than the first, and generally equi-convex. The proportionate curvature of the first and second lenses seems to be not far from equal, varying from about 4 : 5 to 7 : 10. If the correction could be satisfactorily carried out in the manner indicated by Tulley, a great practical point in favour of his system is the small number of tools required; for, as there are only three different radii in the triplet, three pairs of tools would be sufficient.

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* Boscovitch's formula appears also to be adapted for triplet computations. An example by Robison is quoted by Rees from Brewster's Table V., Appendix to Ferguson's Lectures, Vol. II., page 418.

The firm established by Tulley, unlike that of Dollond, does not appear to have had a very lengthened existence. A member of the family seems to have entered the service of another London optician. Of him and his practice with triplet combinations, "Prismatique" says:—"Although Ross, Dallmeyer, and Browning still make small object-glasses triple, the double form is in general use for large work. Originally, the nearest approach to achromatism was supposed to be gained by the triple form. Tulley made triple object-glasses with two shades of inherent colour—viz., Dutch plate, of a perfect pink, and green English crown. He made use of these inherent colours, really, to correct the secondary spectrum."

Dollond and Tulley are justly looked upon as the fathers of English optical art. Genuine instruments of their make, like paintings by the old masters, still retain their values. When we remember the improvements that have since been made in the qualities of optical glass, and in the methods of working and polishing it, the fact that their telescopes still hold a place amongst the best work of the present day is no slight monument to their skill, industry, and perseverance. When the character of the glass was so uncertain, and good discs very difficult to meet with, the production of a fine object-glass must have been a task of immense labour. No one but an artist, having a higher object than that of mere gain, would have been content to expend the amount of time and patience such a production would necessitate. That Dollond and Tulley worked upon a correct model is evident from the fact that the general features of their construction are still retained in the best English work. The changes in curvature are chiefly matters of detail, due to the difference in the character of the glass, rather than to any rearrangement of the proportionate curvature of the lenses.

Sir John Herschel appears to have made a complete systematic analysis of the theory of the object-glass. His essay is probably the first correct and convenient account that was ever published in the English language. Possessed of high mathematical abilities, and an intimate knowledge of the laws of optics, his researches extended over the methods of most of the celebrated European geometers; and the results of these investigations were embodied in an elaborate paper, printed in the "Philosophical Transactions" for 1821. It is to be regretted that this account, from the pen of the highest authority on the subject that ever lived, is not procurable in a more accessible form.

Herschel advocated a different arrangement of curvatures. Whether he was the first to do so I cannot say; but it is an essential departure from the orthodox practice of the representative English opticians. Instead of using two positive and two negative curves, he made the outer surface of the flint also positive, thus having three convex surfaces opposed by one concave inner surface. I do not think this form has been largely used in English work, but French opticians have extensively adopted it. Dr. Kitchiner, I believe, states that Tulley made a fine objective on this principle, expressly in accordance with Herschel's formula. When lenses are combined in this manner; the longer convex radius is placed outwards, thus increasing the spherical error; but as there is only one negative surface, slight alterations of it must have a powerful effect on the balance of aberrations.

Herschel has drawn up a numerical table, for computing the radii required by different refractive and dispersive powers. It is simple and concise, and needs the rule of simple proportion only to find any desired results; but it is always advisable, as a check upon the numbers, to try whether they satisfy the foci which the dispersive ratio requires. Most likely some slight alterations will be found necessary. Herschel proceeds on the plan of making the inner curves constant for the same dispersive value, while the outer ones vary jointly with the refractive indices. In using this table, if the given dispersive ratio lies between any of the tabular numbers, it is necessary, first, to find the whole horizontal line of numbers due to it, by taking the proportional difference from the numbers immediately above and below the given value. Then the radii may be rectified separately for the refractive indices by taking the proportional difference, due to the difference in refraction.

Herschel's Radii for an Aplanatic Object-Glass.

Crown refractive index, 1·524: Flint index, 1·585. Compound focus, 1,000.

	First Surface—Convex.			Second Surface. Convex.	Third Surface. Concave	Fourth Surface—Convex.				
Dispersive ratio or value of δ.	Radius R, for above refraction.	Variation in R, for a change of + 0·01 in crown index.	Variation in R, for a change of + 0·01 in flint index.	Radius *r*, for above refraction.	Radius R^1, for above refraction.	Radius r^1, for above refraction.	Variation in r^1 for a change of + 0·01 in crown index.	Variation in r^1 for a change of + 0·01 in flint index.	Focus of Crown-Positive.	Focus of Flint, Negative.
0·50	674·85	+ 5·00	− 0·36	428·27	415·75	1436·97	+ 99·21	− 39·62	500	1000·00
0·55	671·84	+ 7·40	− 0·11	363·32	360·06	1453·53	+ 100·80	− 50·33	450	818·18
0·60	670·69	+ 6·76	+ 0·37	304·88	306·40	1429·37	+ 100·49	− 56·59	400	666·67
0·65	673·16	+ 5·63	+ 1·25	252·08	255·66	1357·09	+ 116·14	− 63·23	350	538·46
0·70	682·79	+ 3·35	+ 3·12	204·22	208·31	1231·54	+ 116·13	− 75·70	300	428·58
0·75	708·16	− 1·74	+ 5·68	160·73	164·50	1051·86	+ 108·47	− 72·07	250	333·33

Herschel's standard refractive indices are not likely to occur very often in modern combinations. As a rule, the crown index will be lower, and the flint higher than those he uses, unless Chance's light flint be used, which has a refraction slightly lower. An approximate rule for finding a tolerably correct proportion of curves for ordinary indices may be formed in the following way:—Taking the compound focus as 1000, assume the outside crown radius as 672, the outside flint radius as 1420; then, from these conditions and the refractive and dispersive powers, the inner radii may be found*.

It may not be inappropriate to illustrate the use of the foregoing table by means of an example. Suppose we take Chance's hard-crown, refractive index 1·51, and Chance's dense-flint, refractive index 1·62, to find the curvatures from the table.

The most difficult matter is to get the accurate value of the dispersive ratio; I believe it will be found equal to 0·6 as near as possible. As this agrees with one of the tabulated values, no alterations are needed for dispersion; the horizontal line of numbers is:—

Radius of first surface = 670·69
Variations for 0·01 in crown, 6·76; in flint 0·37
Radius of second surface = 304·88
Radius of third surface = 306·40
Radius of fourth surface = 1429·37
Variations for 0·01 in crown, 100·49: in flint − 56·59

These are for indices 1·524 and 1·585. In the example they are 1·51 and 1·62; hence, the crown difference is —0·014 and the flint + 0·035. Multiplying 6·76 by — 1·4, and 0·37 by + 3·5, we have 9·46 to be subtracted, and 1·29 to be added to 670·69, making it 662·52. This is the corrected crown curve. Next for the back flint curve; multiplying 100·49 by — 1·4 and — 56·59 by + 3·5, we get 140·68 and 198·06, both to be subtracted from 1429·37, making it 1231·31. Hence the corrected radii are:—

$$\text{Crown lens}\ \left.\begin{matrix}662{\cdot}52\\304{\cdot}88\end{matrix}\right\}\ \text{both convex.}$$

$$\text{Flint lens}\ \begin{matrix}306{\cdot}40\\1231{\cdot}31\end{matrix}\ \begin{matrix}\}\ \text{concave.}\\\}\ \text{convex.}\end{matrix}$$

These radii are for a compound focus of 1,000 inches. If the objective in the example be desired to have, say, 50in. focus, we must divide each of the numbers by 20; thus obtaining:—

$$\text{Crown lens}\ \left.\begin{matrix}33{\cdot}13\\15{\cdot}24\end{matrix}\right\}\ \text{Flint lens}\ \left\{\begin{matrix}15{\cdot}32\\61{\cdot}57\end{matrix}\right.$$

I do not think that this form is one which would be liked by practical men, as it is of the "rider" pattern. It will be noticed that the inner convex radius is deeper than the adjacent concave, so that the lenses would "ride" or touch in the middle, unless prevented by a brass ring used in centring. An examination of Herschel's table will reveal the fact that between the dispersive values 0·55 and 0·60, a gradual change in the inner conditions occurs. For the former and all preceding values, the concave curve is the deeper; but a gradual tendency to approach to equality exists, and for some intermediate number the two will be in contact; after which, for 0·6 and all succeeding values, the convex is the shorter radius.

An explanation of this matter may readily be found. When the value of δ is low, the difference in dispersive power is great; consequently, a short focus convex is combined with a long focus concave. Sufficient aberration in the former can then be obtained, without an abnormally deep posterior curve. But with an increase in the value of δ comes a decrease in both crown and flint foci, more so with the second than with the first lens. Hence, shorter curves are needed in each case, but especially so with the flint lens. This reduces the concave surface so much, that sufficient positive aberration cannot be got without throwing more convexity into the adjacent surface—thus reversing the condition of the inner radii, and making the glasses to touch in the centre, instead of round the margin.

Therefore, it may be taken as a general rule, that:—

For all values of the dispersive ratio, greater than 0·575, Herschel's form of object-glass has the convex inner radius shorter than the adjacent concave flint radius.

I am far from thinking that such an arrangement of lenses is in any respect inferior to the more common forms. With regard to spherical and chromatic correction, theory would seem to indicate that where a large amount of influence is exercised by the inner radii, the convex should be the deeper. For as the action of flint-glass is much stronger than that of crown, to produce an equal effect it will need only a much less angle of incidence, or, which is the same thing, the ray should fall on a flatter surface of flint than the crown from which it emerges. Practical men, however, have an objection to the "rider" form of object-glass; though, I believe, it is occasionally adopted in the best class of work; but if substantially equal results can be obtained from a more convenient practical arrangement, it is natural that they should prefer the form, which occasions least trouble in finishing.

If, then, we are determined to make the lenses conform to the common condition of marginal contact, though this condition is by no means essential, we must put a limit on the applicability of Herschel's formula, and say that these rules are only suitable for glasses having a very great difference in their dispersive powers.

(*To be continued.*)

A TORPEDO DETECTOR AND A SCIENTIFIC DIVINING ROD.

TWO inventions which are based on the principle discovered by Prof. Hughes and illustrated in his induction balance, claim some little attention, as being probably very useful appliances. These are Capt. M'Evoy's torpedo detector and Mr. C. F. Varley's "divining rod," a simple arrangement, by means of which it is believed that it will be possible to discover the existence and position of metallic lodes without the practical test of sinking costly shafts. M'Evoy's apparatus will probably be found of use as an indicator of the position of lost anchors, cables, &c., as well as of torpedoes, and the following will give an idea of its construction. It consists of a small mahogany box, containing a pair of coils or bobbins, a vibrator similar to that employed in electric bells for making and breaking contact, and a telephone. To this box is attached a given length of flexible cable, with four conducting wires in it. To the other end of this cable is attached a flat wooden case, in which there are two coils. This case is weighted so that it will readily sink when placed in the water. There are also terminals on the box for attaching battery wires, and an arrangement for putting on and cutting off the current is provided. There are two complete circuits through the box, cable, and wooden case, the one primary and the other secondary. The battery, the vibrator, one coil in the box and one coil in the wooden case are in the primary circuit, while the telephone, one coil in the box, and one coil in the wooden case are in the secondary circuit. When the battery is on, the coils in the box are adjusted so that little or no noise from the make-and-break action of the vibrator is heard in the telephone. When thus adjusted the instrument is ready for work, and if the wooden case is then brought near a metallic body a loud noise is heard in the telephone, thus indicating the proximity and locality of such a body.

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* Herschel gives references to several foreign works treating on the destruction of spherical aberration. Perhaps those who can obtain access to them may be able to extract useful theoretical or practical details, and will send them to these pages. Such researches are valuable, especially if the subject embraces correction by means of other curves than spherical, and touches upon chromatic correction also. Mention is made of Euler, *Dioptrica*, Petersburg, 1769; Clairaut, *Mem. del. Acad. Sci*, 1757; D'Alembert, *Opusc.*, Vol. III.; Lagrange, *Miscell.*, III., II., I., 152; *Mem. Acad.*, *Berlin*, 1778; Schmidt, *Lehrbuch der Analyhschen Optik*; Santini, *Teorica. degli. Stromenti Ottici*. Also *Phil. Trans. R.S.*, 1821 and 1827; Littrow's Memoir, Vol. III., *Mem. R.A.S.*, *Lond.*, Sir J. Lubbock, *Lond. and Edin. Phil. Magz.*, 3rd series, Vol. VII., Sept., 1833.

Mr. Varley's instrument, which has been patented (No. 5353, 1881), consists of a rod of one metre to two or three in length, pivoted in a frame. At each end it carries two helices of 20 to 30 centimetres in diameter, the planes of the rings being parallel with the axis, and the centres of the two helices placed about one metre apart, more or less. These helices are connected together by two wires passing along the rod so as to form one circuit, but broken at a convenient part of the axis and attached to two insulated semi-cylindrical pieces of metal mounted upon the axis and against which two springs press. This arrangement forms a commutator, and the contacts change during the rotation as the planes of the rings or helices become vertical. The axis is connected by means of a pulley and cord with a large wheel carried on the frame, which supports the pivots, or is otherwise geared so as to permit of its being rapidly rotated. The two springs of the commutator are connected to a delicate astatic galvanometer at a convenient distance, or to a movable coil placed in a magnetic field. At right angles to the plane of the rod projects a pointer. This pointer is attached to the frame carrying the rod. The frame is mounted on pivots so as to turn in any direction; the stand carrying the frame having two axes, one horizontal, the other vertical as in the altazimuth mounting of a telescope. If there be an electric current passing in a straight line of indefinite length underneath the axle it will produce a magnetic field diminishing in power as the distance from it increases. This magnetic field, when cut by the helices, tends to generate currents in them. The commutator causes all the currents to flow through the galvanometer in one direction if the pointer is placed in a line perpendicular to the lode, but when the rod is suitably placed and the pointer is in the direction of the lode, the currents are directed half in one direction and half in the other through the galvanometer, which returns to zero. Thus if the galvanometer is deflected with the rod in any position, it shows the presence of a lode. By inclining the rod until no current is produced, the pointer is brought to a position in which it indicates the direction of the lode, and by taking two observations, one on each side of the lode, at which the pointer shows an angle of 45 degrees, half the horizontal distance between these two stations is the distance of the lode beneath the surface of the earth supposing the surface to be level or uniform. As cases may arise where it is not possible to place the apparatus on each side of the lode, for example, suppose the lode to be near the side of a sloping mountain, the apparatus may be provided with means of shunting the lower coil until the currents generated in the two coils are equalised, then by a little calculation based upon the known laws of electricity the distance of the lode from the surface is indicated.

Lastly, if desired, by making the resistance coils of the shunt suitable functions of the resistance of the coils, and making them into the form of a slide resistance box and numbering them, the position of the shunts at which neutrality is obtained may be arranged to indicate without calculation the number of metres that the lode is below the surface. The hollow helices at each end of the rotating bar may be varied in form and may be replaced by two bar electro-magnets.

THEILER'S TELEPHONE RECEIVER.

THE telephone receiver recently patented by Messrs. Theiler, of Canonbury-road, N., differs from its predecessors in dispensing with an armature, the lateral vibration of the electro-magnet itself being utilised. In previous systems in which an electro-magnet is used, the sonorous vibrations are due either to the motion of an iron diaphragm or armature placed close to the poles of the electro-magnet, or to the expansion and contraction of the magnet itself. In Theiler's telephone the electro-magnet may be of the usual U shape, and may consist either of soft iron or of hardened steel permanently magnetised, wound with a suitable number of turns of insulated wire. This electro-magnet is fixed in such a manner that the vibration of either one or of both its limbs is communicated to a diaphragm or diaphragms. The patentees also employ two or more electro-magnets in the same circuit, and utilise the vibration of both magnets in the manner described. By attaching a light disc or discs to the vibrating limbs the diaphragm may be dispensed with. Fig. 1 represents one of the telephone receivers provided with two diaphragms or sounding boards, connected to the two limbs or cores of the U shaped electro-magnet by short tongues. These tongues are firmly inserted in the diaphragms and fixed to the magnet, as shown. The poles of the electro-magnet are brought very close together by being shaped as shown, and the middle part of the magnet is firmly screwed to the case of the instrument. The ends of the helix surrounding the magnet-cores may be attached as usual to two terminals, or soldered to a flexible conductor communicating with the other parts of the telephone apparatus. When a vibratory current is sent through the helix of the electro-magnet, the extremities are rapidly attracted and repelled, and this vibratory motion of the magnet cores being communicated to the diaphragms or sounding boards, the latter are set in vibration of varying amplitude produced by a current of varying strength, as in all other telephones. Instead of making the electro-magnet of one continuous piece of iron, as represented in Fig. 1, the patentees find it more practicable to make it of the form shown in Fig. 2, where the electro-magnet represented consists of two limbs or cores, a sole piece, and pole extensions, the whole being screwed together and practically constituting one continuous piece of iron carrying the two coils. In Fig. 2 only one of the limbs or cores of the electro-magnet is attached to the diaphragm, the other limb being held fixed by a screw. Sometimes the patentees hinge one of the magnet cores, or both, in the sole-piece, in which case the diaphragms or sounding boards can be made much thicker than when the cores are rigidly fixed to the sole-piece, because the magnetic attraction of the poles has then only to overcome the resistance of the diaphragm. Instead of using a diaphragm, they sometimes fix a stem to one of the cores of the electro-magnet, and mount thereon a light disc of vulcanite, wood, ivory, guttapercha, or any other substance which is capable of vibrating. When using this telephone receiver, the disc is pressed to the ear in such a manner that its surface covers the aperture of the ear. When these telephone receivers are used on a line of some considerable length, the patentees prefer to magnetise the electro-magnet by a constant current from a local battery, and to effect the variation of this constant magnetisation inductively, and not directly. The electro-magnet is, then, not inserted in the line at all, but in the primary circuit of an induction coil, and connected with a local battery. The line is connected to the secondary circuit of the induction coil. This device possesses the advantage that the electro-magnet can be powerfully magnetised with very little battery power, no matter how long the line may be, and that steel magnets are entirely dispensed with. It is not necessary to have a separate battery for this purpose, as the microphone battery may also be used for the telephone receiver. The shape of the vibrating electro-magnets is immaterial, as they may be made of a variety of forms.

FIG. 1.

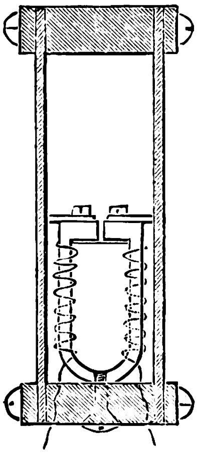
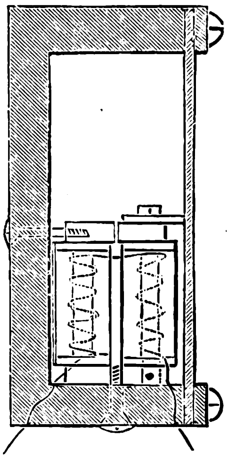


FIG. 2.



MERCURIAL AIR-PUMPS.

VARIOUS modifications of the so-called Sprengel or mercurial air-pump have been made from time to time; but since the introduction of the incandescent electric lamps, great improvements have been made, not so much, perhaps, in connection with the extreme rarity of the vacua produced, as in the speed of working, which is a consideration if the lamp is ever to be sold for the promised shilling. We have, in recent volumes, illustrated several mercurial air-pumps, which are highly useful appliances in many branches of science and some of the arts; but on p. 34 ante will be found one of the simplest and best, not only for the purposes of the electrical lamp-maker, but also for all purposes where a high degree of vacuum is required to be quickly produced. In the simplest form all that is required in a mercurial air-pump is an arrangement of glass tubes, with one tolerably large globe or oval vessel, which can be rapidly filled and emptied. This globe, at its upper side, is connected with an air-outlet tube, and at the lower side with the tube by which the mercury enters. Somewhere near the junction of the latter, the tube leading to the vessels that are to be exhausted is connected, and those three parts being clearly grasped the action is easily understood. The parts being adjusted, and all joints made air-tight, mercury is forced into the globe until it fills it, thus driving out the air, which, passing a bend in the exit pipe, finally escapes into the outer air from a tube dipping beneath the surface of mercury. It will be understood that no air can return. The mercury in the globe is now withdrawn, and it is obvious that it leaves a partial vacuum in the globe into which the air in the tubes and in the vessels to be exhausted expands. The mercury is again forced into the globe, driving out the air therein, and the process is repeated until the desired vacuum is obtained. In reality, the apparatus is rather more complicated than this, for it is necessary to absorb moisture, and that is accomplished, perhaps, in the simplest way, by compelling the air to pass through a vessel containing sulphuric acid, so placed that the acid can be easily renewed. A reference to p. 34, No. 886, will give the reader a good idea of the principle of all mercurial air-pumps, and will introduce him to one of the simplest, and, we believe, most efficient. In Sutton's air-pump, which is there illustrated, the mercury is caused to rise into the globe by the action of a force-pump, and it is obvious that the operations can be performed very rapidly; but the chief merit of the device is that the mercury is used in the form of solid columns, not drops. At the recent Crystal Palace Exhibition, Mr. Müller had a mercurial pump which also employed mercury in the solid column form, and, apart from some minor differences in the arrangements of the tubes, it was almost identical with Mr. Sutton's, save that, instead of employing a pump, Mr. Müller puts his mercury into a reservoir connected by a flexible tube and utilises gravity as the force. Thus his mercury reservoir, holding perhaps half a gallon, is attached to a cord working over a pulley in such a manner that the reservoir can be raised above the level of the globe in the pump. The mercury thus flows by gravity into the pumping-chamber, as we may call it, and the operations can be repeated with great rapidity. Both devices are notable for their simplicity and effectiveness, and are preferable to the elaborate arrangements adopted by rival inventors. We believe they are not patented. A more elaborate device, which has the not altogether established advantage of an automatic change of feed, has been recently patented by Mr. Stearn, of Osborn-road, in the city of Newcastle (No. 5,000, 1881), and is thus described:—The main feature of the invention is an automatic feed, by which the mercury is frequently returned from a lower to a higher level, whereby a large reservoir is dispensed with, and the quantity of mercury necessary to keep the pump in continuous action is greatly reduced. The fall tubes of the pump are inclosed in or connected at their lower ends with a partially exhausted vessel, and are made of less length than the barometric column, the vessel in which they are inclosed being exhausted by a mechanical air-pump or other exhausting mechanism. The atmospheric pressure is used to effect the raising of the mercury by allowing it to act intermittently, either directly on the surface of the mercury, or on a flexible diaphragm or indiarubber vessel containing the mercury. In mercurial pumps constructed according to this invention great uniformity and celerity of action are obtained by reason of the reduction in the length of the exhausting portion of the pump, and by keeping the mercury in closed and exhausted vessels during the period of its circulation. An immunity from danger to the operators from mercurial vapours is also insured by completely secluding the mercury from contact with the external atmosphere, and when a number of the pumps are combined together in a general system the mercurial portion of each pump is rendered completely independent of that of the others. The compound fall tube passes through a closely-fitting indiarubber or other air-tight stopper, which fits into the outer or inclosing vessel. This tube communicates by another tube with an upper mercurial receiver, and also is capable of being placed by means of a flexible tube and stopcock in communication with a mechanical air-pump or aspirator, or exhausted chamber, so that the vessel before referred to may be exhausted, after which the stopcock is closed. The lower mercurial receiver (which is constructed of iron or other material not acted on by mercury) consists of two hemispheres separated by a flexible diaphragm, by preference of indiarubber. This receiver is mounted so as to be capable of turning upon a centre, and is supported by a spring, the tension of which is adjusted so as exactly to counterbalance the weight of the receiver when empty or nearly so, and keep it in close contact with a valve or stopper, which is carried by a support and adapted to an orifice in the receiver. The receiver is provided on one side of its diaphragm with a tube in communication with another air-pump or aspirator, and on the opposite side of the diaphragm it communicates on the one hand by means of tubes and a valve with the lower end of the inclosing vessel, and on the other hand through the intervention of a narrow tube and a valve with the upper mercurial receiver. The latter receiver communicates by an outer tube surrounding the narrow tube, and by a supply pipe with the compound fall-tube, a trap being provided of ordinary construction.

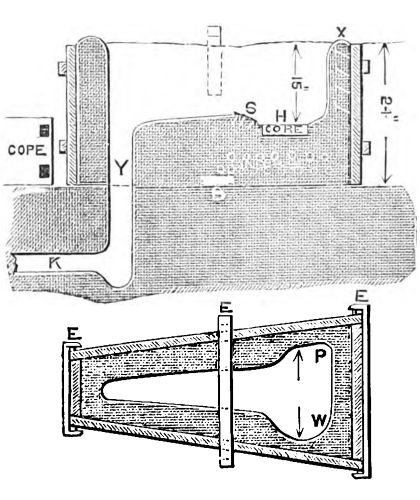
The lower receiver being full of mercury, so soon as the air-pump communicating with the inclosing vessel and the upper receiver is put in action, the air is partially exhausted from the vessel and receiver, and from a vessel attached to the inclosing vessel. On opening the stopcock (the valve or stopper of the lower receiver being also open) the atmospheric pressure on the indiarubber diaphragm forces the mercury into the upper receiver, whence it passes through the compound fall-tube of the apparatus in the usual way, the valve interposed between the lower receiver and the vessel which incloses the compound fall-tube closing and preventing the mercury from passing direct into the said vessel. So soon as the lower receiver is empty the spring draws it against the valve or stopper, and the air-pump or aspirator connected with it exhausts the air from one side of the flexible diaphragm, and the mercury passes from the vessel inclosing the compound fall-tube through the interposed valve into the lower receiver. The area of the valve or stopper of the lower receiver is such that the weight of the receiver when full of mercury is sufficient to overcome the atmospheric pressure and open the valve. By this arrangement, if connected with a constantly acting mechanical air-pump or other exhausting apparatus, the mercury is periodically returned to the upper receiver, and a very small quantity of mercury is sufficient to maintain the receiver in constant action. All contamination of the mercury and all loss by waste or danger to the operator is completely avoided, whilst at the same time the space occupied by the apparatus is extremely small, and there is little risk of breakage. The intermittent admission of the air may be effected by the use of an electro-magnet, the circuit of which is completed by the mercury on reaching a fixed point, the electro-magnet attracting a valve attached to its armature; or the closing of the valve may be effected by a counterpoise instead of a spring; or the air may be admitted by means of a stopcock, the lever of which may be turned at the right moment by any of the above-mentioned devices.

MAKING A GREEN SAND BASIN—RUNNERS AND GATES.*

In making castings, the basin, runners, and gates are often responsible for their being bad. There is nothing in the whole art of moulding that requires more care than the making of these parts of a mould. A moulder may slight the rest of his mould and have his casting come out all right, but any carelessness or ignorance in making the basins, runners, or gates, will almost always cause trouble. To get some idea of the action of liquid iron in the mould and in the basin, runners, and gates, think of a river in the spring of the year rushing into the ocean, or into a lake.

In pouring a mould, the iron first drops from the ladle into the basin; from the basin it runs with more or less of a rush into the upright runners, from the runners into the gates, and from the gates into the mould. With the exception of that portion of the mould which the iron onters or drops into, there is very little agitation of the metal as it gradually rises.

In the cut shown, H is the cavity into which the iron first drops as it is poured out of the ladle; Y is the runner through which the iron flows to the gate K, from which it runs into the mould.



For pouring five-ton ladles, the width of a basin should not be less than 18in. and the depth should be 9in. The bottom of the basin where the iron first drops should not be less than 2in. deeper than at S. From S down to the runner, Y, there should be an easy incline; the longer the basin, the more incline there should be. This assists the iron in flowing, making sure of keeping the runners full, and also prevents any iron remaining in the basin when the mould is full, except that which is in the cavity that is formed for the iron to drop from the ladle into. This cavity is provided for the purpose of preventing the cutting of the bottom of the basin, which would be the case were this part made even with the rest. This cavity, which is soon filled, allows the iron to fall into iron instead of on sand. When this cavity is filled, the iron runs easily from it to the mould, lessening the danger of cutting and allowing to be rushed in, so as to keep the runners full.

For the pouring of larger ladles than five tons, the width of basins should be from 18in. up to 30in., and the depth from 9in. to 15in.

When making green sand basins, the sand should be well mixed and riddled before it is shovelled into the basin box. The careless use of unmixed sand for making basins often causes bad castings.

There is one way of making basins that many moulders follow, but which a careful moulder will never do; that is, they will shovel in some sand, and form the shape of the basin by packing up the sides with handfuls of sand. This makes a loose basin, and that is liable to cause trouble.

To make a reliable basin, the box should first be evenly rammed full of sand, after which the shape of the basin can be dug out with a shovel or trowel, thereby giving a firm, solid basin, as far as the ramming of the sand is concerned. The trouble with basins usually commences at the bottom, and is caused by the falling iron cutting the sand and letting the iron get to the wooden bars. A good moulder will never have less than 3in. of sand between the bottom of his basin and the wooden bars.

There are two or three ways that the bottom of green sand basins may be secured so as to prevent cutting when used to pour heavy castings. The first is to stick nails all over the botton, having the heads even with the surface of the sand. The second and third ways are to set in a flat core, or two fire or common bricks to form the bottom. In either of the last ways there is very little danger of the falling iron causing any trouble.

For the pouring of heavy castings it is best when possible to build basins outside the copes instead of on the top of them, for the reason that high heads can thus be avoided, thereby not having so much strain upon the mould. The cut of basin shown is one thus made. In this basin will be noticed a coke or cinder bed placed underneath the basin, which is a very good plan for large surface basins, as it will carry off the gases and steam, and thereby prevent any boiling or scalding of the bottom of the basin. Sometimes dry sand basins are made and hoisted fron the oven carriage and placed where wanted for the pouring of very heavy castings. Some moulders prefer to use them instead of green sand basins.

Another part of a green sand basin that often gives way while the mould is being poured is the front X. Sometimes a moulder will cut out the front as if he were trying to make the end at exact right angles with the sides of the basin, as shown at P. This may do well enough for small basins, but for large ones it should never be done. The safest way is to form this end as shown at W, having the end very nearly a circle. Sometimes it is best in the instance of very large basins to have this end of the box full of nails, driven so as to stick out two or three inches to have a good hold on the sand.

How often have moulders seen castings lost by having the basin box spread open, which would have been prevented had there been some narrow strips of wood nailed accross the bottom, as shown at B; or cast or wrought iron clamps used to hold the sides together, as shown at E E E. Again, the iron will burst out from underneath the box, from the lack of weights or wedges to hold it down. There are very few moulders that can be trusted with the making of a basin to pour a large casting with. They *think* they know, and it is not until they have lost a number of castings that they are convinced of their carelessness or ignorance. They are not always convinced, but will lay the blame to the basin box, the sand, the helper, or will confidentially tell some of their friends they were made to pour the iron too hot, or too fast, and that no basin will stand such treatment.

The rammer and swab pot are very necessary tools in a foundry, but in the hands of a thoughtless or ignorant moulder they are about as dangerous as a loaded revolver in the hands of a child. There are no tools used in a foundry that are more responsible for bad casting than the rammer and swab. "Bring me that rammer," yells the moulder to his helper, and when he gets it he uses it lustily. "Bring me that swab pot." He gets it, and on goes the water, plenty of it too. What's the use of being afraid of water?

Around comes the ladle, and out of the ladle into the basin goes the iron. From the basin up to the roof it flies, the men let go the ladle and run to the corners to see if they are burned; then they will sit down and think of the moulder and his swab pot and rammer. When a good moulder, or one that thinks he is, loses a casting on account of his basin, he should never blame any one but himself; for he should know from experience what is required. A moulder can tell by the looks what sizes of runner sticks or gates he wants. If a moulder orders a runner or gate stick made without having one to get the size from, he will hardly ever be satisfied with it. In thinking of the number and size of runner or gate sticks for a mould, there are many points that should be considered. The first is the weight of the casting, and whether it should be poured fast or slow. The second, the form of it, and whether its proportions are heavy or light. The third, what temperature of metal will the mould require to be poured with; will it be run from the bottom or from the top of the mould; and also the height of the basin above the mould.

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* By Thos. D. West in *American Machinist.*

As a general thing, the faster a mould can be poured with safety to all of its parts, the better it is. It is not always the weight of a casting that decides whether the runner and gate sticks should be large or small, to pour the mould fast or slow. The common, old style grate-bars that have thin openings or cores in them, is a good example to show why some moulds require to be poured slow.

Many very good moulders have worked on this class of castings, and have been astonished at their lack of success in making good ones. A grate-bar, or any mould that has similar thin green sand cores in it, should be poured with hot iron, and slow. Pouring them slow gives the gases and steam in the sand a chance to escape through the vents, and the iron being hot will easily run level, and not pile up higher nearer to the gates than in distant portions of the mould, as dull iron will generally do, thereby causing thin bodies of sand to be displaced. Hot iron will also admit of the pouring of such moulds slow without danger of the castings being cold shut.

Moulds having thin, dry sand cores in them, should often be poured hot and slow for the reasons above stated. Very heavy castings that have no dangerous dry or green cores in them, should have large runners and gates so as to admit of the iron being poured dull and fast, and the same with any moulds that the copes would easily draw down.

There are also large and small moulds that require hot iron poured in them fast, in order to have all the parts run and not be cold shut.

Again, there are some moulds that require the liquid iron to be forced into them as fast as possible, for which high heads or basins should be made. Castings, such as cylinder or pipe-shaped moulds, that are cast vertically, should have larger runners and gates where they are poured altogether from the bottom than where they are poured from the top, by dropping the metal down, as when the iron is all poured from the bottom it gets duller as it rises up in the mould. Many times such moulds poured from the bottom and top also, so as to avoid having any trouble from dull and dirty iron in the upper portions of the casting. As regards the making of different forms of gates, runners, and basins, the interested readers will perhaps remember some that have been published, while others that are to follow will illustrate some of the different ways of pouring castings.

ELECTRICAL ACCUMULATORS, OR SECONDARY BATTERIES.*

By Prof. Oliver J. Lodge, D.Sc.

(Continued from page 421.)

So far we have only considered in the roughest and broadest manner the chemical action going on in a Planté or Faure cell; but to understand all the details of their behaviour it is necessary to investigate these actions very closely. In this study we shall be greatly assisted by an excellent memoir of Messrs. Gladstone and Tribe, which is to be found in *Nature*, January 5th and March 16th, in the *Electrician*, March 25th, and doubtless also in other places. A letter of Professor A. S. Herschel, in *Nature*, February 16th, is also of great interest.

As a preliminary, the reader is recommended to try a few experiments with two simple lead plates, say about the size of a finger. Scrape them both bright, and immerse them in ordinary dilute sulphuric acid as mixed for charging batteries, supporting them by some convenient arrangement which will hold them steady and vertical, and permit either of them to be withdrawn and reinserted easily without disarranging the wires.

First connect them with a single Grove cell, and you will see a few minute bubbles of hydrogen rise from the plate connected with the zinc, while that connected with the platinum is slowly coated with a white crust of $PbSO_4$. In about a minute the current will be very much weaker, and no bubbles will be noticed, and presently all action nearly ceases. The discharge current which can be obtained is exceedingly weak and practically *nil*. No peroxide is formed with the EMF of one Grove, which, as is well known, is unable to decompose water.

Now put on two Grove cells instead of one. Immediately bubbles of gas rise from both plates. The darkening of the + plate shows that some peroxide is being formed, and in a few seconds a discharge current can be obtained from the two little plates sufficient to ring a bell. It dies away very rapidly, however, and requires a fresh application of the current to resuscitate it.

One may note in passing that it was by no means essential, or even helpful, to the success of this second experiment that the first should have preceded it. If two cells are joined up at once to the clean plates, without first clogging one of them up with $PbSO_4$, the same things go on and perhaps rather more easily. If a preliminary coat of sulphate has been allowed to form for a long time it exerts quite a serious clogging action, by reason of its want of conducting power.

Another experiment of Gladstone and Tribe's is this: Immerse the plates in plain water—or salt and water—and act upon them with twenty Groves if you like; no peroxide will be formed, but only hydrated protoxide, which refuses to give an appreciable counter-current.

One more experiment—this time Professor Herschel's. Having charged the two lead plates with a couple of Groves properly, remove the hydrogenised plate, insert in its place a bit of clean lead, and try for the discharge current. It is very weak and can scarcely ring a bell. Remove the clean and replace the hydrogenised lead, and a strong bell-ringing current is obtained for a few seconds; but it stops suddenly. Why does it stop suddenly? Modify the experiment by immersing only half the charged surface of the plates when you are going to discharge, and as soon as the bell stops depress one of the plates more so as to bring a fresh surface into action. It will be found on depressing the + plate that a fresh surface of peroxide does no good, showing that that is not what is exhausted; but a fresh surface of hydrogenised lead (i.e., depressing the — plate) rings the bell again instantly. The current stops, therefore, as soon as the hydrogen is exhausted. It is not correct to say the current stops though, but it is suddenly and seriously weakened: clean lead and peroxide do not give a powerful EMF; the current from clean lead and hydrogenised lead is nearly as strong in the opposite direction.

A further experiment is instructive. Having peroxidised a lead plate, insert it in a beaker of acid in opposition to a plate of platinum, and connect them both with a galvanometer. It will be found that the current sets out from the lead, showing that even platinum is electro-positive to peroxide of lead. If the platinum has been alloyed with hydrogen the current is strong, but if it is clean the current is still perceptible without a very delicate galvanometer.

If instead of hydrogenised lead we try zinc, we shall find a strong current; and it appears that hydrogenised lead and zinc are almost equal to one another at first, though the hydrogen gets exhausted, while the zinc does not. Doubtless amalgamated zinc keeps itself permanently coated with a layer of hydrogen. Amalgamating metals seems to make the layer of hydrogen adhere better, and even amalgamated copper acts extremely well if it has been charged with hydrogen. Indeed, as long as the hydrygen lasts, it is scarcely inferior to zinc or hydrogenised lead. A curious thing, however, is that clean copper opposed to peroxide of lead gives a bell-ringing current much stronger than clean lead, and nearly as strong as hydrogenised lead does. This, of course, is the foundation of Sutton's cell.

All these experiments show the high value of peroxide of lead as the electro-negative element of a cell. Peroxide of manganese is very good, but peroxide of lead beats everything with which I am acquainted. In order that any of these oxides may act in this way, it is of course necessary for them to be in good metallic contact with the electrode, so as to form its real surface.

We can further learn from the first three experiments that peroxide is not formed on the + plate until there is a visible evolution of oxygen gas; and one becomes convinced that its formation is due to some secondary action.

The action is probably this: Of the SO_4 liberated against the + plate, some combines with it, forming $PbSO_4$; but the whole is not thus consumed, if it is liberated sufficiently fast, and the rest decomposes the water, liberating oxygen, and forming free sulphuric acid. Of the oxygen atoms so liberated, some unite into molecules of oxygen, others into molecules of ozone; and perhaps all this escapes as gas. But another portion liberated in contact with $PbSO_4$, acts upon it thus: $O + PbSO_4 + H_2O = PbO_2 + H_2SO_4$, making some more sulphuric acid and also peroxide of lead. Another portion of oxygen may very likely attack the lead itself in its nascent state, peroxidising it directly; and perhaps it is the ozone which is active in this manner.

It is therefore not easy to say exactly what goes on at the + plate, though the broad facts are these—that some sulphate of lead is certainly formed, being visibly white; that as soon as oxygen gas is liberated some peroxide is formed; that some of this peroxide is in such close conducting contact with the lead plate—see above—as to justify the belief that it is formed by direct oxidation; that the sulphate of lead itself gets ultimately, though slowly, peroxidised; and as sulphate of lead is a non-conductor it can only be acted on by secondary action, as explained.

At the — plate nothing particular goes on. Hydrogen is liberated against it, and partly clings to it, but mostly escapes as gas. If the clean lead surface has stood in the acid a short time before charging, it will load itself very slightly with $PbSO_4$; but this substance dees not appear to be easily reduced by the hydrogen, and it is seen to fall off as a faint white filmy descending current.

BRENNAN'S TORPEDO.

This torpedo has been in process of manufacture and improvement for some considerable time at Melbourne, partly under the auspices and with the assistance of the Victorian Government. The invention has been patented in England and the Colonies, but it was not considered politic to exhibit it at the late Melbourne Exhibition, pending the negotiations with the British Government. It is difficult to convey a clear idea of such a machine as a locomotive torpedo to the general render without the aid of sketches; but compared with the Whitehead, Fiume, or the Woolwich Royal Laboratory patterns, the Brennan is simplicity itself. Its motive power is not compressed air, neither is it contained in the body of the torpedo. To propel the weapon through the water at a speed of from 15 knots to 20 knots an hour for 1,000 yards, a separate engine, or at least a special connection with an existing one, is necessary. This engine drives two drums, about 3ft. in diameter, with a velocity at their peripheries of 100ft. per second. Their duty is to wind in two fine steel wires No. 18 gauge, the same as used in the deep-sea sounding apparatus of Sir William Thomson. The rapid uncoiling of these wires from two small corresponding reels in the belly of the fish imparts to them, as may readily be conceived, an extremely high velocity. The reels are connected with the shafts of the two propellers which drive the torpedo through the water. The propellers work, as has long been known to be necessary to insure straight running, in opposite directions and both in one line, the shaft of one being hollow and containing the shaft of the other. At first sight it would seem as if hauling a torpedo backward by two wires was a sufficiently curious way of speeding it "full speed a-head," but it is found in practice that the amount of "drag" is so small, as compared with the power utilised in spinning the reels that give motion to the propellers, that it may be left out of calculation altogether. The steering-gear of the Brennan is a most ingenious contrivance, whereby the relative velocities of the two driving drums, and consequently of the two propellers, can be varied at any moment. The perpendicular rudder, which is marvellously sensitive, is reacted on by the screws, and in this way the torpedo may be made to follow as tortuous a path as a figure-skater. The course the torpedo is taking is indicated to the operator by a slight steel telescopic mast carrying a pennon, which, when not in use, is folded along the back of the torpedo.

FLAMELESS COMBUSTION.

At the soirée of the Society of Chemical Industry at Owens College, on Thursday, a new theory of combustion was practically illustrated by Mr. Thomas Fletcher, of Warrington. Mr. Jacob Reese, the inventor of the Reese fusing diic, has stated his belief that if it were possible to produce combustion without flame, the temperature and duty obtained from any fuel would be enormously increased. It has remained for Mr. Fletcher to not only prove the possibility of flameless combustion in more than one form, but also to demonstrate practically the enormously high temperatures which can be obtained by this means. Taking a ball of iron wire about three pounds in weight, Mr. Fletcher placed it on a slab of fire-clay, and directing a blowpipe flame on it for a few seconds he suddenly blew the flame out. The temperature increased so rapidly that in a few seconds the wrought iron fused and ran into drops, and this temperature was steadily maintained. The room was darkened, but the closest examination did not show a trace of flame, although the fact that the gas was burning was proved by repeatedly relighting and extinguishing it. The same experiment was repeated in another form by directing the flameless heat into a small fire-clay chamber, in which a refractory clay crucible, made specially for nickel melting, was partially fused and worked into a ball like soft putty, the sides of the fire-clay chamber being at the same time fused. The heat was so tremendous that the blowpipe laboratory, which was given up to Mr. Fletcher for the evening, was much too hot to be agreeable, in spite of open windows and ventilators. How far this discovery can be utilised remains to be seen; but it would appear that the presence of flame, usually considered to be a sign of combustion, is really an indication of imperfect results, and the best duty is to be obtained only when flame is totally absent. It is certain that such temperatures as obtained by Mr. Fletcher without flame have never previously been obtained with the fuel used, which was nothing more than a small gas supply for a ¼in. pipe, assisted by an air-blast.

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* From the *Engineer*.

SOME POSSIBLE SOURCES OF ERROR IN COMPUTING THE AGE OF FOSSILS.

IN a paper on the "Limit of the Innuit Tribes on the Alaska Coast," contributed to the *American Naturalist* by Ivan Petroff, the writer gives some evidence that errors in computing geological time, and in reckoning the age of fossils, may be easily made through an imperfect acquaintance with the capabilities of natural forces. Mr. Petroff was compelled to reside for some months in Alaska, in that section where the Innuit and Thlinket tribes meet, and he formed a theory that the Innuits are comparatively recent immigrants. An argument in favour of the view that the Innuits spread over the Alaska coast may perhaps be found in the existence of a branch of this tribe on the Aleutian islands. I fully agree, says Mr. Petroff, with Mr. Dall, that the theory of an Asiatic influx of population over the Aleutian chain of islands is entirely untenable, and that they were peopled from the east, but I do not think that this migration took place before the invention of the kaiak. Timber evidently never existed on these islands; the only equivalent being the drift wood collected along the beaches and promontories; but this kind of material, waterlogged and sodden, was entirely unfit for the manufacture of wooden canoes, or even for the construction of rafts, by which means Mr. Dall supposes the early Aleuts advanced from island to island. The frequency of gales, the violence of currents and the width of channels between these islands would also prevent the use of rafts as a means of transportation and traffic. The assumption that the earliest inhabitants of the Aleutian islands were without a kaiak or boat of some kind, is based upon researches in the shell heaps of abandoned village sites on those islands; but a kaiak with a whalebone or even a wooden frame without its modern ornaments of ivory and bone, contained no material that would withstand decay and final absorption. The skin covering when worn out and unfit for use as such, was, no doubt, then as now, cut up into straps and patches, or served as food in time of famine, while the frame could be utilised in many ways that would leave no trace behind. The mere absence from the lower strata of shell heaps of anything pointing to the existence of the kaiak, can scarcely be considered as proof conclusive of its non-existence. My personal observations have led me to believe that the remains of former villages and dwellings found on the Aleutian Islands and on the continental coast of Alaska, are not of the antiquity ascribed to them. Wherever I had the opportunity to observe such localities at long intervals of time, I was astonished at the rapidity with which nature extinguished the traces of man by a growth of sphagnum and other vegetation, giving to the site of the village abandoned but a few years every appearance of great antiquity.

The absence of stone and bone implements of more delicate construction from the lower strata of the shell heaps can easily be attributed to the same cause that explains the absence of iron implements from the upper layers that must have accumulated within historic times. Such articles were the product of much labour, and consequently too precious to be lost. At every successive removal from one dwelling-place to another all such products of their ingenuity were carefully collected and removed by the ancient Aleuts, just as it is done now with regard to iron by the natives of the present day.

On these treeless isles, the removal from one hunting or fishing-ground to another of a few families or a community always involved the transportation of every log or plank, and every particle of wood to be found about the place. As an instance of this kind, I may point to the removal of the people of Makushin, on Oonalashka Island, which took place in the early part of the year 1879. In the summer of 1880, I visited the spot from which the people had removed, and found the outlines of every house indicated by a slight depression in the ground, and inclosed by low ridges of earth covered already with a dense growth of sphagnum and grasses. Every piece of wood about the whole settlement had disappeared simultaneously with the people; and I have no doubt that an explorer unacquainted with the circumstances could dig up these remains without finding a scrap of iron, or anything indicating their recent occupation by at least a semi-civilised people. Another example of this kind, and even more forcible in total absorption of all signs of recent occupation, can be found on the island of Atkha at the site of the former settlement of Korovinsky, the people of which removed to Nazan on the other side of the island less than fifteen years ago.

In the settlements remote from the trading centres the people of Innuit stock live to-day as they did probably centuries ago, in a manner not at all inconsistent with the remains found in the lower strata of shell heaps. Even the presence of stone and bone arrow and spear-heads is no true indication of age, as they are manufactured at the present day, as I had an opportunity to witness frequently during my travels in remote regions.

The time required for the formation of a so-called layer of "kitchen refuse" found under the sites of Aleutian or Innuit dwellings, I am also inclined to think less than indicated by Mr. Dall's calculations. Anybody who has watched a healthy Innuit family in the process of making a meal on the luscious echinus or sea-urchin, would naturally imagine that in the course of a month they might pile up a great quantity of spinous débris. Both hands are kept busy conveying the sea-fruit to the capacious mouth; with a skilful combined action of teeth and tongue, the shell is cracked, the rich contents extracted, and the former falls rattling to the ground in a continuous shower of fragments until the meal is concluded. A family of three or four adults, and perhaps an equal number of children, will leave behind them a shell monument of their voracity a foot or eighteen inches in height after a single meal. In localities in Prince William Sound, I had an opportunity to examine the camp-sites of sea-otter hunters on the coast contiguous to their hunting grounds. Here they live almost exclusively upon echinus, clams, and mussels, which are consumed raw in order to avoid building fires and making smoke, and thereby driving the sensitive sea-otter from the vicinity. The heaps of refuse created under such circumstances during a single season were truly astonishing in size. They will surely mislead the ingenious calculator of the antiquities of shell heaps a thousand years hence.

On the coast of Cook's inlet I have observed other instances of the rapid transformation of dwelling sites.

In the year 1869, I erected a substantial log-house in the vicinity of the village of Chkituk. I visited the spot last summer and discovered nothing but faint lines of the foundation of my house indicated by low ridges overgrown with mosses and grasses, and two young spruce trees growing up from the spot where my fireplace had been located. In the same locality, at the mouth of the Kaknu or Kenai river, the remains of the first log building erected there by the Russians in 1789, can now be seen protruding from the almost perpendicular river bank 15ft. or 20ft. under the present surface.

As an instance of the rapidity with which the tides of this region will change outlines of coast and other landmarks, I may cite an observation made by me during my stay on Nuchek Island last summer. At a short distance from the settlement there was a cave in a rocky cliff situated about three or four feet above high-water mark. I visited the place frequently, as it afforded a view over the approaches to the harbour. About the middle of June an eclipse of the moon occurred when it was full or nearly so, causing tidal commotion of unusual extent and violence. When I visited my cave on the day following the eclipse, I found it almost filled with shingles and débris. This cave was situated at about the same height above the water as the cave of Amaknak, from which Mr. Dall extracted such voluminous information as to the antiquity of strata of refuse found therein. I cite these instances only for the purpose of showing that it is not safe to ascribe great age to any and all accumulations of débris found on the coast of Alaska, and also as a support for my theory of a general Innuit migration along the coast at a comparatively recent period, subsequent to the invention of the kaiak or a similar structure.

WHAT IS ELECTRICITY?

ASKS Col. J. D. Shakespeare in the *Electrician*, and then continues—"To this question I have failed to see given any reliable answer, and my suggestion may be equally unsatisfactory. However, when endeavouring to solve a law of nature, my experience tells me to inquire into and search it out from the simplest form known to us in daily life. We know electricity is produced to our senses in one of two ways—either mechanical—i.e., by friction, or chemical, i.e., by the conversion of some sorts of matter into other sorts. I submit that, as electricity is common to all things, its mechanical production has precedence of the chemical, and that the electricity in things partakes of the principle of "storage." We only know things by what they do. Bearings heat by frictional contact to a very high and even visible temperature. Two rapidly revolving discs, not in contact, but so close together as to admit only of an air-space between them, develop electricity quickly and in a most powerful form from the rubbing together of the molecules of air between the discs.

Let me now observe that the world rolls round itself at the rate of 1,000 miles an hour, and travels round the sun at the rate of 6,500 miles an hour, the atmosphere travelling with it. Is it not a fact that our planetary system works from east to west by the south, and that our world revolves from west to east? Surely with such motion there must be a "slip" producing friction and electricity. If there is a "slip," then electricity would be an effect of Nature's laws of friction; but whether that friction produces it *de novo*, or stimulates it into action from a latent state, I am not prepared to say, but prefer the latter theory. If it is a "primary," there is no use in asking "What is electricity?" but we may ask—Where is its source?

PORTABLE DOOR-FASTENER.

A POCKET device for securing doors, that can be attached to any door rapidly without any implements, has been patented by Mr. Charles A. Crongeyer, of Detroit, Wayne county, Mich. U.S.A. A metal strip is provided at one end with a flat hook, and a rod is pivoted to its opposite end, and the outer end of the rod is screw-threaded. A U-shaped piece, whose shanks are of unequal length, has an aperture in its curved middle part through which the rod passes in such a manner that the ends of the shanks of the U-shaped piece project toward the hooked end of the strip. This piece is secured in any desired position on the rod by a milled nut screwed on the outer end of the rod. The ends of the shanks have a flat smooth surface to rest against the surface of the door and frame. The short shank is adapted to rest against a moulding or casing, and is provided with a swinging leg of such length that when it is swung outward its end will be flush with the end of the long shank. When used, the hook of the metal strip is placed against the jamb of the door, and the U-shaped piece is turned in such a manner as to permit the closing of the door, and when the door is closed the hook is forced into the wood of the jamb. The piece is then turned so that the long shank will rest against the surface of the door. The device does not mar the door and keeps it locked perfectly, and is applicable to doors of any thickness, and with little or no trouble.

RECENT ADVANCES IN PHOTOGRAPHY.—I.[*]

By Capt. Abney, R.E., F.R.S.

THE first germ of photography was when Scheele investigated the action of light on silver chloride, and found that it discoloured it. It was subsequently found that this discolouration of the chloride was due to a liberation of chlorine from the chloride of silver. In 1802, eighty years ago, Wedgwood read a paper before the Royal Institution, in which he described a method of taking profiles, and also copying painted pictures, by means of what we should now call photography. These profiles were taken on paper washed over with silver nitrate. In other words, the profile of the person to be portrayed was thrown against sensitised paper, in a strong light, and the outline was photographed or made visible by the strong light acting outside the profile. Of course, it produced a white profile on a black background. About the same time that Wedgwood read this paper, Sir Humphrey Davy was practising this process, and he found that silver chloride was preferable to silver nitrate. He also found that if he used white kid as a basis of what I will call the photograph, he got a stronger impression than if he used simply paper. In 1814, twelve years later, Niépce devoted himself to studying the action of light upon asphaltum, and he worked out a process which up to this day is still used, and which I shall not refer to more particularly now, as I shall hope to do so in a subsequent lecture. He developed the process which was then called heliography, which consisted in the production of a picture in bitumen on a metal plate, the light causing the oxidation of the bitumen or asphaltum, and rendering insoluble or less soluble those parts which had been acted upon.

In 1827, Niépce came to England, and endeavoured to introduce the results which he had obtained to the notice of the Royal Society; but, owing to the process being a secret one, the communication was not received.

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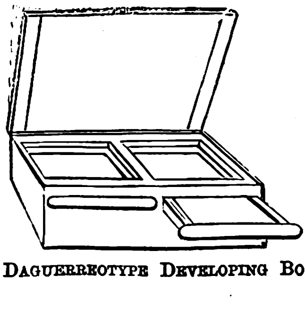
[*] A series of Cantor Lectures delivered before the Society of Arts.

In 1824, Danguerre, a name to be remembered, a French painter, began similar experiments in the same direction, and, in 1829, he and Niépce entered into partnership to work out that which eventually received the name of photography. Now, Niépce has left it on record, that in his bitumen pictures he had one considerable trouble: he found that, instead of the lines of an engraving being represented by black stains on the white metal, the lines were represented by white metal on black bitumen. In order to overcome this difficulty, after coating the silver plate with his bitumen, and developing it by dissolving away the unaltered parts, he treated the metallic silver plate beneath with any ingredient which he might choose, and, amongst others, he has left on record that he treated it with iodine, and then rubbed off the bitumen. This, in the case of an engraving, would, of course, give dark lines on a white background. Here we have the first introduction of iodine and silver together.

Now, we cannot suppose that two such shrewd observers as Niépce and Daguerre could have used this combination of iodine and silver without noticing that it was altered by light; and I may say that there are a number of grave grounds for considering that this was really the origin of the daguerreotye process, which consists, as you know, in the treatment of a silver plate primarily with iodine, and subsequently with other substances, to cause sensitiveness. Daguerre and Niépce must have noticed the alteration by light in the siver iodide which they had formed on the silver plate, but up to that time of which I am talking, they had not discovered the secret of what we now call development; and when we come to consider the early history of photography, it is a most remarkable fact that the two first modes of development were discovered, if I may say so, by flukes. The discovery of the development of the daguerrean image was as follows:—He, Daguerre, had been trying to reduce the exposure of iodide of silver in order to get an image in a reasonable time. Instead of exdosing his plate for a quarter of an hour or an hour, he wished to obtain an image in one or two minutes, which, to him, would have been very quick. Many months were passed in these apparently fruitless researches, until one day he placed one of his iodised plates, which he had exposed to light for some short time, in his chemical cupboard. Now, in that chemical cupboard were a variety of bottles of all descriptions. He had worked hard, and as chemists know perfectly well, when a man is working at research, there is usually a collection of all sorts of chemicals. He placed his daguerreotype plate in the cupboard over night, and to his astonishment next morning when he opened the cupboard, he found that he had a fully developed daguerrean image. This was a discovery which he immediately turned to account. He exposed other plates, shifting first one bottle then another, and by this process of elimination, at last he was able to find that it was an open bottle of mercury which had caused the development of the image. This was really, I believe, the true history of the daguerreotype process, so far as the mercurial development was concerned. It was considered a very short exposure in those days if you sat five or ten minutes in the sunlight to have four portraits taken. We have changed all that now, and I dare say before this course of lectures is over, not only five or ten minutes will be considered a long exposure, but perhaps 5-100ths of a second will not be considered short.

I have the pleasure to-night of introducing to your notice an old worker of the daguerreotype process, Mr. England. He has kindly consented to show the whole manipulation of the process from beginning to end, thinking it might interest what I may call a juvenile audience, for juvenile I suppose most of you are, as regards photography. Mr. England has left me to do the talking, and, therefore, I must do the best I can to explain the operations which will be gone through. We have a little box, divided into two parts, in one of which is placed iodine, and in the other is placed what is called bromide of lime—that is to say, caustic lime impregnated with bromine. You will find that, first of all, having polished it, he will place the plate over one of these apertures—over the iodine; the iodine vapour will be allowed to play upon it a certain time, and then he will shift the plate over to the bromine, and thus he bromises the silver. He will finally give it another touch of iodine vapour, and the plate will be ready for exposure. Mr. England has taken the trouble to polish these plates beforehand, since their polishing is one of the chief difficulties of the daguerreotype process. The fact is, the plates require the most elaborate polish, such as even a silversmith can scarcely give them. One of these plates he will now place over the iodine, and for two minutes allow the iodine vapour to rise and attack the silver. [Mr. England here explained that the first process is to bring the plate to a deep yellow colour, by means of the iodine, and then to place it over the bromine.] In the first place, it is necessary to be able to see the colour, so that a reflector is placed on the one side of the sensitising box, the other being open. By this artifice, the plates may be viewed, and the colour of the daguerreotype plate can be watched, till it has attained a deep yellow colour. It is passed on, to be acted on by the bromine, and that is continued until it attains a rose colour. It is a little difficult, by artificial light, to see the exact colour; this process was seldom worked by artificial light, and, therefore, one may be misled by false colour.

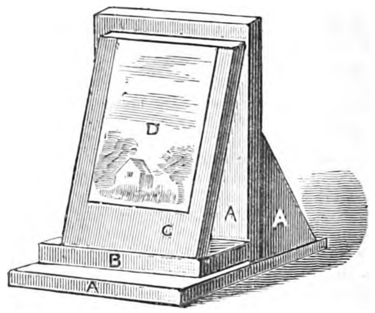


Daguerreotype Developing Box.

We propose, between us, to take a daguerreotype picture. Now, the operation of sensitising is very nearly finished. It has been treated with iodine, and then with bromine, and now it is having a final submission to iodine. The plate Mr. England prepared has now been exposed one minute; Mr. England is rather doubtful about the sensitiveness of the plate; but I am afraid, myself, it is rather over-exposed. Mr. England is now going to develop the picture, and he will do so by the use of mercury. He has here the original mercury box with which he was accustomed to manipulate. He will hang it against the wall, and light a small spirit lamp under a bowl of mercury beneath it. The mercury fumes will rise through an orifice into the box, and so on to a plate; he will watch it from time to time, until it is developed, when we will show it to you. [A copy of an engraving was here taken whilst illuminated by the electric light.]

I should like you to understand exactly what takes place in the daguerreotype plate when it is exposed and developed. On the surface of the plate we have a mixture of silver iodide and bromide, but, for simplicity's sake, I will suppose that there is simply silver iodide on it. When light acts on such a compound, the action is to split up the silver into a salt, which we call silver subiodide, and iodine is liberated, $Ag_2 I_2 = Ag_2 I + I$. The iodine is taken up by the silver plate at the back of the sensitive film. To develop the picture, mercury vapour is caused to condense on the subiodide, and leave the iodide in tact. Amongst some pictures which Mr. England has kindly brought, we have an instantaneous view of New York Harbour, taken about 25 years ago; and I doubt very much whether there are any wet-plate instantaneous picture equal to that; from age it has become a little bit tarnished, but otherwise it is a most perfect picture—the size is about 5in. by 4in. I have a transparency taken from this, and one from a negative, also in the possession of Mr. England. This last is a portrait of Daguerre, taken by himself. This is interesting as showing one of the very earliest daguerreotypes known.

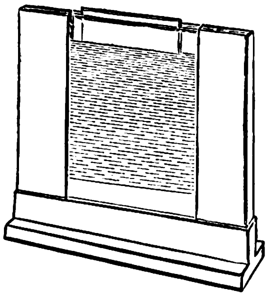
The next process is the Talbotype process. In Talbot's original process, chloride of silver formed the basis, and from that sprung our silver printing process of the present day. But the great improvement he made was by the introduction of iodide of silver. I may mention that he introduced this in January of the same year in which Daguerre introduced the daguerreotype process in France, namely, in 1839. The outline of the talbotype process is as follows:—First of all, he gave a wash of nitrate of silver to plain paper—some papers answered better than others—this he dried, and then washed over it the iodide of potassium, so forming iodide of silver, then dried the paper, and again washed over it the nitrate of silver. Such a paper was found sensitive enough to take camera pictures. But how about the development? Curiously enough, the development of the talbotype picture was discovered in an independent way by the Rev. J. B. Reade. He was practising with the solar microscope, and copying certain objects. One afternoon, having given his paper, which he had washed over with gallic acid, a short exposure, he was obliged to leave it for the night; next morning he found that his image was fully developed. That gave him the idea of the development of what was called the latent image. Talbot introduced this mode of development into the calotype process. This calotype process was the subject of litigation, and the claims of the Rev. J. B: Reade to be the discoverer of the gallic acid development was disputed. I do not wish to enter into the legal question as to who was the discoverer, my own opinion is Mr. Reade should have the credit which belongs to the discovery. From the negative pictures so produced, an unlimited number of portraits would be made by what we call the ordinary silver-printing process. A daguerreotype, on the other hand, could be only reproduced by electrotype, and Mr. England has kindly lent me such a reproduction, which can be examined afterwards. I propose, however, to show you how Talbot was able to make a picture on paper. I intended to have taken a camera picture by the process, with the aid of the electric light, but I find it will take up too much time. I have here a negative with some talbotype paper upon it, prepared as described. I will expose this to the light from a bit of magnesium wire, and then will develop it in the way in which that development was practised in the old time. I have a solution of gallic acid, which I place in a little dish, and with it will mix a solution of nitrate of silver and acetic acid. The acetic acid is meant to retard the action of the gallic acid, to prevent the reduction of the silver before the development takes place. I should say the usual method of using the paper was as follows:—A final wash of gallic acid and silver nitrate was given it, and it was then exposed while damp in the camera. This is what I intended to do, but the minutes steal on us so very rapidly, that I have been obliged to leave out the wash of gallic acid and silver, and to give it a rather longer exposure behind a negative, and thus I shall produce a positive on development. The undeveloped picture is now placed on this piece of glass, and now I proceed to develop it. The glass is placed on a stand, and the light from the lantern, after passing through orange glass, is allowed to illuminate it. The lines begin gradually to appear, and they must now be visible to you all. I continue brushing over the picture the solution of gallic acid and nitrate of silver, with acetic acid, and it becomes still more visible. A paper process is a most fascinating process, because you can dabble about, and do exactly what you like; it is not like the gelatine plates of the present day, which you have to leave to come out mechanically. With paper, if you want to bring it out a little better detail in one place there, you can dab it out; and if you want to keep it back, you can put a little water over the place. There is no process like the paper process to please an artist; not that I profess to be an artist, but, belonging to the Science and Art Department, I have a sort of art instinct, I suppose. I think you can see that the image is very fairly out now. In the old days, I dare say it wonld be considered passable for a beginner—not that I am a beginner, because I practised it in India; but it is a long time ago since I did so. So much, then, for the talbotype process. Now, what is the meaning, I would ask you, of that development? It is a curious thing that a small exposure to light should cause an image to appear. I will ask Mr. Woods to throw on the screen something which perhaps will illustrate how development arises. This morning I was in my laboratory, and I saw lying on the bench a feeble negative which I had badly developed, and which I had fixed with hyposulphite of soda. On taking it up, I found the salt had crystallised over the surface in a most beautiful manner, and I do not think I could point out to you anything which would give you a better idea of what development is than those crystals whose images you see on the screen. When you have silver precipitated from a solution by any means whatever, you have it always in a crystalline form, and as all crystals possess polarity, so crystals of silver possess polarity; and where one silver particle is deposited, there another silver particle will deposit, exactly in the same way as those crystals of hypo-sulphate of soda follow one another in regular course in those beautiful feathers. Thus, then, I look upon it as a physical development; we have a crystalline action going on during development, and nothing else. The iodide of silver is altered into sub-iodide, and this, like the pole of a magnet, attracts the precipitating silver, and from that time, where the silver is deposited, other crystals of silver are deposited. That is what I call physical development.



Stand for Developing Paper Pictures.

Now, there is another kind of development, which some call chemical development; and here I differ from some of my brethren who live on the other side of the water, in Germany, who have chosen to name as chemical development something quite different to what my idea is of chemical development. I say chemical development is only a development which is shown by a change in the colour or material of the substance acted upon, and not by a building-up process, such as we have had before us. Now, I have something which I hope will show you what I mean by this chemical development. I have here a picture, which has been printed on nitrate of uranium; I am going to use simply silver nitrate for a developer. I do not want a reducing agent in the developer in this case, because the uranic salt is reduced to the uranous state by the action of the light, and we shall have a picture formed of silver oxide, because the uranous salt will reduce the nitrate of silver to the state of oxide, and that of itself can be reduced afterwards to the state of metallic silver. This paper was exposed, just before you came to the lecture, to the electric light behind a negative. There is an outline of it now, but when I apply the silver, you will see that it springs out into vividness. It has been rather over-exposed, but this I do not mind, as I merely wish to illustrate a principle. The whole of that picture is formed by silver oxide reduced by the particles of uranium nitrate which have been acted upon by light and by nothing else. The silver oxide reduced is an exact equivalent of the uranium salt which has been altered by light. That is what I call chemical development, and I know no other meaning for the term. It is impossible, except where you have a change in a large amount of the material that is acted upon by light. I hope I have made you understand the difference between this development and the development you saw just now. The gallic acid, in the one case, reduces the silver solution to the state of metallic silver; and, in the other case, the uranous image itself reduces it to the state of silver oxide; but still that silver oxide was only equivalent to the amount that had been acted upon by light, and nothing more. I have here a wet plate prepared. I dare say most of you know what a wet plate is, though some of you may not if you only began photography when the gelatine process came in. To such, I suppose, a wet plate is as much a matter of novelty as a daguerreotype is to many who know what the collodion process is. I will ask you to bear with me, however, while I produce the picture, because I want to show you the use of the electric light. Of all the recent aids to photography, the electric light is one of the most powerful, because with it you can photograph by night or by day. In fact, in some of the advertisements I have seen it stated that they prefer to take portraits by night; I do not know why, but in a country town I saw an advertisement in which they said distinctly they preferred to take photographs by night, as it was more convenient. [An engraving was focussed on the camera screen, and the wet-plate exposed for twenty seconds.] A short exposure will do for this. Now I will try to show you the development on the screen. You see a cell there with water in it. Now I hope you will see the crystalline action taking place before you, and the image will be seen on the screen gradually coming out. A cell containing ferrous sulphate in solution, and a small quantity of glacial acetic acid, is focussed on the screen. The plate of sensitised (and now exposed) collodion is fairly transparent. After placing a piece of yellow glass in front of the lantern, the plate is immersed in the cell, and the image is seen gradually being built up.

There is another mode of development which our friends across the water have chosen to call chemical development, though I cannot agree with them, and that is the method which is called alkaline development. I dare say I could very rapidly demonstrate that to you. The *rationale* of the alkaline development is that when you have a strongly oxidising agent in the presence of an alkali and a silver compound, solid or in solution, then you have the last reduced to the metallic state. Such an oxidising agent we have in the pyrogallic acid, and the alkali generally used is ammonia. Now, this kind of reduction is evidently useless unless it can discriminate between a compound which has been acted upon by light and one which has not. When pyrogallic acid is used in order to make this discrimination, or, in other words, in order that those parts acted less on by light may alone be reduced, something more has to be added, which is usually a solution of a bromide of an alkali. This restrains the reduction inducing the change to take place in the part acted upon by light. It has been usually said that alkaline development is only available for bromide of silver, and until recently I dare say that was the case, or rather it was not the case, but it was thought to be so. I hope on a future occasion to show that iodide of silver is as amenable to alkaline development as bromide of silver, although not so rapidly; and that chloride of silver is very amenable to alkaline development, giving in fact most beautiful pictures. The plate I am going to expose now is a bromo-iodide plate. I have shown you this form of it simply because it is transparent. I have here a negative, and the sensitive plate behind it, ready prepared. Now I expose it to the light from the magnesium wire for a few seconds. I will take a cell, in which I will place some of the alkaline developing solution. The pyrogallic acid and bromide are mixed, and to which the ammonia is ready for adding. I mix a small portion of this latter with the pyrogallic acid and bromide—the bromide, remember, being for restraining purposes. I place the plate in the cell, which is seen in focus on the screen. The picture is one of Mr. England's beautiful statuary studies, and you can see the outline of the bust gradually appearing. That, I say, is another case of physical development.



Cell for Demonstrating Process of Development.

Now, I want to show you why I say it is physical development. I throw on the screen a slide, which is a picture of a young lady, seemingly cut in half, part of her figure being intense, and part not intense. This difference in intensity was produced by exposing a plate behind a negative, and then before development, coating a portion of the plate with bromide of silver. The top layer thus had no exposure whatever, and yet you see where the unexposed film is, there we have the picture very much denser than in the case where there was only the one film. This shows that here we have a case of physical development, for the image is built up from the film itself, being partly fed, as it were, from the film which had received no exposure. There is thus crystalline action taking place in the film, just as much as there was in the silver reduced from the nitrate of silver. I want you to understand why I object to the words chemical development, when we are talking about alkaline development.

There is another mode of development which is now very much in vogue, and that is with ferrous oxalate. In this case we have an organic salt of iron in the ferrous state which is capable of reducing silver bromide, iodide, and chloride, to the metallic state, whilst itself is reduced to the ferric state. That was a development which also required a restrainer. If I had had time there were several more experiments I should have gone through, but I must omit them. There is, however, another kindred developer, which I think is one of the most recent advances in photography, about which I am supposed to be lecturing. I speak of it with great tenderness, because it is my own child. I have now got an iron developer which is capable of being used without any restrainer whatever. I call it ferrous citro-oxalate; it is rather a long name, and some of my audience may not understand it, but I will tell you how it is made. You take a solution of citrate of potash, and then you add ferrous oxalate to it till no more will dissolve, the resulting compound is probably citrate of iron, but in a stronger form than is usually found, and much more energetic than that form which was recently recommended by Dr. Eder, to whom I shall have to refer more at length presently. I propose to use some of that same paper which I used just now. Its use for the purpose I have in view is a novelty. This paper can be developed by the alkaline method, or by the ferrous oxalate method, or by the ferrous citro-oxalate method; it is an excellent paper, and was prepared as I described about two years ago at the Photographic Society, before the gelatine papers came into vogue; it gives a very clear picture, and I dare say that you will also see that it gives very satisfactory negatives. I expose a piece of the paper behind a negative to the light of the magnesium wire again. The negative used in this case was kindly lent me by Mr. William Bedford. It is rather a dense one, and requires longer exposure than I should have given to a thinner negative. The exposure is now given, and on withdrawal from the frame it apparently is a perfectly blank piece of paper. [The paper was wetted and placed on the developing-stand already described, and brushed over with ferrous citro-oxalate without any bromide being added. The lantern was covered with yellow glass, and the light of the disc thrown on the paper.] You see it is beginning to develop; see how beautifully it comes out. This, I say, is a novelty in photography, for here we have an iron developer which needs no restrainer, and a paper which can be developed by an energetic developer. I think I may claim that as an advance over the calotype process.

WHERE THE HOUSE-FLY BREEDS.

As "fly time" approaches every housekeeper wonders where and how the increasing swarms of pests multiply so rapidly. The eggs, mere whitish specks to the unaided eye, are laid in little agglutinated piles in warm manure or in decomposing vegetation, especially that about our stables and barn yards. From 80 to 100 are laid at a time, and, probably, at three to four different intervals by the same fly, though on this point we have no exact data. Within twenty-fours in summer, they hatch into footless maggots, which, after rioting in filth till their tender skins seem ready to burst from repletion, become full-fed in less than a week, and descending into the earth, or sheltering under some old board, contract to brown, shining objects, rounded at both ends, and technically known as puparia. Within the darkness of this hardened skin profound changes rapidly take place, and the insect passes through the pupa to the perfect state, and finally, in about five days, the anterior end of the puparium is pushed off, and the fly quickly crawls out. At first its parts are pale and soft, and its wings are crumpled and useless, but these soon expand, and suddenly, without practice or teaching, the new fledged fly wings its way to your table to mock your displeasure—to share your repast. The length of time required from hatching to maturity varies with the season and temperature, but will not exceed ten days in midsummer, while the life of the perfect fly lasts about three weeks at the same season. As cold weather approaches propagation ceases, and the older flies perish. A few of the more vigorous females, however, retreat, to some nook or cranny, where, in a state of torpor, they survive until the ensuing season—links 'twixt the summer gone by and to come. The insect may also hibernate in the pupa state in the ground. In rooms kept continuously warm, or in more southern latitudes, the fly remains active all winter, and the palace sleeping cars bring them daily to New York from Florida during the coldest months of the year.

Cleaning Dull Gold.—A solution of 80grm. chloride of lime, 80grm. bicarbonate of soda, and 20grm. common salt in three litres distilled water, is prepared and kept in well-closed bottles. The article to be cleaned is allowed to remain some short time in this solution (which is only to be heated in the case of very obstinate dirt), then taken out, washed with spirit, and dried in sawdust.

Sunstroke.—Sunstroke is caused by excessive heat, and especially if the weather is "muggy." It is more apt to occur on the second, third, or fourth of a series of hot days, than on the first. Loss of sleep, worry, excitement, close sleeping-rooms, debility, abuse of stimulants, predispose to it. It is more apt to attack those working in the sun, and especially between the hours of eleven o'clock in the morning and four o'clock in the afternoon. On hot days wear thin clothing. Have as cool sleeping-rooms as possible. Avoid loss of sleep and all unnecessary fatigue. If working indoors and where there is artificial heat (laundries, &c.), see that the room is well ventilated. If working in the sun, wear a light hat (not black, as it absorbs the heat), straw, &c., and put inside of it, on the head, a wet cloth or a large green leaf; frequently lift the hat from the head and see that the cloth is wet. Do not check perspiration; but drink what water you need to keep it up, as perspiration prevents the body from being overheated. Have, whenever possible, an additional shade, as a thin umbrella when walking, a canvas or board cover when working in the sun. If a feeling of fatigue, dizziness, headache, or exhaustion occurs, cease work immediately, lie down in a shady and cool place, apply cold cloths to and pour cold water over head and neck. If anyone is overcome by the heat, send immediately for the nearest good physician. While waiting for the physician, give the person cool drinks of water or cold black tea, or cold coffee, if able to swallow. If the skin is hot and dry, sponge with or pour cold water over the body and limbs, and apply to the head pounded ice wrapped in a towel or other cloth. If there is no ice at hand, keep a cold cloth on the head and pour cold water on it, as well as on the body. If the person is pale, very faint, and pulse feeble, let him inhale ammonia for a few seconds, or give him a teaspoonful of aromatic spirits of ammonia in two tablespoonfuls of water with a little sugar.

SCIENTIFIC NEWS.

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THE death is announced of M. Antoine Breguet, at the early age of 32 years. Many visitors to the Electrical Exhibition in Paris will remember him as one of the most energetic of the directors.

The endowment of research is being gradually brought about without the assistance of the Government. In October, the Senatus Academicus of Edinburgh will proceed to elect five graduates of some Scottish University to five fellowships of £100 each, the funds for which have been supplied by an anonymous donor, who promises a repetition of the gift for one or two years at the request of the Senatus. The fellowships are intended for those who, having attained some proficiency in mathematics, physics, chemistry, biology, mental philosophy, history, or the history of literature, are desirous of prosecuting unprofessional study or research into those subjects. The holders of these fellowships must reside in Edinburgh during the winter and summer sessions, and give evidence of their progress in some way approved by the Senatus.

At the request of Mr. Philip Magnus, one of the Commissioners on Technical Instruction, Herr Reuter, director of the Fach-Schule at Iserlohn, has sent to London a collection of specimens of his pupils' work, which is on view at the offices of the City and Guilds of London Institute, Gresham College, E.C. The Fach-Schule at Iserlohn is one of the new German schools of the kind of which a large number exist in Austria, and its special object is to give practical instruction in artistic metalwork. The course lasts three years, and comprises mathematics, physics, chemistry, drawing, style, modelling in wax and clay, wood-carving, engraving, electro-plating, metal chasing, &c. The City and Guilds Institute propose to establish a school of applied art in the City, the first classes being for cabinet-makers and furniture designers.

The Yorkshire College, Leeds, is to be finished as soon as possible. The existing portion of the buildings is that devoted to textile manufactures and dyeing; but the contracts for the other portions having been signed, the works will be pushed on until the College is complete.

At the meeting of the Aëronautical Society of Great Britain last Monday, Mr. Simmons stated that it would be of great advantage if some means could be devised of measuring the pace at a high altitude. The speed of the wind was much greater above than on the earth. When he recently crossed the Channel in a balloon, part of the journey was accomplished at the rate of 130 miles an hour. The reason of the difference he attributed to the resisting power of the uneven surface of the earth. Mr. Craig read a paper which advocated the use of gas engines as a motive power for aërial voyages, to be made by flying machines worked by a screw propeller. Mr. Rogers read a paper upon "How to Sail in the Air by the Use of Wings, as Exemplified by Nature." He dealt generally with the theory of flying, and also advocated light gas-engines as a motive power. A paper was read by Mr. F. W. Brearey upon "The Action of the Pectoral Muscle in the Flight of a Bird," the study of which he commended to all investigators into the mechanical principles of flight. He argued that the power exerted by a bird in its flight had been greatly exaggerated, and that weight became a great accessory to power, an assertion he verified by the use of flying models.

The Manchester Ship Canal scheme is about to take a tangible shape, for at the recent meeting of the provisional committee, the engineers were appointed and instructed to make the necessary survey and furnish the committee with a report and an estimate of the cost.

At a recent meeting of the South Staffordshire Institute of Mining Engineers, Mr. H. Johnson read a paper on "Electricity and the Utilisation of Small Coal," which suggested a very pertinent question. It had, the author said, been stated over and over again that electricians could carry stored electricity without any appreciable loss. If that were so, he saw great advantages to be derived by both electricians and coalmasters by bringing the motors to the coal instead of taking the coal to the motors. The electricians would obtain power cheaply, and the mine-owners would get rid of their slack, which cannot now be sold at a profit. The question is, Why is not something of the kind done?

The Moore Fossils in the Museum of the Bath Literary and Scientific Institution are being classified by Mr. Etheridge, jun., and Mr. Bullen-Newton, of the British Museum, so far as the invertebrate portion is concerned; Mr. Davies has undertaken to arrange the vertebrates.

M. Girard, a young officer in the French Navy, has started for Zanzibar with the intention, if possible, of making a journey across Africa, following in the track of Stanley, and reaching the mouth of the Congo. He pays his own expenses, but is recognised by the French Minister of Public Instruction, who has given him a mission.

We have received a copy of the rules of the Postal Photographical Society, which has been established for the circulation of photographic scrap-books, and for the exchange of prints and notes upon matters connected with the practical operations of the art. Mr. H. H. Cunningham, 7, Fig-Tree-court, Temple, is the hon. sec. The annual subscription is five shillings, and each member is bound to contribute at least six prints to the scrap-books every year.

Oxygenated water, or hydrogen di-oxide (H_2O_2), has been lately attracting attention in various aspects. MM. Bert and Regnard suggested the treatment of wounds with it; and two surgeons at the Saint Louis Hospital, Paris, have thus applied it with considerable success. The substance has advantages over carbolic acid, in the absence of danger of poisoning, and of bad smell. Its action is two-fold: killing microbes (or small organisms), immediately, and furnishing a continuous supply of oxygen to the wound. Ulcers, abscesses, and the like, are advantageously treated with it. In his studies on thermo-chemistry, M. Berthelot has inquired how oxygenated water is decomposed by electric forces. Electromotive force may produce two different phenomena: (1) merely a liberation of oxygen; (2) a liberation of hydrogen and oxygen, giving water by combination. This second phenomenon only occurs if the force reaches that of a Daniell. This accords with theory. A Daniell gives a chemical reaction liberating 24·5 calories; while the decomposition of oxygenated water into H and O_2 requires 23·7 calories.

The following experiment is described in a French contemporary: If drops from a lighted candle be let fall into pure water in a vessel from a height of 6 or 8 inches, these suddenly stiffen in the form of light hemispheres. If a slightly moistened bar of soap be now introduced, the small particles are repelled by it to the sides of the vessel, where they adhere. One may bring these back, and repeat the experiment two or three times; but ere long it fails, because of the dissolved soap. It should be recommenced afresh. The repulsion is attributed to the rapid dissolution of the soap, which at first is at the surface only; when the water already contains a little soap dissolved, the dissolution occurs through the mass of the liquid.

From observations at Vienna with the Campbell-Stokes sunshine-recorder, last year, by Herr Pernter, it appears that the sun shone there 1676·3 hours, out of 4172 hours of possible shining, *i.e.*, only 37 per cent. In the winter half-year, the duration of sunshine kept pace with the height of the sun above the horizon, so that at midday there was the greatest duration; while from morning to noon there was increase of duration, and from noon to evening decrease. Not so in the summer half-year, however. The maximum was not at midday, either on an average, or in separate months; but the duration rose till 11 o'clock (the maximum), fell thereafter, and rose again till 2 o'clock, after which it gradually decreased. Further, in the summer half-year there was more sunshine in the forenoon than in the afternoon; but in the winter half-year the reverse was the case. In the winter half-year the maximum and greatest sum of cloudiness is found in the forenoon; and accordingly the forenoon sunshine has a less duration than the afternoon. The distribution of sunshine over the several months in percentage of the possible sunshine was as follows: Jan., 32·1; Feb., 21·6; March, 27·6; April 25·1; May, 56·2; June, 47·7; July, 60·1; Aug., 57·5; Sept., 39·7; Oct., 10·2; Nov., 20·9: Dec., 21·4.

If an iron or steel bar is brought into a hot solution of common salt, it becomes covered with an irregular layer of salt crystals. According to Mr. Ch. Thompson, an American, who has lately investigated the phenomena, these salt crystals adhere very firmly, and even in wire-drawing they are not stripped off. This property affords industry a welcome means of making hard iron or steel slippery. Mr. Thompson sought to elucidate the action in the process by heating in water a salt-covered wire which, by successive drawing, had been reduced from a diameter of 0·092″ to 0·067″. He found no trace of a soluble iron salt: thus chemical action is excluded, though by oxidation of iron a cement is formed, which helps the adherence of the salt. The cause is rather to be sought (Mr. Thompson thinks) in the powerful pressure in drawing, and consequent high temperature (about 237°), whereby a fusing together of the salt occurs—a kind of regelation. Experiments with other crystalline, easily fusible compounds gave similar results, while infusible or amorphous salts do not show the property of regelation.

A series of experiments have been recently made by Herr Angstrom to determine the changes of volume water undergoes when it absorbs gases of small solubility; and for each of the gases (viz., air, nitrogen, carbonic oxide, oxygen, hydrogen, and carbonic acid) he finds that the increments of volume of water are proportional to the quantities of gas absorbed. Thus, a law formerly established for carbonic acid and ammonia may be considered general. Further, Herr Angstrom constructs a table of *coefficients of dilatation by absorption*, showing for various gases (little and largely soluble) the increase of volume of water in absorbing unit volume of gas. These coefficients differ very little; which seems to prove that the dissolution of gases in liquids is a purely physical phenomena, occurring similarly in the case of so-called permanent gases, and in that of gases easily liquefiable.

A regulator of temperature not requiring the use of gas, is described by Dr. Regnard in a recent number of *La Nature*. He has employed it for some time, and found it to act with great regularity and sensitiveness. In a water bath is inserted a thermometer, having a fine platinum-wire adjustable in its tube above, while another wire enters the mercury of the bulb, being soldered in the glass. These wires are connected with a battery; the circuit being closed when the mercury covers the end of the upper wire. In the circuit is an electromagnet, and armature with long lever attached, which carries at the end a small petroleum lamp. While the current does not pass, this lamp remains under the vessel of water; but immediately the circuit is closed by the mercury the electromagnet acts, so that the lamp is removed from the vessel. Presently, the thermometer cooling, the mercury retires and breaks circuit. Thereupon the magnet loses force, and an antagonist spring pulls the lamp under the vessel again, and so on. This arrangement can be instantly regulated to any temperature one may desire.

A phenomenon repeatedly observed, of late, by Herr Schiaparelli, in the outer ring of Saturn, may (in his opinion) have an important bearing on the physical nature of the ring. The fine, hardly visible line in the ring, seen by Kater and Encke, is not symmetrical on the two sides. In the following loop it divides the outer ring almost exactly into two halves; but in the preceding loop the line (much finer and more difficult to see) is not in the middle, but nearer the outer edge, dividing the breadth as 1 : 2. These observations were made with the Merz refractor, having an 8in. objective, 10ft. focal distance, and magnification of 322 to 417. For greater certainty, Herr Schiaparelli asked Herr Meyer, in Geneva, to look at Saturn with his 10in. refractor; this was done on three separate evenings, and the non-symmetry of Encke's line exactly verified. It will be interesting to test the phenomenon at the next opposition of the planet.

In the French Academy of Medicine, a successful case of treatment of hydrophobia with pilocarpine has been lately reported by M. Dumont, a Caen hospital surgeon. But it would appear that the substance is by no means an infallible remedy; other medical men having injected it in several cases, without apparent good result, while, in still other cases, it has merely abated the violence of crises, and given a little calm—a result obtainable equally by other means.

M. Payart proposes that there should be set up, in the market-places of French provincial towns, a drinking fountain, which should be a means of useful instruction to the peasants and others around. "The Galileo fountain," he names it. The form is that of a pyramid some 13ft. high, resting on a block of stone, which measures exactly one cubic metre (recalling the metric system). One metre is divided on one face of the cube. Four stop-cocks, with plentiful flow of water, are fixed on the faces of the sub-basement. The pyramid has a lightning-rod, and at top, a wind-vane, giving the four cardinal directions. On one of the pyramid-faces is an aneroid-barometer, on the second a thermometer, on the third a clock, and on the fourth, are geographical indications of the commune, or canton; the longitude, latitude, altitude, &c. The remaining space presents the names of the inventors of the various instruments, and the dates of their inventions. (The fountain is represented in *La Nature*, July 8.)

A plentiful supply of vanadium (now largely used for aniline dyes) has been found by MM. Osmond and Witz in the scoriæ of the Creusot works, from dephosphoration of certain cast-iron. These scoriæ contain 2 per cent. of vanadic acid, and have merely to be treated with hydrochloric acid to yield a green liquor, which can be directly utilised in dyeing.

From experiments recently made by MM. Bouley and Gibier, it appears that the trichinæ in meat are killed by being submitted to a temperature of 20°, and even 15°, below zero, Centigrade.

Erratum.—"Scientific News," p. 425. Note on Hildesheim rosebush. The dimensions are given incorrectly, and should be, height about 38ft., width about 34ft. (i.e. "onze mètres," and "dix mètres.")

USEFUL AND SCIENTIFIC NOTES.

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An Artesian Well.—A true overflowing Artesian well, tapping the chalk formation, has just been carried out in the neighbourhood of Woking. The waterworks company, established for the supply of that district, has, for the last six months, been sinking a large shaft at West Clandon, through the London and plastic clays, and, a few days ago, the chalk water-bed was touched by it at a depth of 310ft. below ground, when the water immediately rose in the shaft, finally overflowing the surface at a height of 200ft. over sea-level. It is not often that a well sunk for over 300ft. in dry soil touches a spring strong enough to overflow the surface, and it must be a source of considerable gratification to those interested in the project to know that the anticipations of the engineers have been so completely realised.

Electric Transmission of Power.—J. J. Chrétien states that the first attempt to transmit motive power by electricity was made in 1873, at the Vienna Exposition, by H. Fontaine. In 1876, at Philadelphia, and in 1878, at Paris, the experiment was repeated. Patents were afterward taken out by Chrétien and by Felix for the application of this mode of transmission to cranes and hoisting apparatus. Important experiments upon ploughing by electricity were made at Sermaize, early in 1879, and since that period great progress has been made in pumping, pile-driving, punching, sawing, sewing, embroidering, weaving, printing, etc. He thinks that it is safe to calculate upon the transmission of 50 per cent. of the whole power. Falls and watercourses, when properly regulated, would allow the utilisation of a considerable motive force, at the same time that they favoured irrigation and diminished the probability of disastrous freshets. Tides and windmills, in spite of the intermittence of their labour, may be advantageously used through the help of accumulators. Solar heat, when transformed into electricity, seems to offer a more desirable solution than the direct application to the production of steam. Coal can be more profitably employed under large boilers, which supply powerful and well-perfected motors, at a moderate rate of consumption, than under smaller boilers, which consume from five to thirty times as much fuel per horse-power.

LETTERS TO THE EDITOR.

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[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."—*Montaigne's Essays.*

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CATALOGUE OF SUSPECTED VARIABLE STARS.—III.

(*Continued from page* 427.)

[20285.]—Cepheus—Cetus—Corona Borealis Corvus—Cygnus—Delphinus.

		h.	m.		°	′		
	Cepheus.							
97.	θ Cephei	20	27	+	62	35	—	Herschel.
98.	B. 579	21	9	+	59	37	6½ — 9	Birmingham.
99.	25	22	14	+	62	4	6·8	Herschel.
100.	B. 610		18	+	55	21	6½ — 8·0	Secchi.
101.	26		23	+	64	23	6·1	Herschel.
102.	B. A. C. 8122	23	12	+	72	52	7	Franks.
103.	T		14	+	55	24	—	Argelander.
104.	B. 651		46	+	74	51	6 Var. Col.	Secchi.
	Cetus.							
105.	11 Ceti	0	24	—	1	55	6·2	Herschel.
106.	15		32	—	1	18	5·6	Herschel.
107.	37	1	8	—	8	36	5·3	Gould.
108.	43		16	—	1	6	6·6 — 7·3	Gould.
109.	L L 2598		19	—	4	36	6½ — 8	Gould.
110.	L L 2798		25	—	7	21	6·9	Gould.
111.	61		58	—	0	55	5·5	Herschel.
112.	79	2	29	—	4	11	6·7	Herschel.
113.	85	2	35	+	10	8	5·7	Herschel.
114.	93		56	+	3	47	5·3	Herschel.
115.	—	23	59	—	9	44		Peters.
116.	3		58	—	11	12	4·9 — 5·9	Gould.
	Corona Borealis.							
117.	Σ 1932	15	13	+	27	16	5½	Struve.
118.	μ		31	+	39	22	6	Franks.
119.	Σ 1964		34	+	36	37	6 8	Webb.
120.	Anon.		43	+	28	41	11 — 13	Schmidt.
	Corvus.							
121.	α Corvi	12	4	—	22	48	4·7	Herschel.
122.	ε ,,		4	—	21	57		?
123.	γ ,,		9	—	16	53		?
124.	δ ,,		23	—	15	51		?
125.	Σ 5747		23	—	23	0	5¾ — 6½	Gould.
126.	η ,,		25	—	15	32	3·7	Herschel.
127.	β ,,		28	—	22	44		?
	Cygnus.							
128.	B. 492	19	14	+	27	0	7 — 9	Birmingham.
129.	β		25	+	27	41		Klein, Webb.
130.	B. A. C. 6728	19	31	+	43	22	6½	Franks.
131.	P. xix. 276		41	+	35	48	8	Dembowski.
132.	B. 514		42	+	44	49	10 — 0	Birmingham.
133.	η		52	+	34	46	5	Webb (?)
134.	27	20	1	+	35	34	5·8	Herschel.
135.	B. A. C. 6959		8	+	51	0	6·0	Franks.
136.	B. A. C. 7001		13	+	38	32	7	Franks.
137.	ω³		26	+	48	42	6	Franks.
138.	47		29	+	34	46	4·1	Herschel.
139.	B. A. C. 7114		29	+	40	34	7	Franks.
140.	63	21	2	+	47	10	Var. Col. Mag.	Espin and Stubbs.
141.	B. A. C. 7189		26	+	51	57	7	Franks.
	Delphinus.							
142.	B. 558 Delph.	20	19	+	9	39	6 — 0	Birmingham and Gould.
143.	B. 569		39	+	17	39	8	D'Arrest.
144.	13		41	+	5	32	6	Schmidt.
145.	14		43	+	7	23	6	Schmidt.
146.	B. 578		51	+	15	47	6½ — 0	Birmingham.

T. E. Espin.
W. H. Gage.
T. Read.

Errata.—Catalogue of Suspected Variable Stars.—II. Sawyer's Variable U Ophiuchi.—No. 79, for 8 Canis majoris, read δ (delta) Canis majoris. No. 86, for 4114970, read L. L. 14970. No. 87, for 48381, read L. 8381. In my letter (No. 20261, p. 426), instead of "the big star ρ Ophiuchi," read "the big star ζ (zeta) Ophiuchi."—T. E. Espin.

WELLS' COMET—MATHEMATICAL V. GRAPHICAL.

[20286.]—Cloudy weather prevented me searching for the comet until July 6th, when I at once found a strange body near the place given for that date, but differing very much in appearance from Wells' comet when I last saw it. It much resembled the nucleus of the great comet of last year, or the planet Mars slightly out of focus. I could not detect any coma or tail in the strong twilight with a 3in. o.g. On the next evening I found it had moved about the right distance for Wells' comet, but the direction of motion was slightly towards the ecliptic, instead of, as it should have been, away from it; but on the 8th and 9th it had only moved about half the former distance each day, and bent down still more towards the ecliptic. On Sunday night it was plainly visible to the naked eye when about three degrees above the horizon, since which time clouds have prevented any further observations. I append approximate positions of this body, which I have also sent to the Astronomer Royal:—

		R.A.	N.D.
July 6th	......	10h. 20m.	12° 15′
,, 7th	......	10h. 25m.	11° 25′
,, 8th	......	10h. 27m.	11° 0′
,, 9th	......	10h. 29m.	10° 35

May I be allowed to explain, in reply to your correspondent, "W. C. E." (letter 20214, p. 377), that I did not intend to convey the meaning that a method of finding a comet's orbit by projection could be superior to a mathematical investigation: the projectional method will be true to within certain limits, depending upon the skill and care of the operator, the mathematical will be perfect if the data are correct; but I conceive any errors in the latter will be embodied in the result.

In finding an orbit, three points are assumed, forming a parabolic curve that will pass through the observed places, having the sun for its focus, and the radii vector joining these points with the sun, and the distance between them shall be equal portions of the plane of the orbit. For this purpose accurate observations are necessary. Now, it will be evident that should the path be altered between the times the observations were taken, the effect upon the orbit so found would be the same as though one or more of the observations were in error, and it would be difficult to satisfy the above conditions, an approximation only being possible, and the investigator would be more likely to distrust the observations than suppose anything had gone wrong with the comet, and every after attempt to find an orbit from three observations while one or more of them was taken before the point of disturbance was reached, would result in the predicted places being in error, though every succeeding attempt would be more correct than the last, and it might be a long time before the investigator would suspect the truth. Such, I believe, has been the history of the present comet: we have had many orbits and corrections, till at last the predicted and observed places for the comet have been nearly alike.

Now, I claim for the graphical method that the cause of all this can be more easily seen, every observation when mounted for use in all future investigations, the whole forming a model, every part of which can be seen at a glance. The case stands thus, I believe; by the graphical method I have discovered that the path of the comet has been disturbed about April 23rd, and have indicated that an orbit found from observation from April 27th enwards, the places found on such an orbit before that date will not agree with the observed places of the comet. I cannot do as your correspondent suggests, and demonstrate this mathematically, but it should not be difficult for those used to such investigations to prove or disprove this proposition; but I am willing to show my apparatus as now set up, which shows this matter very clearly, to any one sufficiently interested to take the trouble to inspect it, if they will communicate with me by letter first, to arrange the time.

Since writing this letter I have obtained two more observations of the comet mentioned above:

		R.A.	N.D.
July 15th	....	10h. 42m.	9° 15′
July 16th	....	10h. 46m.	8° 45′

It is getting fainter, and its motion seems to be very irregular. **J. Lane.**

29, Wyvis-street, Bromley, E., July 16th.

ON THE CONSERVATION OF SOLAR ENERGY.

[20287.]—It is not long since Dr. Siemens laid before the scientific world his ingenious theory to account for the conservation of solar energy, which has attracted so much attention both in this country and abroad; and it is worthy of notice that, though the theory has been subjected to a considerable amount of criticism at the hands of qualified judges, it has, as yet, received no refutation. This is saying a good deal when we remember the indifferent success other hypotheses have met with, and the difference of opinion which existed, and continues to exist, among solar physicists on this deeply-interesting subject.

Our readers doubtless remember the hypothesis upon which Dr. Siemens works, and, therefore, there will be no necessity for us to dilate upon it here. Dr. Siemens sums up the fundamental conditions involved in his theory as follows:—

1. That aqueous vapour and carbon compounds are present in stellar or interplanetary space.
2. That these aqueous compounds are capable of being dissociated by radiant solar energy while in a state of extreme attenuation.
3. That these dissociated vapours are capable of being compressed into the solar photosphere by a process of interchange with an equal amount of re-associated vapours, this interchange being effected by the centrifugal action of the sun itself.

The third condition contains the most important point in the argument—the principle of fan action. To understand this most important principle it is necessary to bear in mind that, as the sun completes one revolution on its axis in 25 days, and its diameter being taken at 882,000 miles, it follows that the tangential velocity amounts to 1·25 mile per second, or to 4·41 times that of our earth. An equatorial rise of solar atmosphere is the result of this high rotative velocity, by which the sun acts mechanically upon the floating matter surrounding it in the manner of a fan, drawing it towards itself upon the solar surfaces, and projecting it outwards in a continuous disc-like stream.

It must be remembered that it is not owing to the centrifugal moment overcoming the action of gravity that the outflow takes place, for the outflowing current is entirely dependent upon the former force. As for the products of combustion rendered back into space, Dr. Siemens assumes that they would gradually change the condition of the stellar material, rendering it more and more neutral, and he even ventures to suggest the probability that solar radiation would, under these circumstances, step in to bring back the combined materials to a condition of separation by a process of dissociation carried into effect at the expense of that solar energy which is now supposed to be lost to our planetary system.

Those who have seen photographs of the eclipsed sun in 1867 and 1878 must have been struck with the resemblance between the hypothetical diagram of Dr. Siemens, and the currents in the solar atmosphere as revealed by these eclipses; they seem, in fact, practically to bear out that which Dr. Siemens theoretically assumes. It is quite certain, however, that in the years of greatest solar activity, the coincidence between Dr. Siemens' hypothesis and what is actually observed, vanishes; and on account of this reason, it was, we believe, that during the last eclipse, the analogy above noticed was not observed.

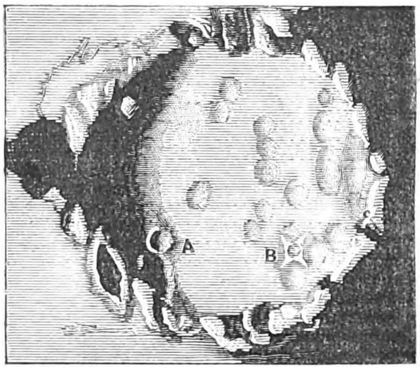
There is another factor which plays not an unimportant part in Dr. Siemens' system of solar economy, and that is shrinkage, or a gradual reduction of the sun's volume, which in some measure counterbalances the expenditure of energy produced at the expense of solar rotation, and helps to give something more than a merely limited signification to the concluding sentence of Dr. Siemens in his paper read before the Royal Society, which is well worth quoting, as it contains sentiments which, even if his highly ingenious hypothesis were rejected to-morrow, would still be re-echoed by all whose delight it is to investigate the mysteries of nature, and to whom our physical relation with the celestial bodies must ever form a lofty subject for contemplation.

"If these conditions could be substantiated," says Dr. Siemens, "we should gain the satisfaction that our solar system would no longer impress us with the idea of prodigious waste through dissipation of energy into space; but rather with that well-ordered self-sustaining action capable of perpetuating solar radiation to the remotest future."

C. H. Romanes.

PTOLEMÆUS.

[20288.]—Referring to Mr. A. S. Stanley's letter on above region (20236, p. 399), the following observations from my note book respecting the depressions on the floor thereof, and the accompanying sketch, made at the time, may be interesting.



FLOOR OF PTOLEMEUS APRIL.22ND 1866

"April 22nd, 1866. I obtained some good views of Ptolemæus, which was on the terminator, and was much struck by the irregularities of its surface. The principal crater, A, was, of course, most conspicuous. There appeared to be a wall, or low ridge, running N. of it, and also a mound to the N.W. The surface of the plain (generally as smooth as water) appeared much diversified with numerous shallow depressions (I can't call them craters), which were generally very large. It was difficult to trace out the smaller crater B, which stood between four of these hollows, appearing to be on the summit of a mound, and having four bright ridges running from it (after the style of Copernicus, but the ridges more rocky and high). I have never seen this appearance of the little crater before, always imagining that it stood on the smooth surface. This shows how careful we should be in not arriving at conclusions from a few observations. The appearance and sketch of the crater was confirmed by my brother William, who observed it some time, and drew my attention more particularly to the small mound N.W. of the principal crater. The small crater B could not be seen with a lower power than 225."

At the moment, I have an impression that this roughened appearance of the floor is by no means frequent, as I have generally seen the surface (even under very oblique light) perfectly smooth and unruffled, and it is only another of those instances which tend to strengthen a lurking idea always present in my mind of an obscuring medium on the lower levels of the moon. But further knowledge may alter these views. In any case, as the region is an interesting one, it should be well watched under different illuminations. I have, unfortunately, lacked opportunity of noting the locality with the superior means now at my disposal.

Herbert Ingall.

Champion Hill, S.E., July 14th.

SMEATON'S BLOCK.

[20289.]—In letter 20260 (p. 426) "F.R.A.S." scarcely does justice to the Smeaton block. According to the plate and description in Dr. Pearson's "Practical Astronomy," it consists of a wooden cylinder divided into two parts by an oblique section, as shown in Fig. 1—in this position it would be an *alt-azimuth*. If, however, the upper part B is turned half-round, as in Fig. 2, it becomes an *equatoreal*. A catch at *c* engages with another at *d*, securely locking them together when in position 2. Of course the angle of the sectional cut has to be so contrived that the upper surface of the combination shall be equal to the co-latitude of the place when at 2.

FIG. 1.

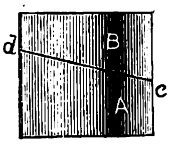
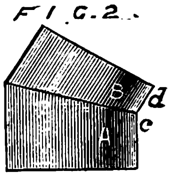


FIG. 2.



Leicester. **W. S. Franks.**

THE INDIAN CARPENTER.

[20290.]—His tools usually consist of an iron-bodied plane, about a quarter the size of an ordinary jack plane, with a piece of an old file hammered down thin for a blade; one or two chisels, these also usually made out of old files; a saw, like a very bad keyhole saw, but with the teeth made to cut the wrong way—i.e., when drawing the blade towards him: a rough fiddle-drill (this is his most useful tool, being the only one with which he can make a hole); and last, but certainly not least, an adze. Some lucky carpenters possess a screw-driver; but with the ordinary run this seems to be considered rather a luxury.

He has not the slightest respect for any of the tools he uses, and will knock out a plane-iron to make a scraper of it, or use a chisel if he wants a screw-driver, with the greatest complacency.

Once a year, however, his religion teaches him (I am speaking of Hindus) that he must go through a sort of consecration ceremony, piling all the tools in a corner of his house, and propitiating the god that presides over them with cocoa-nut and rice.

His usual position when at work is squatted on the ground, or on one end of a board on the ground, the rest of the board serving for a bench. He has an advantage in this position, as he is thus able to hold work between his toes if small, or with both feet if the piece is too large to clasp with his toe. In this our Aryan brother certainly has an enormous advantage over his English fellow-workman, as he can hold a chalk-line with his left foot and right hand, and strike it with the left hand, and use his feet in a thousand other ways, instead of calling some one to assist him.

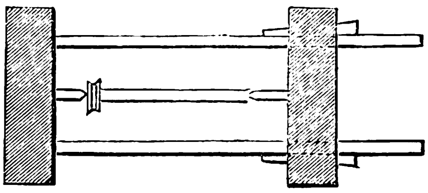
If he is made to work at an ordinary carpenter's bench, he will stand awkwardly at it until his foreman's back is turned, and then sit on it cross-legged as though he was on the floor.

Given English tools, it is usual for him to stick an extra handle to a jack-plane or a hand-saw, so as to get somebody to help him to pull it along. He attains great proficiency with the adze, and can leave work as smooth with it as from an ordinary jack-plane. Moreover, he can split a line with it quite as well as with a chisel. Hammer he has none; the reverse side of the adze doing duty instead.

Considering the tools he works with, it is perfectly marvellous how he can turn out such really good work. He usually combines cabinet-making, and will make furniture, or roof a house, or mend a bullock-cart with charming impartiality.

I am, of course, writing of the ordinary up-country carpenter, not of such as are usually to be found in Presidency towns or large works, where they will compare very favourably with English workmen.

I should like to describe his lathe. It consists of two blocks of wood, with an iron centre in each, connected together, by two pieces, about an inch square by 5ft. long. One block is fast to the connecting-pieces; the other slides on them, so as to be adjustable for different lengths of work. The following is a sort of rough sketch of the general arrangement:—The sliding-block is kept in place by wedges. His only turning-tool consists of a file-tang (I mean the end that goes in the handle) sharpened to a point. Another arrangement of lathe (save the mark!) is necessary if he wants to turn out a box, or any work that requires to be chucked. I had almost forgotten the driving-gear. However, to take an instance. Suppose he wants to make a round ruler. He will first adze the wood something like round, and then fasten it between the centres of his lathe. Having done this, he passes a cotton rope round it, anywhere about the middle, and gets a friend to pull the rope, first by one end and then the other, holding one end in each hand. This imparts a circular motion to it, and when it is moving towards him he will press the file end to it and so turn a groove at one end. Into this groove the rope is put as into a grooved pulley, and then the work is turned. When finished the piece forming the pulley is cut off, either before or after it leaves the centres. For very small work, such as pipe-stems, it is common to find a man turning the work round by means of a bow, the string of which is wrapped once or twice round the work, which bow he holds in his left hand, and the turning tool in the right; but this is only suitable for very small work. The Indian carpenter is a capital hand at copying anything which is given to him. I have recently had some excellent billiard-cues made, the butt being of a different coloured wood joined to the cue proper by what is known as a four point or star splice—not at all an easy thing to work, even with good tools. As a rule, I think, the Hindoo is not gifted with what we call a straight eye. He will deliberately nail a batten on a box, making an angle of 10 or 15 degrees with the side, and look complacently at it, wondering why he is made to pull it off again, and thinking all the time that the sahib is very hard to please.



To sum up my experience, the Hindoo carpenter is essentially lazy. He is not strong enough built to use English tools. He takes no pride in keeping his own tools in good order. For all that, if he is properly taught, he can turn out very good work indeed. As a rule, he is very sharp at picking up an idea, and the only wonder is that carpenter caste being hereditary, like many other Indian castes—once a carpenter always a carpenter—they are not better taught to begin with.

A Melting Mechanic.

THE FOREGROUND IN SKETCHING.

[20291.]—My thanks are due to J. A. Westwood Oliver (202, 275), although the question is still not entirely set at rest. I also procured Green's book, as advised by a previous correspondent, but it leaves out precisely the point at issue. Let the building, &c., be four fields off. I can sketch it thus, and delineate the four fields—i.e., the whole scene—from my feet, and put in at the latter carefully-drawn, detailed leafage; and so far all would be in some sense correct. But, practically, I don't want to draw the four fields, but to take such extent only as the natural sight comprehends when viewing the scene—i.e., what is included within an angle of about 60° in all directions—and this will not embrace the ground near my feet, nor, let us say, any part of the two near fields. I am not sure, but I think such scene *photographed* would be true to nature; but such photo. would give, I imagine, no detail of foreground, but the foreground would, by its composition and structure, have the appearance of being, as it really is, two fields distant from the eye, and the building would also appear at its true distance—viz., *four* fields distant.

The oft-advised rule of art is, I believe, "Draw what you see"; and in a sketch, "Take just what the eye easily embraces," or "Hold up at arm's-length the sketching-block, and include what it covers." But it does not in the case supposed cover the near ground, nor does the eye see it. Ought it to be drawn?

Country Sketcher.

A BLIND MAN'S VISION.

[20292.]—Under the head "Useful and Scientific Notes"—"A Blind Man's Vision," you have published (p. 398, July 7th) a note, the scientific importance of which I do not very well understand, as it gives no explanation of the related phenomena. My chromogerminator and vegetator, which you would not even mention, are, in my opinion, vastly more scientific, and, at the same time, useful. Indeed, the French Académie des Sciences is of my opinion in this respect, and was greatly interested by the presentation made by the *savant* Paul Bert, the late Minister of Public Instruction, of vegetables cultivated in lanterns glazed with coloured glass, which produced most startling phenomena. The learned body was also very much interested by M. Poey's communications of General Pleasanton's experiments in the application of violet-coloured light on the growth of animals.

But since M. Plateau's case has attracted your attention, I venture to write the following lines, probably useless, on the subject, which, in my humble opinion, will present a very scientific and useful interest.

Having read in a French paper a few words about M. Plateau's paper, which did not contain the details, I wrote to this learned gentleman a rather long letter on the subject. It being said that M. Plateau attributed his blindness to his having observed the sun with naked eyes, and that he advised astronomers and amateurs not to imitate him, that he thought that his retina had been paralysed by the action of the sun's rays, &c., &c., I informed the learned *professeur émérite* that I also frequently looked at the sun with unprotected eyes, and that then I could realise its sphericity, see the spots, discern their nucleus, their penumbra, the faculæ, &c.; that I could perceive what Father Secchi called the willow leaves, &c.; that after such observations my eyes were deeply insolated for a long time. That having carefully studied all the physico-physiological phenomena thereby produced, and the conditions of their gradual disappearance, I had sought for and happily found the means to de-insolate the eyes in less than ten minutes, by a process which, ten years ago, I communicated to the Academie des Sciences, where no attention was paid to it. I supposed that, had he been in possession of this means, most probably he would not have lost his sight. I persist in thinking that this discovery has a great value, the more so as it has just led me to another still more important, of which I will say a few words presently.

M. Plateau, still experiencing some effects of light, and precisely those naturally produced on sound eyes by insolation and complementary colours, I am of opinion that his retina is not entirely paralysed (if at all), else he would not feel any light sensation. Very likely his blindness is caused by some matter which prevents the passage of light from the cornea to the retina, it being interposed in the vitreous humour contained in the hyaloid or choroid membrane. I informed M. Plateau of a case of cataract completely cured by electricity. I mentioned my unsuccessful experiment upon the eyes of a French gentleman who, in Mexico, had become blind quite suddenly in an excess of anger, which caused an instantaneous amaurosis. Electricity produced some brightness (*clarté*) in the eyes, sufficient to enable him to distinguish, by their respective and differing *colour*, the positive from the negative poles, but sight could not be revived; which proved that, in this case, the retina was not absolutely paralysed, but that the optic nerve was either paralysed or ruptured. I called his attention to the different sorts of amaurosis, gradual or sudden, partial or total, caused by atrophy or by hypertrophy, in which cases the colours which first become insensible are reversed, &c., and the cause thereof. I advised him to try a peculiar application of electricity, &c. The learned gentleman had the kindness to acknowledge the receipt of my letter, and to send me thanks, but said no more.

Since this, a new fact occurred to me after my observation of the eclipse of the 17th May last. This brought the, to me, great discovery of the real cause of M. Plateau's blindness, and, at the same time, of the powerful action of the magnet upon the circulating fluids and liquids of the human body, which action is most likely to produce the cure of hitherto incurable diseases of the eyes. The action of the magnet on the eyes is wonderful; no doubt, that when known it will become a great therapeutic agent. I am now writing a paper to be sent to the Académie des Sciences on the subject. I might send you a copy of it. I would write it in English if it had any chance of being inserted in the "E. M.," but will not take the trouble if it has none.

Ch. Rabache.

Morchain, Somme, France.

MR. SCOTT-RUSSELL AND THE VIENNA DOME.

[20293.]—The way in which the subject of the expansion or non-expansion of Scott-Russell's structure has been handled by your correspondents, puts me in mind of the story of a certain king asserting that a glass globe full of water weighed the same with or without fish in it; all his courtiers demonstrated how this happened, and proved him to be right—which he wasn't.

I don't hesitate to answer for Scott-Russell that he never by anything he may have said about his dome, or any other iron structure, intended to imply the least particle of doubt of the fact that railway metals expanded on increase of temperature when they were laid as a track; or that they could be linked in, as it is termed, without "expansion," being left between the ends of the rails. Railway engineers have not now to learn the truth of this.

"J. J. A.," another correspondent, will have it that it is easy to understand (?), in the case of a "dome," that the expansion would rather be upwards (!); and Mr. Oliver winds up his views with the belief that "bending" (!!) may possibly account for what is supposed to happen, or rather *not to happen.*

As this latter gentleman defers the discussion of the question to some future opportunity (if ever), it will be well for him, and all who may be drawn into the consideration of this subject, to start with at least one common *fact*, and that is, that the so-called "ring" is *not a continuous length* (one piece) of metal, which, an' it were, would itself have put an end to all opposition and discussion, by expanding in the direction of its length, and consequently in the dimension of its diameter also, on being heated.

The "ring" was built up of plates in sections, in Belgium; and after arriving on the ground, was put together in the form of an endless girder of about 5ft. deep (as near as I can remember), and with heading joints enough, in all conscience, to allow of *local expansion or contraction*, without interfering with the total length of it. This sort of compensated expansion happens in other and straight girders, according to construction, and is *nothing new, after all*, to practical men.

Let me add, for the information of readers who may not be acquainted with the particular construction of the roof in question, that the "ring" is a made-up band of iron plates on edge, acting as a foot to the thrusts of straight iron rafters; or the "ring" may be considered as an endless tie for a series of "principals," the upper ends of whose rafters butt against another much smaller ring at a higher elevation, and upon which an observatory was constructed. The spaces between the rafters are filled in with deeply-indented panel work. The ring was put together on the ground just inside a series of wooden stagings, and *lifted* up as a whole by large long screws made for the purpose at several lifts, and when at the proper height, was held until the iron supports were built under it.

Now that the name of Scott-Russell has come up as it has, Mr. Editor, I am very desirous of "improving the occasion" in another way. I wish to beg that some one of "ours" who may, perhaps, know the story well, will tell us how this giant intelligence — this constructor of colossal ships, and other engineering works of cyclopean dimensions, years ago raised the nearly defunct Society of Arts to healthy life; and, by his own strong will and almost unaided effort, got together that little exhibit of wares in John-street, Adelphi, in 1849, which, undoubtedly, was the parent of the great "Exposition in Hyde-park in 1851," and, consequently, the direct ancestor of all the rest of those other expositions that followed fast and follow faster.

There may happen one of the associates of this great man among "ours," or some one, perhaps, of his immediate assistants of that day, who can tell us what Scott-Russell did in the week before the opening of the "conversazione," as it was modestly called, when, because of the little or no response of "home manufacturers," to the invitation of the "Society" to send in exhibits, absolute failure stared in the face of all concerned in the venture. Can we not learn the precise circumstance of how Scott-Russell, with two helpers—(all honour to them, and their names are world-renowned too), it being too late to work up the country people—started out in London in four-wheel cabs for three whole days, from early morn till late at night, almost *demanding* exhibits; and by personal "entreaty"—(yes! that's the word he used) Scott-Russell and his two friends induced, among others, London *tradesmen who were not even manufacturers* to send, as well as to allow them to fill their cabs many times a day with, goods and exhibitable things from among their wares.

Not only was enough obtained in this way to avoid all appearance of failure, but as much was actually got together as there was space for in the exhibition rooms to exhibit comfortably, and success crowned this first desperate attempt at exhibition.

One more item, Mr. Editor, if you please. Some of your readers may have been visitors at the show I have just referred to, and may probably remember that just before its close a little green baize-covered table, having a roll of paper set out to receive signatures, appeared just where a lecturer would now stand to address an audience. I well remember the paper remaining a whole day with something like a dozen names appended; and *this* was the petition of the Society of Arts and the public to H.R.H. the Prince Consort that he would graciously take the lead in the promotion of a "World's Exhibition," proposed to be held somewhere in London two years after date, or 1851, declaring that such an exhibition was necessary and *rendered possible in consequence of the very flattering way in which exhibitors had come forward,* and the public had met them, at this John-street Exhibition.

"Leviathan" was an appropriate name for the big ship, and the iron roof at Vienna is the largest work of its kind in the world. But, to my mind, the biggest thing Scott-Russell ever did, and that which has had the most influence on mankind at large, was the infusion of new life into the Society of Arts, and afterwards making a success of that little show A.D. 1849, and thereupon moving for the larger one in Hyde Park in 1851.

Now! Who of "ours" can give us details of the above interesting incident in Scott-Russell's life? **J. W. W—s.**

THE JUBILEE OF THE LEICESTER AND SWANNINGTON RAILWAY.

[20294.]—ON Monday last (17th inst.) the town of Leicester enjoyed the advantages of railway communication for a period of fifty years.

Upon the 17th of July, 1832, the Leicester and Swannington Railway (which now forms the oldest part of the Midland system) was opened; and although it does not appear that any festivities will take place upon the fiftieth anniversary, still an event of such interest both to the town and the engineering world should not be allowed to pass without, at least, some mention.

Clement E. Stretton.

Saxe-Coburg-street, Leicester.

RAILWAY SIGNALS—TO H. STOOKE.

[20295.]—WOULD not the signals be safer if the arm were weighted at one end, so that if the rod connecting it with the lever and weight at bottom of post broke, the arm would keep at danger? Also, the coloured specs to be fastened to the arm instead of worked lower down by the rod, as they frequently are? I think the arms, when lowered down to 85° are more likely to work to "danger"—that is, to go to the horizontal position—than when lowered to 45°, as the lower the arm is the more impetus it has to fly up to that position when required. I see on most railways the "home" and "starting" signals are worked clear to 45°, while the "distant" nearly any position between about 25° and 90°. Would it be any practical use to coat the arms with "luminous paint"? **G.**

[20296.]—MR. STOOKE'S gentle comment upon the present state of signals is very true; but it is correspondingly true that the progress of improvement is proportional to the intensity of man's necessity. At last it is found essential that these signals be governed by a more rigid rule than has hitherto been observed, and steps are being taken to bring them to the present state of scientific accuracy. Now it is evident that it is essential for these signal-arms to distinctly indicate danger, clear, and no signal, then why not divide the quadrant into three distinct divisions of 30° each, say, from zero to 30° danger, from 30° to 60° clear, from 60° to 90° no signal. This we venture to think would be a more uniform division than the one before us, which has called forth these remarks. And in all cases we should advise the degree being opposite the centre of the arm. As for the arm being above the horizontal, this should be avoided, and the movement so constructed that it cannot rise above zero. The mechanism which regulates the arm ought to be so arranged that the arm will fall from zero to 15° then from 15° to 45°, and next from 45° to 75°, thus clearly indicating each signal, and avoiding all confusion. **A. Manock.**

[20297.]—IN the ENGLISH MECHANIC, October 21st, 1881 (letter 19338), there is an account of General Hutchinson's report upon the Bow-road accident, of which the principal cause was the negligence of the signalman in not putting on the signals. Now, I had some time previously stated that neglected signals might be avoided, and at the Exhibition of Life-Saving Appliances there are many inventions for railway purposes. I have placed a working model before the public as per advertisement, which appeared in your columns last week. In the adaptation of my apparatus I do not interfere with the locking arrangements in the signal-box or the block-system.

The signalman takes "off" the signal in the usual way, and can place it back to "danger" with his locking lever at any moment; but should he neglect, no ill consequences can ensue, as the train in passing the apparatus has put "on" the signal notwithstanding the "off" position of the signal lever in the locking frame; thus, every train sets its own "danger signal" for any length of time until taken "off" by lever in box. Electric contact apparatus can be connected to give notice to signalmen of an approaching train, or an electric catch could keep the signal in the danger position by preventing the mechanism being actuated *from* the danger position by the signalman himself until the train had passed a certain section of the line.

It is mechanical in construction, and its action could be horizontal, vertical, or segmental, as most convenient; and its release could be caused by an arm, treadle, or other projection being acted upon by an arrangement to the engine or the pressure of the wheel.

The invention is patented in this and other countries, and is approved by practical railway men, to whom it is quite a new idea for signals.

John Harrisson (Inventor),

July 11th. 185, Well-street, Hackney, E.

ON THE ABERRATION OF A PARABOLIC SPECULUM.

[20298.]—MR. WASSELL'S interesting letter sets at rest all doubts respecting the true rule for calculating central error. I see I have mistaken Dr. Hastings' meaning about the difficulty of finding the point C. He is alluding to the focus, whereas I took it as referring to the radiant point. Mr. Wassell says there is great difficulty in finding the focus of the central rays, on account of their small angular intersection. Dr. Hastings evidently refers to the same thing. I am glad, however, that my mistake has caused Mr. Wassell to investigate the effect of a slight variation in the position of the pinhole. He has most conclusively shown that no extreme care is needed in adjusting the place of the lamp.

On referring to my original formula, I find it gives the error due to any position of the radiant point. Neglecting powers of y greater than the square, it is;—

$$\frac{fd}{d-f} + \frac{y^2}{2} \cdot \frac{1}{d-f}.$$

In which d is the distance of the pinhole from the mirror, and f the focus for parallel rays. The first part is the conjugate focal length; and the second, the increase in it, due to aberration from aperture. Now, if $d = 2f$, the aberration is evidently $y^2/2f$; but if $d = 3f$, then it is $y^2/4f$, or the same quantity as Draper gives. The focal length in this case is shortened to $f \times {}^3/_2$.

We may now lay aside theory; and as Mr. Wassell has been furnished with so many excellent specula, he will doubtless have much interesting matter in store for us. I can assure him that it is a pleasure to me to find that my investigations have been of some slight service in the intricate and delicate operation of parabolising a speculum.

Before closing this letter, I will add a few lines containing the opinion of "Prismatique" on this matter. He says:—"With regard to the aberration of a mirror, the difficulty of finding C is equal, to my mind, in the case of both o.g. and mirror: it is certainly a variable point. Thus, if I test an o.g. on luminous point, and a pencil of rays is long in centre of annular out-of-focus disc, I feel sure that when figured to bring all rays to a point, A is not brought to B, or *vice versâ*; but a point between the points A and B is produced. (A and B are the central and marginal foci). Suppose this has caused a zonal error of very slight measure, but sufficient to produce a diffraction ring; when the glass is again figured for this—that a fresh position for C is produced—I am certain.

"As the conditions are exactly the same, to produce good definition in o.g.'s and mirrors, as to ray paths, I think you will agree with me, that even if the zone test proves practically successful—and I feel sure it will—final testing on a star, with all the surface at once, will not—in fact, cannot be, surpassed. If the appearances are understood, sections of the cone of rays in a diagram will certainly help the amateur."

July 10th. **Orderic Vital.**

SMALL DYNAMO-MACHINES—MOTOR FOR TRICYCLE.

[20299.]—I BEG to inform Mr. A. H. Allen, Sheffield, that I make small dynamos as I described on page 354, No. 900, for laboratory use, from the power of one cell upwards. Such a machine as I described is no infringement on any patent. The most I have done with the I armature is to heat to redness 12in. of platinum wire. Of course this is on the "Shunt System," and this is the only kind that is of any use for experimental purposes, as it will work bells, motors, induction coils, and perform every experiment equal to an equivalent number of Bunsen or Grove cells. A machine on the circuit system will not operate on instruments which have an interrupted circuit, such as bells, motors, and induction coils, and to meet the wants I make them on the "Shunt" principle, unless ordered otherwise. We have had some capital notes on dynamo-machines, but it is like throwing pearls to swine. I make this remark on account of over 200 letters which I have received, asking questions concerning my small dynamo—whether it would light 1, 2, 4, 6, 10, and 20 Swan lamps of 10 and 20-candle power, or an arc light of 1,000-candle power. If our valuable correspondent, "E." and others would send sizes, &c., of parts of dynamos instead of these mathematical calculations (which are only understood by one in a thousand) it would be a great boon conferred on us. We have had too many problems. We want something between this and those melancholy replies.

I consider a machine to light one incandescent lamp of 16-candle power is an instrument of torture. I have never recommended them. What possible use can they be to work by hand-power, when one lamp takes about an eighth of a horse-power; and a man has to exert his *full strength* to get a glimmer. The game is not worth the *candle.*

The small dynamo I described is equal to one cell; will do for depositing, charging electro-magnets, &c. The wheel-gearing is for multiplying the speed; although the mitre-wheels are of equal diameters, the flywheel revolves two to one of the handle. The commutator is made of one piece of brass tubing (not of four pieces).

Motor.—Some months since I mentioned I was making one for tricycle; it was made, was very powerful with two Bunsen cells; sure eight cells would do the work when I was constructing it. I knew it would do as a dynamo. Having tried by means of a gut from a foot-lathe flywheel, I heated a foot of wire; so pleased with it, use it as a dynamo; have no time to apply it to a tricycle; am too busy with dynamos. This motor *replaces* several Bunsen cells, and is now my only *source* of obtaining a *quantity* current.

Some person has written to me stating that my description of the small dynamo is an advertisement. But, as I have sent a full description of it, I am exempt, according to "O. S." Perhaps Messrs. Patrick and Son (page 405, last week) will send a full description of their machine; they have stated all it will do. Now, if they will do as I request, their letter will not be a gratis advertisement. **George Tolman.**

[20300.]—I SHOULD be pleased to read a letter from anyone who has fitted up one of the small dynamo machines referred to in letter 20253. I am sorry to have to doubt "Patrick"; but a machine to produce as much current as would require 40 quart Bunsens to be driven by one man is altogether past my belief. I can only repeat what I have said before—that there is at present no machine to be driven by hand capable of really good work. Of course I am open to conviction, and nothing would please me more than to see such a machine, driven by one man, giving a current equal to 40 quart Bunsens. I don't want a statement as to what a machine should do; but I want a statement from someone who has made such a machine, and has been able singly to light and keep lit for half an hour 4 Swan 10-candle lamps.

W. J. Lancaster.

A NEW FORM OF STEAM-ENGINE.

[20301.]—IN reply to George E. Wood (letter 20270), I should be glad to be informed in what manner the 20 per cent. gain is realised, in favour of the "*new form of engine*," seeing that it is admitted to be = to 42 H.P., and the engine against which it has been tested is only 36·5 H.P., both theoretical calculations, showing one to be by 20 per cent. the larger engine, according to his own figures the actual H.P.'s, as tested by the brake, appear to be in the same proportion as the theoretical calculations. *Where, then, is the gain of 20 per cent.?*

The arrangement appears to be so absurd that it is difficult to understand how it could have been entertained, except as a curiosity, seeing that it has double the number of working parts, and the cylinder, weighing 9 cwt., working upon guides, adds a serious amount of friction which does not exist in a stationary cylinder; and the advantage claimed for the cranks being placed at an angle is not realised, as their throw is only one-half of the ordinary type of engine, consequently at the full point only half the power of engine is exerted; therefore, it cannot be credited with the advantages of a double cylinder-engine. Why the foundations should be of less strength is also difficult to see. **H. A.**

THE VIOLIN MUTED.

[20302.]—I CANNOT admit the idea that a light mute placed on the bridge of a violin has a greater effect than a heavy mute, p. 405. It is not the weight, but the pressure, that makes the sound weaker. At first thought, most persons would say the vibration was less or smaller, but the oscillation, or to-and-fro movement, in the middle of the string remains the same either with or without a mute. A wood mute is as effective as brass, so that mere weight (if we could get it without pressure) would not mute the violin. It is known that the slightest pressure on the belly, away from the soundpost, reduces the tone. Yet the bass bar (a strip of wood under the left leg of bridge) is put there to increase the resonant qualities of the soundboard, and is a remarkable instance of adding weight without pressure. Adam was not more surprised at the first sunrise than I when I heard a muted violin. It seems easy to conclude that if the violin is muted by pressure on the bridge that, *per contra*, making the pressure less must increase the sound. Here a great problem stares us in the face, how to produce this pressure without weight, or weight without pressure, for tension represents both weight and pressure; that is, it is dependent on them either in the present application of them, as in a strained drum, or in the natural condition of a piece of wood, which wood possesses tension without the addition of extra weight. It seems easy to suppose that if we fine down the wood we shall ease the pressure. True, but we lose the normal weight which produces the tension. I presume that the Berliner violin is constructed to remove the pressure of the downbearing of the strings without lessening the inherent tension of the body. How do we know what tension or capacity for producing sound there is in a piece of wood? A long piece of wood has more weight and less tension than a short piece, and a thick piece than a thin piece; size has to be considered. And to produce the best result the soundboard should be short and thick enough in the treble, or long and thin enough in the bass, to return the vibration of the strings. We fine down the wood to make it return the motion or pulsations of the string, and add weight to the sides and back to make up for the lost tension; but I think that the sides should be free (this is partly remedied by the *f* holes in the violin), and the lost tension applied to the soundboard itself (this is partly represented by adding the back to belly by sound-post). Now, if Mr. Berliner can reduce the pressure and yet simulate tension (this cannot be done with a chin-rest) in various parts of soundboard to suit the different strings, it will be a grand thing. Now, will he do me a favour, and try, instead of putting off the weight of metal resonator through the breast at the treble end under the finger-board, will he use the *f* holes as means of communication between back and resonator, leaving the breast free and untouched? Less weight would be required with greater power of control, and, I think, an additional tension. **Fiddler.**

THE BERLINER VIOLIN.

[20303.]—Mr. Schucht, page 405, says of the Berliner improver that he believes it to lower the value of any violin it is put on. This is so sweeping a conclusion, that I think it ought not to pass unchallenged.

I described in a former number of the "E. M." a simple way in which anybody might try the effect of this adaptation on his violin; and I then and now maintain that whilst it does not benefit the tone of a really good instrument, it vastly improves the tone of a cheap violin. E. E. Fennessy.

LANTERN-SLIDE OUTLINES.

[20304.]—An easy method: Coat a glass with negative photo. varnish, the glass to be cold; it will dry quickly. When set, lay on the glass a bit of carbon-paper the size of the glass; then lay on the carbon-paper, your print, drawing, or copy, and go over the outlines with a smooth, fine-pointed, bone tracer; be particular not to bear on too hard, or the varnish will leave the plate. Outlines may be traced on the clear glass in this manner. Carbon-paper must be of the fatty kind. I have tried both methods and succeeded.

W. H. Gardner.

FORECAST AND PERIODICITY OF STORMS.

[20305.]—The solar system obeys the law of periodicity. The earth obeys the law in its annual and diurnal revolution. The motions of the moon are periodical. The ocean tides are periodical. Is the ocean tide gathered up at new moon? Then the more mobile and vapour-laden air is proportionately displaced; and it may be that an atmospheric tide exists governed by similar laws. When the moon is at quadrature, or ninety degrees from the sun, both of these bodies are exerting their forces at that angle, neap tides ensue, and where the water flows out the atmosphere flows in, thus the atmosphere is subject to periodical disturbance. The Polar current is influenced by the same causes in some degree. Similarly, the Gulf Stream is at times retarded, and at other times its flow is accelerated. The Gulf Stream leaves our coasts and imparts its warmth to us. The Polar current engages with it, and they modify each other. The air current most prevalent with us coincides with the direction of the Gulf Stream. This air current obeys the combined forces of sun, moon, and tide.

Depressions float over us in this air current, sometimes exerting little force, at other times the depressions are in rapid motion. As the storm period approaches us small depressions are borne up from the Atlantic ocean, and oftentimes they pass to the North West of us, but gradually the current of air in which they travel is deflected, so that the largest depressions pass over these islands. The weather in the British islands oscillates about a certain average standard; hence the old saying, "be it dry or be it wet, the weather will always pay its debt." Here, too, the natural law of compensation, or balancing, comes into play; thus a series of rainy years is balanced by brighter years. Here let me call attention to article, "Saltness of the Sea," p. 395, English Mechanic, No. 902. "The tables show that the neighbourhood of the American coast gave waters very fresh and icy, which are suddenly replaced by hot and very salt waters when the Gulf Stream is entered; then as the route of steam-packets goes along the great bank of Newfoundland, one passes from the current to find anew the fresh and cold waters; these being succeeded by the average water in which navigation continues to European seas. Again, M. Bouquet de la Grye says—"We find under the tropic of Cancer a depression of two metres, and near the United States a considerable surelevation in some cases exceeding four metres. Thus, we have a difference of level of six metres between two points of the same ocean." Now, if we grant the above statements to be true, and I know not how to controvert them, it is evident that a vast salt water-trough, as it may be called, passes from the northern tropic to the frigid zone. This warm salt stream subject to a glowing sun heat during our summer solstice, may evolve large quantities of electricity to be carried by the cloud currents in an eastward direction. And may not the moon, by her power of attraction, deflect both Gulf Stream and air current at the periods of new and full moon? And as cause precedes effect, may not the attraction of the moon retard the flow of air current as well as cause spring tides? In such a case, would not the air-current rush onwards again as the cause of retardation was removed, which would be as the moon neared quadrature? The severe gale of the 14th of October, 1881, when pressure of 53lb. on the square inch was registered (vide English Mechanic, No. 902, p. 413) came seven days after full moon. The gale on the 26th and 27th November, following at an interval of 43 days, or what I term a double period, came five days after new moon. The depression which reached its minimum, April 13th, 1882, came five days before new moon. The depression, April 29th, sweeping along with a velocity of 50 miles per hour, and a pressure of 49½lb. per square foot, came four days before full moon. The depression, May 25th, came when the moon was at quadrature and apogee. The depression of the 9th ult., came within one day of moon's quadrature. The depression of 7th inst. came one day before quadrature. A series of depressions, bringing wind and rain, will begin to move after new moon on the 15th inst., and arrive as the moon nears the quarter. Other depressions will come to us attended by rain a few days before new moon on 10th proximo, and again a few days previous to full moon, 28th proximo; but probably August will be a better harvest month than August, 1881.

I beg to thank my kind advisers, who practically say "Don't say anything about the weather, for you don't know." W. H. Gardner.

GAS-ENGINES—EXPLOSIVES.

[20306.]—Referring to letter 20274, where Mr. "Ll.B.A." makes some calculations showing the power of gas-engines and of chloride of nitrogen, he considers this subject of great interest; and truly it is so, not only in respect of the calculations connected therewith, but also with respect to the anomaly which I shall show appears to exist in the behaviour of the said chloride. I said, in letter 20221, that I thought it likely that some form of nitrogen would become "the power of the future." In this anomaly (I consider) the germ of that power exists, and I now proceed more fully to explain.

Now, as a source of power, heat is universally considered, either directly or indirectly, as the agent, arising from the chemical combination of two or more elementary bodies; but in the case of power arising from the explosion of chloride of nitrogen, instead of combination—decomposition, resulting in the reproduction of the elements N and Cl takes place; whereas, in the ordinary way, if it is desired to produce an elementary body (or unburn a compound), it is found necessary that a chemical equivalent of some other element should be burned; or otherwise, this regeneration is largely effected in nature by the action of the sun.

Now, this property, which seems to belong to nitrogen exclusively (or perhaps to chlorine in some degree), namely, regeneration, holds out the prospect of a perpetual power, without expenditure of fuel, seeing that combination and decomposition both take place *so far as appears* without that expenditure. Imagine that by applying a match to some water, that it immediately expanded into its component gases—hydrogen and oxygen, this would be a similar case of regeneration, inexpensively. Not but that the affinity of hydrogen and oxygen is greater than NCl_3, but yet the affinity of this chloride must be very considerable, seeing that a pressure of 200 atmospheres is required for the liquefaction of nitrogen, and that also chlorine requires great pressure for its liquefaction.

There are two causes which give rise to explosions, and gunpowder may be taken as a type of the joint action of these causes. When a highly-combustible element is intimately mixed with the element required to complete the combustion, a certain degree of quick burning or explosion ensues; but when nitrogen enters into the composition, the explosion is very much intensified, and thus there results a combination and a decomposition explosion united.

It may be observed that nitrogen enters very generally into the composition of explosives. Witness gunpowder, gun-cotton, and allied vegetable bodies acted on by nitric acid; and also the metallic fulminates; and nitro-glycerine includes animal substances.

But let us look a little closer into the behaviour of the chloride of nitrogen. In the process of its formation, where has the latent heat of the absorbed gas gone to? Then, again, in exploding, where has the latent heat of the two gases been obtained from so suddenly? Surely, not from the containing vessel. If we can imagine electricity to be only another form of heat, and "the ether" another form, and suppose that nature really does abhor a vacuum, and that "ether" penetrates all bodies as does the magnetic fluid, then we may possibly account for the great additional space occupied by the original body.

I will now leave this theory to be taken for what it is worth, believing that the exposition I have made of the anomaly referred to will furnish materials for the speculations and investigations of many other correspondents, and designs for the practical application as a motive power.

With respect to the power developed by the explosion of chloride of nitrogen, and calculating only on the ½-volume of nitrogen at 200 atmospheres, this equals 200 × 15 × 144, or an initial pressure on the square foot of 432,000lb., or that number of foot-pounds for 153 grammes of NCl_3, and giving the chlorine gas credit for nothing. This is enough to show that the proper average pressure would be something very considerable, and would answer to a result such as might be expected.

Barry-road, S.E. J. H. Huxley.

COLOUR—PHILOSOPHER'S WHITE, &c.

[20307.]—Having myself been "put down" in the "E. M." (No. 886, p. 79), for venturing to doubt the correctness of the modern blue-and-yellow-making-white theory—and doubting still—I am very pleased to see Mr. Calton reopening the subject, and am anxious to see what the critics have to reply to his arguments. I hope they will be replied to in a more temperate tone than last year, when one infallible presumed to dispose of the whole matter by saying that the whole question had been "thrashed out."

They may be sure that I, and Mr. Calton, too, have but one object in view—the truth; so I will supplement his remarks by a few of my own.

Tyndall's experiments in proof of the modern theory are described in his "Lectures on Light," delivered in America. I will therefore take him as the exponent of the theory, and Longman's edition (1873) of the lectures as a text-book. His popular lecture experiment, of taking two tanks of coloured liquids, one blue and the other yellow, with the different results obtained according as light was passed through these from one or from two separate lanterns, has been so recently publicly repeated, that I will take it for granted that the theory remains exactly as laid down by him in 1873.

I gather that the pigments or colours employed by him are (lecture I., p. 37) ammonia-sulphate of copper for blue, and picric acid for yellow. Whatever they may be, the experiment is a striking and apparently successful one; superposed in one lantern, a green disc is thrown on the screen, passed through the prism (p. 37), "the green band of the spectrum alone remains on the screen." When, however, the two tanks are placed in separate lanterns, and the two coloured discs made to overlap, the commingling of the blue and yellow rays is found to be white instead of green, as one would have expected. I will not even quibble about philosopher's white, but allow, for the sake of argument, that it is to ordinary eyes a good honest white. More, that it is white; that no spectroscopic test I know of will detect anything else. Still, to my mind, it *proves* nothing, for I read (still p. 37), "no natural colour is *pure*. . . . A blue liquid permits not only the blue to pass through it, but a portion of the adjacent green, &c." So we have two acknowledged *impure* colours producing white.

It is an experiment I have performed myself repeatedly with the greatest success; not in public, because I know the fallacy of it. It is so self-evident, because almost any blue and any yellow give satisfactory results if one is satisfied beforehand that blue and yellow make white. The recomposition of white light by the spectrum colours is another lantern experiment which cannot fail. Take any sort of coloured gelatines, anything near the colours, and arrange them on a disc so that they can be revolved rapidly in the lantern; all colour disappears, and a white disc is obtained. I have such a disc, and have often shown it: the colours are absurdly false, scientifically speaking; but I could have sold it over and over again if I would have lent myself to what I *know* to be an imposture.

Our critics, however, will say it has been done with the solar spectrum. That is exactly what I want to know: how, when, and where? I turn back to the same lecture, pp. 30-31, and find an experiment described in which, by a system of lenses and prisms the spectrum is separated into two coloured rectangles, and that "by judicious management one of these colours is rendered *yellow*, and the other *blue*. I withdraw the thin prism; yellow and blue immediately commingle, and we have *white* as the result of their union." This, then, is the proof of the fallacy just exposed by Helmholtz, "that the mixture of blue and yellow lights produces green."

By Tyndall's own showing, what he here *calls* blue and yellow, contain between them all the colours of the spectrum.

I feel most deeply the enormity of the heresy which allows me to call in question Tyndall's usually clear and cogent logic, and am quite ready to be convinced of my error, if error it is; but will first put on record my own explanation. The eye cannot distinguish between yellow and orange. What we call yellow is red and yellow—that is, examined by the spectroscope, it allows the red rays, or some of them, as well as the yellow to pass. *Exp.*—Take a deep ruby gelatine film, one which, spectroscopically, would be passed as safe for gelatine dry-plate work, superpose it with a tolerably deep yellow film (which should cut off any blue rays which *might* pass through); look at the clouds, or any diffused light, and a deep red will be the prevailing impression on the retina; then look at the sun—every *trace* of red will disappear—the impression will be *yellow*.

In the two Tyndall's experiments in question, all the elements of white light are present; in the latter one confessedly, in the former so probably as to amount to certainty.

The question arises, What are the elements of white light? The Brewsterian reply is: Red, yellow, and blue. The modern reply: An infinite number of rays of different refrangibility. Common sense is, generally, so safe a guide that it cannot be ignored, and, therefore, I must incline towards the Brewsterian theory, the more so as, to my mind, it explains the results of the experiments under consideration. Without, therefore, absolutely committing myself to it—for I confess there are points still far from clear—let us see how far it goes towards clearing up No. 1 experiment.

If, then, red, yellow, and blue are the three primary colours, and the yellow allows ever so little red to pass, supposing the blue to be *perfectly pure*, when the two discs are made to overlap we shall have a certain amount of the three primary colours combined on the screen, and in that due proportion we shall have their equivalent of white light. Now take the other side, and suppose that pure blue and pure yellow are complementary colours, and that their commingling produces *white* light, no matter how impure the colours or pigments may be, as far as their *equivalents* are present, an *equivalent* of white light must be produced. By all accounts, then, some white light would be produced. What becomes of the remainder? *Exp.*—Take a coloured disc which can be made to revolve rapidly in the lantern; half-way between the centre and circumference remove the colour from a small portion of the disc (a coloured gelatine film or glass is an easy way of trying the experiment), what happens? We have a uniformly tinted disc, over which light is passing. Supposing the space from which the colour is removed is 36° (i.e., one-tenth white light and nine-tenths colour), the one-tenth of white light will be quite sufficient to destroy all trace of colour to the eye. The impression formed will be that of a white ring on a coloured ground.

Now, in Tyndall's experiment, may we not suppose that, from the acknowledged impurity of natural pigments, the complementary spectrum colours may by accident be present in their respective equivalents to the extent of 10 per cent. If this is so, this in itself would be quite sufficient to account for the apparent purity of the whiteness of the overlapping portions of the discs. There is, however, another element of error. For a film to stand the spectroscope, it must be pretty deep in colour: otherwise the spectrum will be, more or less faintly, visible throughout. But a film in the lantern would not produce, on the screen, such a brilliantly-coloured disc as would be desirable for an audience. The argument may be used against me; but nevertheless I uphold that, up to a certain point, a mixture of white and coloured light seems to be necessary for brilliancy of colour. Is it not, then, probable that each coloured medium, in addition to its contribution to the equivalent of complementary colours, may allow a *trifle* of unabsorbed white light to pass? Each then *may* allow a little white light to reach the screen. Add to these two increments of white light the equivalent of the complementary colours present, and it is no longer astonishing that an apparently brilliantly white disc should be the result.

George Smith.

USEFUL AND SCIENTIFIC NOTES.

Recent Progress in Telephony.—Some important telephone results have been lately obtained by M. van Rysselberghe, the Belgian meteorologist, whose very ingenious meteorograph was shown at the Paris Exhibition last year. He has succeeded in eliminating from telephonic communication through a wire the inductive action of a neighbouring telegraph wire (which gives a crackling kind of noise in the telephone). Moreover, he can employ the same wire at the same time for both telephonic and telegraphic work. Thus, in a recent experiment, a message was sent from Brussels by the Morse telegraph to the directing engineer of telegraphs in Paris, and an oral message sent by telephone was distinctly heard, while the Morse rereiver was in action. Paris is 344 kilomètres wire-length from Brussels. Among other recent telephonic connections we note Venice and Milan (284 kilomètres), Berlin and Hamburg (288 kilomètres), Paris and Dijon (314 kilomètres), Paris and Nancy (353 kilomètres). At the forthcoming exhibition in Munich, telephony is to be tried between that town and Dresden, a distance of 550 kilomètres (or about 343 miles). American accounts report experiments in progress as to what may and what may not be done in telephony on underground wires; a cable for the purpose having been laid by the American Bell Telephone Company along the Boston and Providence railroad. There are 21 rubber-covered copper wires within a lead pipe, ten of these being also covered with tinfoil to carry off extraneous induction currents, while ten are twisted together; the 21st wire is covered with cotton and paraffined. A French naval committee has lately reported on the use of the telephone in diving operations. The transmitter approved as best is a small flat circular telephone, having interiorly two spiral magnets superposed. The Gaiffe telephone as receiver gives good effects. Microphone (doth the ordinary microphone and the Ader) are pronounced less advantageous. A comparison was also made with the ordinary speaking-trumpet, which proves inferior to the telephone, expecially as the depth increases (owing to effects of pressure on the membrane in the case of the trumpet).

Poisoning Insects in Herbarium Specimens.—Baron Thuemen highly recommends the following method:—Have a box made of rather stout tinned iron, which is a trifle wider and longer than the size of genus-cover used in the herbarium. About 1in. from the bottom, a ledge is attached all around the inside; and a tin gutter runs all around the upper edge on the outside. The depth may be adjusted to the requirements of the herbarium; under ordinary circumstances, it need not exceed 24in. to 28in. The box is provided with a cover fitting into the gutter, around the upper edge. When the box is used, a flat vessel (plate, &c.) is placed in the bottom and filled with bisulphide of carbon; a diaphragm of wood or other material is placed upon the ledge, and the specimens of plants, either freshly collected or taken from the herbarium, in their paper covers, laid on top of the diaphragm. The whole box may be thus filled, and it is not necessary to take the plants out of their covers. Finally, the cover is put on, and the gutter filled with water, so as to form a water-joint to prevent the evaporation of the bisulphide of carbon as much as possible. The liquid soon volatilises in the box, and thoroughly penetrates every specimen. Being highly poisonous to the lower animals, it destroys any that may be present, and after a few days, when the cover is taken off, and the plants taken out, they are most effectively "poisoned." The bad odour arising from the fumes of the bisulphide is soon lost by evaporation.

Anti-Fat Dietary.—To those who wish to get some of their superfluous flesh off, perhaps the following anti-fat dietary given by Dr. George Johnson, in *The Practitioner*, may prove of service:—"*May eat*—Lean mutton and beef, veal and lamb, soups not thickened, beef-tea and broth, poultry, game, fish and eggs, bread in moderation, greens, cresses, lettuce, &c., green peas, cabbage, cauliflower, onions, fresh fruit without sugar. *May not eat*—Fat meat, bacon or ham, butter, cream, sugar, potatoes, carrots, parsnips, rice, sago, tapioca, macaroni, custards, pastry and puddings, sweet cakes. *May drink*—Tea, coffee, cocoa from nibs, with milk, but no sugar; dry wines in moderation, brandy, whisky, and gin in moderation, without sugar; light bitter beer, soda and seltzer water. *May not drink*—Milk, except sparingly; porter and stout, sweet ales, sweet wines."

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[46791.]—**Sahara.**—I believe the Cunard Co. altered the above ship's name to the "Servia." Sorry that I cannot give you dimensions, etc.—Nemo.

[46940.] — **Soap-making.**—Bayley gives instructions for preparing standard sulphuric acid, in p. 289 of his book. "Svenska" would probably be able to obtain the solution from any analytical chemist. There are several works on volumetric analysis, of which Sutton's (Churchhill, 16s.) is the best. "Methyl orange" should be used as indicator in titrating caustic leys.—Pygmalion Phibbs.

[46980.]—**Brakes (U. Q.)** — The brakes being tried upon the Highland Railway are the Westinghouse Automatic, and Smith's Automatic Vacuum. The Lynn and Fakenham Railway Company has adopted the Westinghouse brake for the whole of its passenger rolling-stock. I presume that the trials to which "A Driver" refers, were the following:—"The East Lancashire Company reported that a train was run for twelve months, ending September, 1854, between Salford and Colne, with a van and two carriages fitted with Newall's brake; this train ran 47,604 miles, and made 25,332 stoppages before the tires required to be turned up."—In reply to the concluding question. The Lancashire and Yorkshire Railway Company has fitted a very large number of vehicles with the Fay and Newall brakes; when it was decided to try the pneumatic brakes, it was desired that some carriages should be fitted with the Fay and Newall brake-blocks and gear, applied by both air and vacuum systems, in order to prove that in the event of a new brake being adopted the old gear could be utilised. A train of six vehicles was fitted with the Westinghouse brake, combined with Fay's gear. Another train of six vehicles, with Smith's vacuum combined with Fay's. Six vehicles have the Sanders and Bolitho automatic vacuum brake; and ten others have the Eames automatic vacuum brake, in each case working in combination with the Fay and Newall brake-gear. From these details it will be seen that the Fay, Newall, and Eames combined brake is *not* a new or separate system, but simply the Eames brake fitted to nine carriages, and a van in combination with the Fay and Newall gearing.—Clement E. Stretton, July 17th.

[47029.]—**Difficulty with Coil.**—To Mr. Lancaster.—Many thanks for your reply on p. 359. I have done as you said, and have taken off the wire up to the place where it gave ½in. spark before, and it does so again. I rather hesitate to soak the coil in melted paraffin, as I fear that the hot paraffin will injure the intermediate layers of guttapercha tissue. Also, will you please tell me whether I am, in thickening the wire at the middle as you said, to wind the wire farther in each time, or to make the insulation thicker in the middle? If you will answer me as to these two points, I shall be very much obliged.—B. B.

[47045.]—**Wire Harness for Weaving.**—I do not know of but two machines for making wire healds. The one H. Macmillan mentions cuts the wire in lengths, brings the two ends together, then twists up one end, thus forming one of the three loops, and, I believe, is used by only one firm, who hold the patent. The other machine takes the wire off two reels, twisting both wires together and cutting off afterwards; is not patented, but worked under lock and key. Both machines are complicated and expensive. Shall be happy to give H. Macmillan more information, if he will refer to my address in the sale column, which would otherwise be an advertisement.—Counter Tenor.

[47050.]—**Hot-air and Vapour Bath.**—In consequence of my offer to Isabelle Stuart ("E. M.," 901), I have received from England, Scotland, and Wales, numerous letters from private inquirers who want to make personal application of my principle. This proves the usefulness of the query. Astonishing to remark, Isabelle Stuart did not write. One of the letters received contained a stamp to prepay the answer. This is a very delicate, but, unfortunately, useless attention, as English stamps have no more value in France than French ones in England. My offer was made to one person, as I could not undertake to write numerous copies of my patent specification; besides, it was in a general point of view. Now, I cannot choose among the inquirers; still, I should like to be serviceable to them all if possible. I will, therefore, with your kind permission, give here a very simple process—not the patent one—by means of which, such baths can be obtained without extra expense. Take a common gas or water-pipe, bend it in U-shape—a coil would be better—and place the curve over your kitchen fire; it will soon get hot; take your bellows and blow in one end of the pipe. It is obvious that the air so pressed, passing into the heated part of the pipe, will issue out at its temperature. Now, if the pipe is at a nascent red heat, it will be at 525° Cent.; if cherry red, 800°; if white, 1,000°. . . It is easy to obtain any desired temperature, either direct from the pipe or by mixing heated with non-heated air, or simply in modifying the blowing. If vapour is wanted, let the outlet of pipe plunge into some water, and directly, vapour will rise. If scented or medicated effluvia are required, proper substances are placed in the vessel. This is simple enough, efficacious, and costless. Now for the bathing apparatus. Take a common iron or wooden hoop; have it suspended horizontally at a suitable height; round this hoop wrap a sheet or blanket, leaving in the centre at top, room to pass the head; place a seat underneath, and, when seated blow in the pipe, the outlet of which should be under the seat. If a modified, aromatised, or medicated air or vapour be needed, it can be obtained, either in steeping the sheet or blanket in proper liquid, or in plunging the outlet in a solution under the seat. A cool-air bath can be obtained in full sun, in having the apparatus wetted or watered; the evaporation causes a very refreshing and most agreeable temperature. These, I repeat, are not my patent processes, but they are sufficient to lead any intelligent reader to many other useful and inexpensive applications of the system, which, of course, does not interfere with "Gereb Admi's."—Ch. Rabache.

[47054 and 47368.]—**Incandescent Lamps.**—In answer to 47054, I should say that six or eight Leclanché cells would light such a lamp, but it would only maintain it for a few minutes. It would not be worth while to try it with these cells: try Bunsens or the bichromate battery. I have not tried Leclanché for such a purpose, so I cannot be positive; but I have Bunsens and bichromate. To 47368, I would say that there is now in the market a small incandescent lamp of 5-candle power, lighted by two quart Bunsens, the price of which is 2s. I believe it has a carbon filament; it is offered by a firm whom I think can be relied on for selling a good article. If "W. L." will advertise his address, I will give the name of the firm and all particulars. He must remember that the Lane-Fox, Maxim, and Swan lamps give a much greater candle-power than these small ones, therefore a greater battery power is required.—W. R. Hicks.

[47059.]—**Iron Chimney Rusting.**—Many thanks to "G. T." for his answer; but I have tried Brunswick black, and it burns off the first time the fire is lighted. I thought, as so many vertical boilers with wrought-iron chimneys are now used, and as I have not noticed all other chimneys rusting like mine, that perhaps there was some composition that would resist the heat and the weather, and so preserve the chimney. If "G. T." or any other reader can tell me of something that will answer this purpose I shall be greatly obliged.—F. R.

[47107.]—**Bleaching Oats.**—No doubt it can be done by means of peroxide of hydrogen; but probably the sulphur method is still the cheaper.—J. R. T.

[47108.]—**Spring Blind.**—Surely it is very simple. The blind-roller is so attached to the spring that, when the blind is pulled down, the spring is coiled up. A toothed wheel on end of roller is held by a pawl, and when the latter is released by a pull on the string, up goes the blind.—T. P.

[47116.]—**The Livadia.**—The last I remember reading about this vessel was, that she was to be broken up; but I imagine that has not been done, or something would have been heard of it, after all the statements made pro and con. soon after her first voyage.—T. P.

[47120.]—**Enamelled Bowls.**—These, like other enamelled hardware, are covered with a frit and put into a suitable furnace. A full description would occupy a lot of space, and it is not quite clear what is meant by bowls.—Nun. Dor.

[47124.]—**Medical.**—This query cannot well be answered without inquiry into the history of the case, and examination of the patient. The fact that the swelling always occurs in one place points to some local special cause, though the principal is, no doubt, bad state of blood.—M.D., F.R.C.S.

[47128.]—**Chinese Cement.**—This cement is known by the name of Schio-liao, and is said to be composed of three parts freshly-beaten (whipped) blood, to which are added four parts of slaked lime and a little alum. The Chinese use it as a paint. It is said to be thoroughly waterproof.—Nun. Dor.

[47129.]—**Pedals to Piano.**—Mr. Davies and others have replied to this query—the former on p. 44, Vol. XXIX., and p. 343, Vol. XXX. On pp. 99 and 152, Vol. XXIV., there are illustrations of two methods of attaching pedals to pianos.—S. Mayer.

[47150.]—**Steam Engine.**—I should advise him to adopt the compound system, that system having proved the best with steamers; there is less coal consumed for cargo carried, consequently more space for cargo, although the consumption of fuel per indicated horse-power by the indicator card is about the same in both systems; with regard to land engines, we have nothing but the indicator to guide us. If simple engines are used, they must cut off early to give a good result; with the compound engine, the high-pressure cylinder can be cut off at 7-10 of stroke, or later. In the simple early cut-off engines, when the cranks are at half-stroke and greatest piston speed, and greatest leverage, giving off the most useful effect, the pressure on the piston is less instead of greater; and when the cranks are at the commencement of the stroke and less piston speed, and least leverage, and least useful effect, the pressure on the piston is greatest. In the compound engines this is not the case, unless a high grade of expansion is on the high-pressure piston. The high-pressure piston gives out its greatest amount of useful effect at half-stroke of crank, when the speed is greatest and leverage of crank greatest. For instance, an engine with 66lb. effective pressure on piston, area of piston 100 square inches, and speed 400ft. per minute, we obtain the following indicated horse-power for the 1-10 at commencement, and the 1-10 at half-stroke, thus—

$$\frac{66\text{lb.} \times 10\text{ft. per minute per 1-10} \times 100\text{ sq. in.}}{33{,}000} =$$

2 indicated horse-power for 1-10 of stroke (at commencement);

$$\frac{66\text{lb.} \times 30\text{ft. per minute per 1-10} \times 100\text{ sq. in.}}{33{,}000} =$$

6 indicated horse-power for 1-10 of stroke at half-stroke. Although the consumption of steam is the same for either 1-10 of stroke (leaving out the ports and clearance spaces for the first tenth of stroke), this discrepancy occurs on account of the crank speed being constant, and the piston speed intermittent. Again, at the commencement of the stroke (or first tenth) the line of piston force is almost at the angle of 90° to the line of motion of the crank, especially on the instroke of piston.—C. J. Little.

[47196.]—**Electricity v. Gas.**—"Fiddler," in answer, seems to have got his ideas on the above subject what I should call slightly "mixed." He evidently looks upon electricity as a specific substance, which can be handled, and, to use his own words, analysed. He also confuses Lewis's incandescent gas lamp with those in which the incandescence is caused by the electric current, having evidently some idea that electricity is used in combination with gas in the former. What does he mean, too, by the following? "We have two ways of making an incandescent light with almost the same materials—the gas lamp with one jar, the electric lamp with many jars." Perhaps he will kindly throw a little more light on the above very obscure sentence. Referring also to his idea, that "hydrogen gas is a large component of electricity," I should recommend him to study an elementary textbook on electrical science, which would, perhaps, disabuse him of his, to say the least, peculiar views. Now, I think that if people, in answering queries, would confine themselves to those subjects which they know—at any rate—a smattering of—it would be much better for everyone, as those who send queries would not be misled by persons who know nothing of the subject on which they write, and we should none of us have the pain of seeing such nonsense printed in our very excellent paper.—W. J. Williams.

[47239.]—**Deafness.**—I should have said force the air into the ear, not through it. I understood there was no absence of the "membrana tympani." Before seeing Mr. Dalby I tried some false drums without effect. Can Dr. Edmunds give a good cure for biliousness? It is a daily and hourly plague to me, affecting my eyesight, consequently writing, spelling, &c. I am a vegetarian and teetotaler. I am sure we owe great thanks to Dr. Edmunds for the prompt and kind manner in which he answers the numerous queries respecting our numerous woes and infirmities.—John Alex. Ollard, F.R.M.S., Enfield.

[47274.]—**Illuminating Clock.**—A coating of Balmain's luminous paint on the face of the clock would perhaps answer "Light's" purpose. The necessary precautions would have to be taken, before applying the paint to iron.—Pygmalion Phibbs.

[47276.]—**Electrical Indicator.**—Figs. 1 and 2, transmitting instrument. Plan S S, framework placed over the most suitable part of reservoir; A A, shaft running in bearings in the usual way; B, a pulley grooved for chain, say 3ft. in circumference—at one end of chain is the float, at the other a counter-weight; C, a boss with two strips of brass, E and F, insulated from each other; D, a projection having two springs, G and H, insulated—B, C, and D are fast on the shaft, E is electrically connected with G, and F with H; J is a collar working loose on shaft A, cut away as shown, having on it four contact-plates, M M and N N; K, a wheel with 12 contact-making pins on it; L, a boss with brass strip on it—J, K, and L are fast together, M and M are connected to pins on K, and N and N to strip L; O, P, Q, and R, brass contact-springs with binding-screws, rubbing respectively E, F, K, and L. Fig. 2 is a section through D.

FIG. 1.

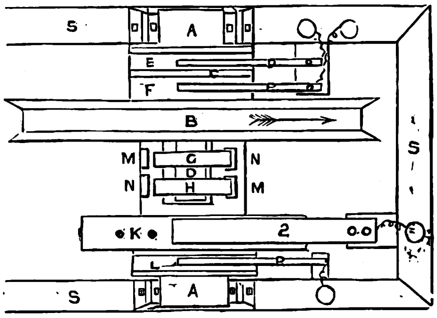


FIG. 2.

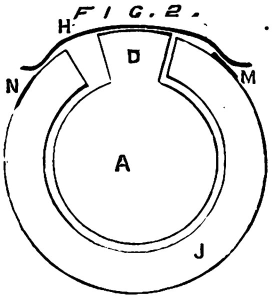


Fig. 3, a polarised relay. Figs. 4 and 5, front and side views of receiving instrument. A, a shaft projecting through front of instrument, having on it the indicator H and a pin, J; a tube works loose on shaft A, on which are fixed two ratchet-wheels, B and C, of 36 teeth each, with their teeth working reverse ways—on B are two pins, between which is J; D and E, two electro-magnets; F and G, their armatures, &c., pivoted at K and L, each having a catch at its upper extremity, G, working on the teeth of B and F of C. *Connections.*—O is connected to one terminal of main battery, P to the other, Q to line, R to earth, F and G (Fig. 3) to line and earth. A (Fig. 3) to copper of local battery. D and E to D and E of Fig. 4, Z to local line. The relay, of course, is at the receiving end of line. *Working.*—Suppose the water to be rising as the float rises, the counterweight pulls B round in direction of arrow, and with it D. D pushes against one side of J, as shown, G making contact with V, and, consequently, L and R; and H with pins on K. Every 3in. the water rises a pin presses Q, and a current passes in this course, P F H M K Q line to relay G C B F earth back to R L N G E O. C (Fig. 3) attracts A, which makes contact with E and sends a local current through magnet E. This attracts

FIG. 3.

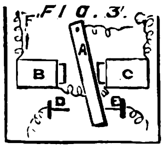


FIG. 4.

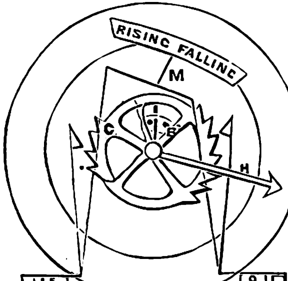
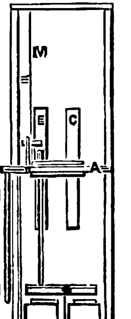


FIG. 5.



armature G, which, engaging in a tooth of B, pulls pin J, and with it shaft A and pointer H round, indicating 3in. on dial. As G is falling it pulls over M, on which are written "Rising" and "Falling," which brings "Rising" in front of a hole in the clock-face. Suppose, now, the water having risen, say, two inches, begins to fall. Float pulls B round contrary way; D leaves present side of J and pushes against the other; G now makes contact with M, and H with N; consequently, when K again makes contact at Q, a current is sent through the reverse way, and B (Fig. 3) attracts A, which, touching D, sends a current through D (Fig. 4) which attracts F, and F draws M over the other way, showing "falling," at same time F draws C round one tooth, and brings the other pin on B against J, but does not move the indicator until another 3in. of water have fallen. If it did move it now, it would indicate 3in. too little, as "Troubled" will at once perceive. It would be better to have wheels B and C, Fig. 4, of more than thirty-six teeth. I hope, with aid of this description and rough drawing, that "Troubled" will manage; but if not, and he will advertise his address, I will do my best to help him.—DEH.

[47279.]—**Spoilt Glass Shelves.**—Thanks for replies, but we have not yet got at the cause. No acids were near as suggested by H. Stooke. The cellar where the shelves were placed is one in an arch under the road facing the sea at Brighton. There may be salt in the plaster of the wall against which they rested, but I know of nothing stronger. One correspondent says, Clean them with hydrochloric acid. I tried that and every cleaning substance I could think of—such as ammonia, rouge, whiting, &c.; I will try the putty powder for polishing when I return home. Business will keep me away for the next three months. My object in inquiring was to know whether it was something which had got on to the glass and had to be removed, or whether anything had eaten away the polish of the glass; but this none of the correspondents seem to able to determine.—J. E. A.

[47281.]—**Tricycles.**—The double-driving tricycle is the mount of the future. It turns corners, covers rough ground faster and easier than the single. The only good single-driver is the Coventry Rotary, which has the one-sided driving counteracted by both side-wheels steering. The best lever machine is the Omnicycle, which mounts hills far better than any rotary machine made; but it is at a disadvantage on the level by not being able to pedal so fast. The question of rear and front steerers has never been settled, and is a matter of opinion. The former—if you have a brake as strong as it should be—is given to lifting the rear wheel if brake is put on suddenly when riding down a stiff descent. If a single-driver it is positively dangerous to travel more than 10 miles an hour. The front steerer is much more safe down-hill, but requires practice to keep the front wheel on ground when ascending an incline. In answer to 47281, Mr. Lancaster asserts that he can ride 12 miles an hour, and keep it up all day. This statement should be taken with a grain of salt, as it is a very good performance for an ordinary man to average two-thirds of that pace, i.e., 8 miles an hour for 12 hours. If what Mr. L. says about his pace is true, he is far and away the best tricyclist that we have; and if he would compete in the forthcoming championship we might see what a tricycle is capable of with other than a racing man mounted. If it is not true, I think it only right that such a wild statement should be corrected, as it might mislead people who fondly imagine that they have only to buy a tricycle to travel about at 12 miles an hour, and who, after a ride or two, throw the whole thing up in disgust, and lay the whole blame on the makers, much to the detriment of tricycling.—CHEROPHUS.

[47301.]—**Errata.—Vacuum Tubes and Coil.**—For *zinc*, p. 411, read *wire*.—GEORGE TOLMAN.

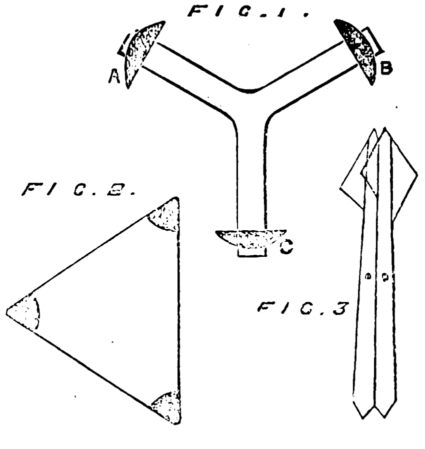
[47307.]—**Mildew on Vine.**—Keep the house as dry as possible as soon as the grapes begin to colour; in fact, no other plants ought to be in the house then. On signs of mildew sprinkle or fumigate with sulphur.—NEMO.

[47307.]—**Mildew on Vine.**—For the past two years I, like "Amateur Gardener" (p. 383), have lost all my grapes through mildew. This year I am more fortunate, as there is no appearance of the pest up to the present time. The treatment I adopted is as follows:—In the autumn I put on the border a thick dressing of manure. In January I pruned off all the lateral shoots, and about a month after I stripped the stems of all fibrous bark. I then made up a compound of soft soap, sulphur, and paraffin-oil (a strong decoction of tobacco is also recommended) to the consistency of treacle; with this I painted over all the branches. When the leaves began to form I covered eight or nine slabs of glass with flowers of sulphur, and placed them as close to the glass roof of the house as possible; I have also, for greater security, placed sulphur in a flour-dredger, and dusted the leaves in certain parts. This treatment with proper ventilation will prevent the pest; but having got it, the only thing I can recommend is to cut the fruit off, throw it away, and ripen the wood ready for the above treatment. My house is a cold one, and filled with various kinds of plants and flowers, as well as the vine, now flourishing.—W. B. L.

[47309.]—**Clarionet.**—As I am about to try my hand at making a B flat clarionet, I should be very glad if "Hampstead" or Mr. Edwin Morgan would kindly give the correct position for the holes; also any other bit of useful information on the subject.—BASSOON.

[47318.]—**Ink-Stains on Carpet.**—Have you tried oxalic acid? If it does no good, I don't think it could do any harm. Milk is efficacious if applied directly after the ink is spilt.—HEMISUS.

[47324.]—**Sketching Stool.**—I send rough sketches, which I think will answer your purpose. Fig. 1 is the shape of iron pins; A, B, C are brass caps which fit the pins; they are put on over the legs, and the pins then riveted, allowing plenty of room in the joints for the seat to fold up. The seat is made of canvas, with strong leather caps at the corners. Fig. 2 is the seat. Fig. 3 is the stool folded up. If querist needs any further information I shall be pleased to give it him if he will advertise his address.—H. B. C., Lambeth.



[47328.]—**Siemens' Armature.**—You can use 16 wire, but make more coils—say one layer of nine rows. Do not have any divisions between wire; no necessity for drilling holes. The new commutator; of course the old form is only for one coil.—GEORGE TOLMAN.

[47331.]—**Brakes on the Midland Railway.**—To "METEOR."—The Midland Railway Company is now in favour of the Clayton modification of the Sanders and Bolitho automatic vacuum brake (generally known as the "two-minute" brake). On the other hand, the Glasgow and South Western and North British Companies have finally adopted and fitted their trains with the Westinghouse automatic brake, for the simple reason that they have proved it to be the best, and they have declined to exchange the Westinghouse brake for any "inferior system." The "M. S. J. S." vehicles, which are the joint property of the three companies, are fitted with both the Westinghouse and vacuum brakes, but all the Scotch traffic is generally worked with the former. As far as the credit and reputation of the Westinghouse brake is concerned, it would be advantageous if its use were discontinued over the Midland line between London and Carlisle, unless the apparatus be maintained by the railway company in fair working order. An article relating to the Board of Trade returns and continuous brakes appeared in the *Engineer* on the 26th May last, in which special attention is directed to the following

COMPARISON OF THE WESTINGHOUSE BRAKE ON THE MIDLAND AND NORTH EASTERN RAILWAYS.

	Total Brakes in use on Engines and Carriages.	Number of Reports.	Proportion of Reports to Brakes.	Miles run.	Proportion of Reports to Miles run.	Reports each should have, supposing the other to be correct, taken from:—	
						Stock fitted.	Miles run.
Midland	332	115	1 for 2·9	430,931	1 in 3,747	11·3	10·7
North Eastern	1984	68	1 for 29	2,734,307	1 in 40,210	686	729

"Here we see," remarks the *Engineer*, "that the failures of the brake on the Midland are apparently ten times as numerous as they are on the North Eastern. Can this really be the truth? If so, why so?" The Midland Company, for the half-year ending December 31st, 1881, return only 5 per cent. of the total miles run with the Westinghouse brake, but make no less than 21 per cent. of the reports against it. These few facts will conclusively prove that, for purposes of comparison, the returns of failures have been rendered practically useless, and that the reputation of a good brake may be unjustly injured by a company who persistently neglect to perform the necessary duty of maintaining it in proper repair.—CLEMENT E. STRETTON, July 15th.

[47333.]—**Drowsiness.**—Some years ago a friend of mine was cured of this complaint, which appeared in a more marked form, by the following treatment:—He moved into a large cool bedroom, where there was a good current of air passing through all night; he undertook to go to bed two or three hours earlier than previously; in this way he obtained ten or twelve hours of very refreshing sleep, which nourished his brain, and armed him for the work of each day. If "P. S." is engaged in writing for twelve hours a day seven days in a week, he can hardly expect to have good health, and his employer must expect him to break down. If, in addition to this, he sleeps all night in a foul or an exhausted atmosphere, the case is much worse, for his lungs are also starved.—H. BARNABY.

[47334.]—**Small Dynamo Machines.**—What can you expect from this small model when the armature does not hold above an ounce of wire?—GEGRGE TOLMAN.

[47337.]—**G.E.R. Engines.**—In answer to "H. S. P.," Sinclair's 8-wheeled tanks are still running. The first ten, Nos. 1400 to 1490, are about to be broken up, having been replaced by Hawthorn's engines. The 580 class of tanks have cylinders, 16 by 22, and coupled leading and driving 4ft. 10in. diameter; 50 of these engines have been built at Stratford since 1878, and 10 more are being built. Nos. 305 and 306 have cylinders 17 by 24, and 6ft. 6in. coupled drivers, with a leading bogie. These are the two finest passenger engines the G.E. have at present. The 245 and 600 class have cylinders 18 by 26, and single drivers 7ft. 6in. in diameter. These engines are very heavy on fuel and repairs, and give very little satisfaction. I may mention that Mr. Worsdell is having some fine 4-coupled express engines built at Stratford, of his own design. The cylinders are 18 by 24 inside, 7ft. drivers, and single bogie wheels 4ft. diameter. They will be fitted with Joy's valve-gear, steel frames, and boilers. The cylinders are a solid casting, the valves working on top in the bed of the smoke-box. These engines, when finished, will supply a long-felt want on the G.E., as most of the trains require coupled engines to work them efficiently.—ETNA.

[47338.]—**Leclanche Battery.**—Use porous cells; well wash the carbon before putting in; will require good zinc rods; four cells would ring two bells.—GEORGE TOLMAN.

[47338.]—**Leclanche Battery.**—Put new porous pots and zincs, charge pots with broken carbon and peroxide of manganese, exciting liquid sal-ammoniac. One cell is sufficient for a small bell. Are these cells worth the trouble?—REYNALDA.

[47341.]—**Electric Locomotive Engine.**—Make the motor exactly like the small dynamo I described, page 354, June 23, but without the fly-wheel and gearing; it is a good motor.—GEORGE TOLMAN.

[47349.]—**Dry-plate Queries.**—To MR. W. ROBINSON, JUN.—Best thanks for your replies, but the first (*a*) does not convey what I wished to elicit. I have long since learned how to temper my developing ingredients to suit circumstances. Please assume that I expose, under identical conditions of subject, light, lens and exposure, two or more plates by as many different makers. One uniform developer may not be best for all. This I know; but I do not know why one of the plates will give as good a negative with ½gr. of pyro. as another with 3gr., and one will bear with impunity as much ammonia as would ruin another. I have tried this over and over, and I wish to learn the reason why different makes of plates require such different treatment. I have not got any book on emulsions to which to refer.—W. H. S. W.

[47351.]—**Mathematical.**—Will you kindly permit me to point out that the assumption made by "An Engineer's Son," on page 434, is entirely illegitimate, for $(1 - x)^{-n}$ is not a constant, but a function of x. Therefore, if we take the coefficients of 7 in $(1 - 7)^n$ and multiply each by $(1 - x)^{-n}$, each product will be a function of x, and not by any means one of the coefficients of x in $(1 - 7)^n (1 - x)^{-n}$.—J. H. M. JACOBY.

[47351.]—**Mathematical.**—I know of no other way to do this except by induction, as given by J. H. M. Jacoby. "An Engineer's Son's" assumption is clearly illegal, as $(1 - x)^{-n}$ is not independent of x. We might say in a similar manner that the coefficients in $(1 - x)^3 (1 - 2x)^{-3}$ equidistant from the beginning and end were equal, because those in $(1 - x)^3$ are, and each coefficient is multiplied by $(1 - 2x)^{-3}$. But this is untrue. —HEMISUS.

[47358.]—**Shocking Coil.**—This size was described within the last eight weeks.—GEORGE TOLMAN.

[47360.]—**Battery for Electric Clock.**—I find the gravity Daniell cells answer well for clockwork. I wrap all zincs in calico. The Silvertown Company wrap all zincs in their medical batteries (Leclanché) in calico.—REYNALDA.

[47360.]—**Battery for Electric Clock.**—The gravity cells are the best you can have. There are, of course, a variety of them, both in size and construction. The zinc does eventually become coated with copper, and if you can devise a method of keeping the copper away from the zinc, you will have the best possible cell for the purpose you wish to use it. The deposit of copper is a difficulty that I am afraid you will be some time getting over.—W. J. LANCASTER.

[47363.]—**Watch Cylinder.**—"A Fellow-Workman's" reply to "Hall" in last week's "E. M." is so wide of the mark, I can't refrain from writing to say that if "Hall," or any other of our amateur horological readers, follow such a course (as described by "A Fellow-Workman") in putting in a cylinder-plug, they could only produce a job as bad as the way of doing it—if, indeed, it could be done at all. In putting in a cylinder-plug, I do not use a file in any part of the job; but, according to "A. F. W.'s" way, it is all done by a file. There are some capital articles in back numbers of the "E. M." by our late correspondent, "Seconds' Practical," on "Turning," which I would recommend "Hall" to read. If, however, he has not the Nos. referred to, I will be pleased to put him in the right way of doing the job if he writes to me. A description here would not be of sufficient general interest to call for the space it would occupy, as the *modus operandi* has appeared so many times in "ours." If "A. F. W.'s" promised instructions, with drawings, on putting in a cylinder-plug are based on his principle of filing them in, they will not be worth anything. An engineer would as soon think of trying to file up a piece to act as a piston-rod for an engine, as a practical watchmaker would think of putting in a plug in the manner "A. F. W." describes.—G. K., Stockton.

[47364.]—**Silver Filagree Brooches.**—Washing with soap-and-water will do very little good. Better follow out "Alfojoe's" directions, only instead of a long immersion in cold vitriol and water, a short boiling in the same preparation will be more effectual. You can boil them in a copper or brass pan. When rinsed out and dried, burnish the edges and points of the work, and you will get the right effect. Don't scratch-brush, as the object is to get a dead white surface in contrast with burnished edges.—J. E. A.

[47368.]—**Incandescent Lamp.**—The filament is platinum. Two Bunsens will do it—cost about 2s. 9d.—GEORGE TOLMAN.

[47368.]—**Incandescent Lamp.**—I think "W. L." would find he could work one of Swan's small incandescent lamps with two good-sized Bunsen cells. I have worked one of Swan's 5-candle lamps with three 1-pint cells.—SPELTER.

[47368.]—**Incandescent Lamp.**—Like "W. L.," I am anxious to hear of the smallest number of cells that will give a fair light. I at present use eight Bunsens, and get only very meagre results. I believe a few lines from some of "Ours" on the subject would be very interesting to many readers of the "E. M."—REYNALDA.

[47368.]—**Incandescent Lamp.**—There is a so-called incandescent lamp, with two coils of platinum wire, that a couple of quart Bunsens will make it give about half a rushlight. This is an imitation of a lamp I brought out last year, and am making now, with about 10 coils of iridium-platinum wire; this lamp requires 5 Bunsens to light it. Then there is the Swan (carbon filament) 2½-candle lamp, which will require about 8 Bunsens to illuminate it. The 20-candle lamps will require 25 Bunsens. You can make an incandescent lamp for even 6d.—W. J. LANCASTER.

[47372.]—**Lens.**—"Focus" does not give sufficient particulars to enable anyone to tell him what curves he requires. He should have said what is the refraction of the glass or glasses he intends using, and the radii of the convex lens. The concave must have a negative focus of 2 1-7in. Now, if his lens be equi-convex, its radii will probably be very nearly 1·5; and if the same sort of glass be used for the concave, the inner curve may be 1·5, and the outer 3·75. This is as near an approximation as can be given, without more definite particulars.—O. V.

[47373.]—**Cracked Varnish on Globes.**—I should advise "J. C. L." to apply a little alcohol or spirits of wine with a sponge to his globes; if it is a shellac varnish, it will be dissolved.—SPELTER.

[47373.]—**Old Cracked Varnish on Globes.**—Use methylated spirit warmed, and apply it with either a sponge or a tuft of cotton-wool; the latter is much the better way. Take your time over it, and you will be successful.—W. J. LANCASTER.

[47375.]—**Lightning Conductors.**—To MR. LANCASTER.—By all means carry the wire straight into the earth, and as far away from the bottom of the chimney as possible. Then let the ends of the copper rope be opened, and either soldered or riveted to a large iron plate imbedded in moist earth if possible. If there is no moist earth, then put the plate in a deep hole—say ten to fifteen feet deep, and the plate to be well bedded in gas coke. I much prefer the plate to be a long one, and let down well in the earth with coke all round it.—W. J. LANCASTER.

[47376.]—**Bone Calcination.**—These are subjected to destructive distillation, the same as wood for pyroligneous acid and naphtha. If required for animal charcoal, in a retort. An iron one is generally used for this purpose, with a coil descending into a tank of water, at the end of which is a well for the end of coil to dip into, to collect the dipple oil or by-products.—JACK OF ALL TRADES.

[47377.]—**Casting Small Articles in White Metal.**—Your moulds must be made of gun-metal, cast iron, or steel, highly polished, and your metal just hot enough to run, to do them to perfection.—JACK OF ALL TRADES.

[47378.]—**Legal.**—A wife who assaults her husband or breaks his furniture can, of course, be summoned to the police-court, and convicted of that assault or the malicious damage. Or, if a wife gets constantly drunk and causes a disturbance, she might be turned out of the house by her husband and taken into custody by the police. But, then, "M. B." does not wish any exposure, and there is the difficulty. The only way I can suggest is for husband and wife to separate—by allowing her so much a week or month, under a deed so drawn that the money shall be paid to trustees, and shall cease if she returns to annoy him. If "M. B." does not even want a separation, then, I fear, his question is quite outside the province of a lawyer.—FRED. WETHERFIELD, Solicitor, 2, Gresham-buildings, Guildhall.

[47380.]—**Clark's Process for Softening Water.**—The process known by this name is very much of a chemical paradox; for, to remove lime from water, more lime is added. Water is hard—as a rule—because it holds in solution carbonate of lime, and it is enabled to do that only when an excess of carbonic acid is present. By boiling or heating to such a temperature as will expel the excess of carbonic acid, the lime is thrown down in the form of carbonate, commonly spoken of as chalk, though chalk is a distinct natural product. By adding a paste or a mixture of lime and water to water holding carbonate of lime in solution, the lime seizes on the excess of carbonic acid, and nearly all the lime in the water is deposited in the form of carbonate. Where the water is hard from the presence of sulphates, sodic carbonate (washing-soda) is added. To soften Thames water, take 1oz. of freshly-burnt quicklime to every 30 gallons, slake the lime and mix it to about the consistency of cream; then either pour it into the water or run the water on to it, rousing it thoroughly. The white precipitate of carbonate of lime will form at once, and in a few hours will be perfectly settled.—NUN. DOR.

[47382.]—**Engine Query.**—Put ⅛in. lead on your valve. The cut-off of course depends to a certain degree on the amount of work you require to do; but ¾ or ⅝ stroke is about the usual in ordinary condensing engines, but in compound engines the cut off is much earlier. A good sensitive governor, with ordinary throttle-valve, would prevent racing when load is taken off.—G. J. C. E.

[47382.]—**Engine Query.**—1-16in. is sufficient lead for the engines you mention. Your second question cannot be satisfactorily answered without an indicator diagram. If you can obtain one I shall be happy to give you every information respecting the cut-off, and general arrangement of the slide-valve.—FRED. WALKER.

[47383.]—**Hardening.**—I have generally seen a very good job made with prussiate of potash. Heat the part to be hardened to a bright red heat in a clear fire, then dust over with potash, and without putting in the fire again plunge it end downwards into water with the chill off. You will find it come out a mottled grey colour, which is easily polished with emery-cloth. Perhaps you heat it too much. —G. J. C. E.

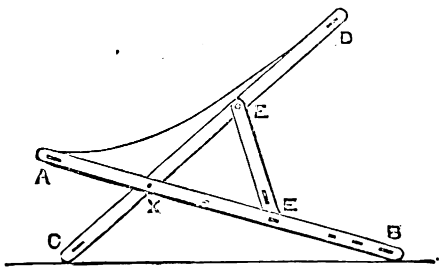
[47383.]—**Hardening.**—You must take one part prussiate potash, two parts of salt, and pour sufficient hot water on them to dissolve. With this wet up some fine wood charcoal dust; place your axle in a tube with about ½in. clearance all round, and ram this in well and stop with clay, and subject it to a dull red heat for one or two hours; you will make a job of it. There is no necessity for slaking it, for it will be very hard without. Bone-dust will answer the same purpose; the longer the process the deeper. By this method they will not become distorted, which they are very apt to be when slaked. They are certainly harder when slaked. A bright cherry red heat is hot enough.—JACK OF ALL TRADES.

[47384.]—**Coil.**—There is very likely a fault in the contact-breaker. I have recently improved mine—not because it did not work well, but because the copper began to get out of shape. I cut out a piece of brass sheet so as to extend ¾in. beyond the coil, and thus lengthened the contact-breaker by that length, and made it of thin clock-spring. This part of the coil requires careful adjustment at any time. It should not, when at rest, be far from the core. See also that there is perfect metallic contact at each joint, and each connection is clean. Do not solder with muriatic acid when connecting. Did you thoroughly soften your wire core? I left my solid one in the forge all night, after blowing it a bright red. Are you also certain that you made your connections according to my description? My coil continues to give satisfaction, and I shall be very glad if I can assist you so that yours may do the same.—FRED. WALKER.

[47385.]—**Spectacles.**—Your correspondent requires a pair of concave glasses; I should think those having a negative focus of about 8in. or 9in. would suit him. He may have some little difficulty in procuring them; but Mr. Lancaster will be able to advise him as to this matter.—O. V.

[47385.]—**Spectacles.**—To MR. LANCASTER.—I should prefer to see you before I could definitely recommend a particular focus concave; but assuming that you have nothing but ordinary myopia, I should give you a pair of 9in. concaves; these should enable you to see well at 20in. to 24in. away. A pair of 8in. would enable you to see the music at 3ft. away; but I am afraid you would not be able to read the music at that distance. You must, of course, remember that the numbers I have given are in each case the focus of the lenses, and not any numbers as usually given in the trade, No. 1, 2, 3, and so on. You might perhaps send another query, stating whether both eyes are of one focus, or whether one eye is in any way better than the other.—W. J. LANCASTER.

[47391.]—**Portable Lounge Chair.**—"An Amateur M." will get out four pieces of scantling, each 4ft. long by 1½in. by ⅞in. This section will vary according to the strength of the wood he uses. I used ash. Joint them two and two as in sketch,



joint × being 14in. from one end of each. Join the two pairs by cross slat mortised in at A, B, C, and D, about 20in. apart, or as wide as he likes. The stay at E, and, of course, a corresponding one on the other side, to be jointed on at 15in. from ×, and to be 15in. long. The two stays to be united by a slat mortised through each, near their lower ends. Said lower ends drop into notches or mortises along A, B, at such places as will give comfortable angles to taste. I have marked the four in my own chair, which I have found comfortable. The webbing is to be nailed to the cross slat at A and D, and to be just long enough to allow of the chair collapsing flat. Be sure that A, B, and its corresponding frame come outside C, D, and E, F, or the chair will not fold up flat. I have found this chair most convenient and comfortable to use, either as an upright chair, a reclining lounge, or a short bed, or hammock, and very firm in all positions.—Treadle.

[47392.] — **Perfumed Pastilles.**—Take gum benzoin in powder; add to it a small quantity of ground cinnamon, pounded frankincense, cascarilla bark, and camphor. Mix these together with a little thin gum-water, roll into shape you require, and dry. To be set fire to. (From Cassell's "Amusing Experiments.")—Nihil.

[47392.]—**Perfumed Pastilles.**—"An Amateur M." will find the following make excellent pastilles.—Gum storax, 6 parts; gum benzoin, 6 parts: gum copal, 6 parts; cascarilla bark, 3 parts; charcoal, 48 parts; gunpowder, 1 part. All these must be in the very finest powder, and moisten with starch mucilage; shape into little cones and dry.—Erin-go-bragh.

[47394.]—**Combustion of Coal.**—Since one cubic foot of air weighs ·0807lb., all you have to do in order to change weight into volume is to divide the given weight by ·0807. Referring to query 47094, 237·4cwt. = 112 × 237·4lb. = 26588·8lb. = 26588·8 / ·0807 cub. ft. = 329477 cub. ft. of dry air at 0°, and pressure of 15lb. (not 2,942 cubic feet, as given in my answer to query 47094, p. 360).—R. Kanthack.

[47395.]—**Large Tank.** — The tank should be put together in position, and the bolts all put in, though not screwed up tight. If there be fillets cast all round the pieces to give parting room for the joints, the bolts may be just hand-tight; if not, some pieces of wood must be cut so as to preserve the shape of the tank, and the bolts tightened just so as to hold wood in position. The rust-joint is made with one part of powdered sal-ammoniac, two parts of flowers of sulphur, 95 parts of iron borings, pulverised as much as possible, and mixed with water, so as to form a paste, and caulked in with caulking chisel. This cement sets quickly, but if time allows, 200 parts iron borings, one flowers of sulphur, and two sal-ammoniac makes the strongest joint, though slow setting. The bolts may all be tightened after cement has set. —Fred. Walker.

[47397.]—**Engraving Machine.**—The tracing point at one end of the brass rod of the machine is passed by hand over the figures, which are held in the curved back, and as nearly in contact with them as may be; the other end of the rod to which the drill is fixed being supported in gimbals is, of course, free to move in every direction. Your querist will probably at once see that the reduction of the copy depends upon the distance of the drill from the point of suspension in the gimbals. The driving-wheel is, of course, turned by an assistant. A very full description of the valuable engraving machine of Messrs. Cooke, of York, will be found in, I think, the November number of *Engineer*, 1870.—N. S. Heineken.

[47400.]—**Electric Light for Workshop.**—The electric light will cost you more than twice as much as gas. You have about 500 candle-power illumination now, and to get a similar amount of light from incandescent lamps you would require 25 of them, and to light them a 30-light dynamo and a good 10-horse engine. You can readily calculate the first cost, and, with interest and working expenses, you will find that twice the cost of gas will be much below the cost of electric lighting by incandescence. On the arc principle you can use a smaller dynamo, and a 4 horse-power engine, and get 3,000 candle-power. If you have plenty of driving power to spare, then, with a little extra attention required in the use of a dynamo, the cost would be about the same as the gas.—W. J. Lancaster.

[47403.] — **Lawn-Tennis Court.** — I should think that it would be best to make the court of cinders, thus:—Level and ram the surface; put a 3in. layer of broken stones or bricks, small enough to pass through a 1½in. ring; cover with about 1½in. of dry breeze or ashes. Well roll and keep rolled. If good binding gravel is obtainable, it may be used instead of the ashes, and makes a very good court. If desired to be asphalte, level and ram as before. Put 6in. of concrete, composed of clean, fine gravel (shingle) and lias lime, one of lime to five of gravel. Cover with gas-tar asphalte (made with gas-tar, a little lias lime and dry clean sand boiled), and spread and level while hot. Real asphalte may be used; but, of course, it is much more expensive. The surface may be formed of the best Portland cement and washed sand, one to three. But this also is expensive, and not so likely to stand out of doors. Altogether, I think the cinder or gravel court would be the cheapest.—Hemisus.

[47403.]—**Lawn-Tennis Court.**—To make any hard court, you must excavate four or six inches of soil and fill in with concrete or rough stones, mixed with blue lias lime, and brought to a level. On the top of this you can put cement; first a layer of 1½in. or 2in. mixed with half sand, and then on the top another layer of pure cement. Or you can put asphalte, i.e., gravel boiled up with gas-tar. If this mixture is not boiled, it is useless. Of this, too, there should be two layers, the top one being the finest; but I would not put this on for three or four months after the first, which may be played on, so that the soft places will be discovered. The asphalte must be well rolled, and over the last coat must be sprinkled a little very fine and clean gravel. Or you can make a fair court of cinders, putting them on coarse below and finer above, beating and rolling them well in; or, if you have good gravel in the neighbourhood that can be used, and, if it is of a binding nature, it will be preferable to cinders. Remember that any court must be made either convex or inclined towards one side, to let the water run off; and that without a margin beyond the bare 26 yards by 12 yards, which at the ends should not be less than two or three yards, it will be very inconvenient, as 25 per cent. of the strokes require the players to run outside the actual boundary of the court. An asphalte court will cost about £50, and a cement one nearly double; if made of cinder or gravel, the cost should not exceed £15 or £20, though in all cases the expense will much depend on the material used for the foundation.—Devoniensis.

[47404.]—**Carriage Lamps.**—One reason why the oil flows over is this:—The reservoir being above the wick the oil flows down and out at top of wick. This occurs always when the lamp is out, and sometimes when lit, on account of the wick not being able to burn all the oil as fast as it comes. I dare say the motion of the train also increases the evil. The remedy would be to have the reservoir below the wick. If you look through the back numbers of "E. M." you will find a similar question fully answered.—G.

[47405.]—**Locomotive.**—One would be better able to form an opinion upon seeing the corrosion, but I have no doubt there has been a galvanic action quite sufficient to account for the wasting of the plates.—W. J. Lancaster.

[47406.]—**Dew-Cap.**—You can make a very good dew-cap out of cardboard. First, put a thin strip of note-paper around the end of telescope containing lens, then begin to paste long strips of thin cardboard round and round until about ⅛in. to 3-16in. thick; then make a cardboard tube, 9in. long, to be glued true on the outside of the cardboard ring you have already made. Paint the inside of tube dead black, and the outside with two or three coats of bright black.—W. J. Lancaster.

[47407.]—**Concave Lenses.**—You can do the grooving with a small wheel; similar to those used by glass-cutters, running in the lathe. You will be unable to make a good job of one: there must be experience before there is success. Still, you can but try, and if you will, you can in time succeed.—W. J. Lancaster.

[47412.] — **Coulomb's Law of Electro-Statics.**—You must read, "inversely proportional to the *square* of the distance between them." This is the correct law.—W. J. Lancaster.

[47412.] — **Coulomb's Law of Electro-Statics.**—The formula $f = 9 \times 9^1 / d^2$ is correct; see also what is said in art. 16, p. 16, which treats on the law of inverse squares.—R. Kanthack.

[47412.]—**Coulomb's Law of Electro-Statics.**—The formula is correct. The former statement must have been an oversight on the part of Prof. Thompson. If "H. E. A." refers to Art. 16 of Thompson's book, he will find the Law of Inverse Squares stated correctly.—Vis Viva.

[47412.] — **Coulomb's Law of Electro-Statics.**—I have not Thompson's book at hand, and, therefore, do not know what may be the case to which he is referring; but, certainly, the force exerted between two small charged spheres is inversely proportional to the square of the distance. This does not necessarily apply to every case.—Ll.B.A.

[47413.]—**Marble.**—Take two parts of carbonate of soda, one part of powdered pumice-stone, and one part of finely-powdered chalk; sift it through a fine sieve, and mix it with water; then rub it well all over the marble, and the stains will be removed; then wash it over with soap and water, and it will be as clean as it was at first.—F. S. Harrison, Alresford, Hants.

[47420.]—**Steinheil's Eyepieces.**—These eyepieces are constructed on what is known as the "solid stick" principle. There are two methods of achromatising a sphere: either by placing a double concave stick of flint-glass between two double convex-lenses of crown-glass, as in the Coddington lens, the whole forming, essentially, a cylinder with spherical ends; or by placing a concavo-convex lens of flint-glass at each end of a double convex-stick of crown-glass. Steinheil's e.p.'s are made on the latter plan; whether they are patented or not I cannot say.—O. V.

[47421.]—**Transparent Gum.**—Have you tried a little alum-water? I have only just thrown some away that I made up five years ago, to mix with plaster of Paris, for putting the brasses of paraffin-oil lamps on, to prevent the capillary action of the plaster. It was as bright as the clearest water to look at.—Jack of All Trades.

[47422.]—**Stamping Note-Paper.**—All whites, for whatever purpose, distemper or oil, require a little black or blue mixed with them, to neutralise the yellow tint thrown up by the medium with which they are mixed. Ivory-black preferred; blue cannot be depended upon. Many colours lose their bloom when mixed, mix them with what they will; but an artist that knows what he is about can remedy this to a great extent. Whites, greens, lakes, and vermilion are very delicate in this way, and the purest medium is required for them, or they get foxey: some blues are the same.—Jack of All Trades.

[47424.]—**Crystallising Vessels for Epsom and Glauber's Salts.**—Why not use stoneware cisterns? Nothing cleaner.—Jack of All Trades.

[47425.] — **Electrical Measurement.** — As current = E.M.F. / R, the law of deflection does not apply to the "electromotive force" and "resistance," for both E.M.F. and R. might be simultaneously decreased, while "current" remained constant.—R. Kanthack.

[47425.]—**Electrical Measurements.**—I am afraid "Student" has rather vague ideas about electromotive force and resistance, but I will try to be as clear as possible. 1st. A galvanometer can only measure one thing directly, namely, current; but we are able to measure E.M.F. and resistance indirectly. Supposing the same current to go through a galvanometer, it is obvious that if the galvanometer be in the same magnetic field, there will be the same deflection. Now by Ohm's law $E / R = C$. We may therefore measure the same current in two different cases, and yet E be different because R is different; if we know E to be the same then R will be the same—not otherwise; or if we know R to be the same, E must be the same. We may thus compare the E.M.F. of two batteries by first getting a deflection with a known resistance—this will be the resistance of battery and coils of galvanometer and any other inserted resistance; now replace the first battery by the second, and add or subtract resistance till we get the same deflection, then the two electromotive forces will be to one another directly as the two resistances. By making the known resistance very large we may neglect resistance of battery and coils of galvanometer. I do not at this moment think of any method of measuring resistance by equal deflections. Any further help I shall be glad to give.—Ll. B. A.

[47427.]—**Calculating Strains in Boiler.**—It is difficult to explain this without the aid of algebra, but the process is so simple that I will proceed as follows. To simplify the matter we wil first suppose that the seams or joints of the boiler are as strong as the plates themselves. Now to get the strains on the circumferential seams, or on the cross section of the boiler, it is evident that if we find the area in square inches of one end of the boiler and multiply by the pressure on each square inch of this surface, we shall find the total strain on the cross section of the boiler, and if we divide this total strain by the number of square inches of iron in the cross section of the boiler, we shall find the strain on each square inch of iron in the section of the boiler. Call the radius of the boiler r, the pressure of steam per square inch P, and the strain per square inch of iron in the section of the boiler S. the area of the circular end will be πr^2, the pressure will therefore be $\pi r^2 \times p$. The number of square inches in the section of the iron will be $2 \pi r \times t$; t being the thickness of metal; divide one by the other and we get $S = \pi r^2 p / 2 \pi r t$, or $S = r p / 2 t$. Now for the longitudinal seams or section. Suppose the boiler to be made up of a series of rings, 1in. wide; the strain tending to force the two halves of each ring apart will be $2 r \times p$; the area of the two ends, or the area of the metal so strained will be 2 (1in. × t), or simply $2 t$; divide as before, and we get $S = 2 r p / 2 t = r p / t$, which is evidently double of the first value of S, obtained for the cross section of the boiler. There appears to be some mistake in the figures given in the query—*feet* have been multiplied by *inches* apparently. The diameter of the boiler is 6ft., so $r = 36$in. p is 50lb., and $t = \frac{3}{8}$in. The first value of S will therefore be 2,400lb., and the second value of S will be double that, or 4,800lb., or something over two tons per square inch strain on the plates of the boiler. The ultimate strain of best plates is 25 tons per square inch, but this should be multiplied by ·7 to get the strength of double-riveted joints, or by ·56 for single-riveted. In calculating the area of the end of the boiler, we must take it as if it were flat, and not curved, as it usually is. I have referred to the query on p. 387, but I never heard of the end of a boiler, 5ft. diam., being made flat and without stays. It would be difficult to find a formula for calculating its thickness.—M.I.C.E.

[47428.]—**Etching.**—To "R. B."—The decimals you give of proportions of etching mordant are quite right; but if you take 15½ grains troy weight to equal 1 gramme, it will be exact enough; I am afraid there is no simpler way of finding proportions, but any druggist would make up the mixture for you. I put 2 drachms of beeswax to 4oz. of turpentine for ground; but I think 3 drachms of wax to same amount of turpentine would be better, as two coats of my ground are not enough to protect the plate properly; you have probably put too much wax in yours; I think Japan varnish is very much the same as Japan black. I used Brunswick black instead. If you pour a portion of the ground on to the plate, moving it about so that it goes all over the surface, and then let it run off at one corner back into the bottle, a sufficient quantity will remain on the plate for a first coat, and a second coat applied in the same way, when the first one is dry, will be enough to protect the plate, and will be easily penetrated by the heavy steel needle with an etching point at each end; it is well to keep a cork on the end not in use when you are etching, as you may injure your eye with the point. The chief advantage of smoking the ground is that it prevents the polished copper dazzling the eye, and also that you can see more readily what progress you are making, the bright lines where you have etched showing through the black surface. If you put the plate in etching fluid before grounding it (page 39, "Handbook") the surface will get dark and will do away with dazzling effect, and the point of the needle will scrape away the dark shade when you etch, and the bright lines will show on the dark surface. The brightness of the copper is deceptive, however, and makes one imagine that there is more work done than there really is. If you wish to smoke plate you might try camphor. I always set fire to my ground when I use ordinary tapers to smoke it; I haven't tried camphor. I have not much experience in etching, but I shall be very glad if I can save you unnecessary failures. You might advertise your address, and I could correspond with you direct, and save your having to wait so long for a reply.—R. B.

[47429.]—**Electro-Gilding.**.—Give the articles a coating of copper in a sulphate of copper bath. The copper will cover the solder. Then try your gold.—Nihil.

[47429.]—**Electro-Gilding.**—Scratch-brush the soldered part dry. Then use a more intense current to drive the deposit on to the part. Don't have too poor a solution.—J. E. A.

[47429]—**Electro-Gilding.** — "An Amateur" who says he cannot make the gold touch the soldered parts of the article he wants to gild, will find that if he takes a few pieces of iron wire and ties them together so as to form a small brush, and dips them in a solution of blue copperas, and then draws them over the soldered parts so as to form a thin coat of copper, he will then be able to manage to make the gold take to it.—Possum.

[47431.]—**Speed.**—The time required is that at which the sum of the lengths would be covered at the sum of the speeds; the question, therefore, becomes, How long will a train take to run 66 yards at 90 miles an hour? 66 yards is 3-80 of a mile; the time required is thus, 3-7200 of an hour, or 1½ second.—Fellow of the Institute of Actuaries.

[47431.]—**Speed.**—Your query is the same as "How long does it take two bodies [brake-vans in this case], the one running at 50 miles per hour, the other at 40, (30 + 36) yards apart, to meet? This is equal to "How long does it take a body, running at 90 miles an hour, to travel 66 yards?" The answer to which is 1½ second, 90 miles: 66 yards :: 1 hour: 1½ second.—Camera.

[47431.]—**Speed.**—As I understand this query, its solution appears to be as follows:—Since the trains are moving in opposite directions at 50 and 40 miles an hour respectively, the two engines are separating at the rate of 90 miles an hour. Now the total length of the trains is 66 yards; how long will a train moving at 90 miles an hour be in travelling this distance? It moves 44 yards in a second, so that the time required is 1½ second. —O. V.

[47431.]—**Speed.**—50 miles per hour = 24 4-9th yards per second, 40 miles per hour = 19 5-9th yards per second. It is, therefore, evident that in one second of time both trains have travelled through (24 4-9th + 19 5-9th) = 44 yards of space. Then, since the first train is 30 yards, and the second 56 yards long, when the brake-vans are clear, both trains extend 66 yards. It is, therefore, required to find in what time both trains will have run 66 yards. Let x = required time in seconds.

$$x\left(24\frac{4}{9} + 19\frac{5}{9}\right) = 66;\ \text{or } x = \frac{66}{44} = 1\tfrac{1}{2},$$

or 1½ sec. = time required.—C. W. B.

[47431.]—**Speed.**—As we have to find when the ends of the two trains are together, it is evidently the same as to find what time it would take two bodies to meet, 66 yards apart, one going at a rate of 50 miles an hour, and the other at 40 miles an hour. This is easily done. Let a = distance in yards first body has to go before meeting, then $66 - x$ is the distance the second body has to go. The first body takes one hour to do 50 miles or 3/4400 minutes to do one yard, and $\therefore 3x/4400$ minutes to do x yards. Similarly the second body takes $(366 - x)/3520$ minutes to do $(66 - x)$ yards. But these times must be equal. $\therefore 3x/4400 = 3(66 - x)/3570$ which gives $x = 110/3$ yards. And the time taken by the first body to do 110/3 yards = 110/3 × 3/4400 minutes, or 1/40 of a minute, which is required time. Or, arithmetically—it is clear that the point at which they meet divides the 66 yards in the ratio of the speeds. And the ratio of the speeds = 5-4. ∴ first body goes 5-9 of 66 yards or 110/3 yards, and time is 1-40 of a minute, as before. —Hemisus.

[47431.]—**Speed.**—Let A = the train 30 yards long travelling at the rate of 50 miles per hour; let B = the train 36 yards long travelling at the rate of 40 miles per hour. If A were at rest, B's brake-van would have to travel 36 + 30 = 66 yards to clear A's van, and *vice versâ*. Therefore, by proportion, if A does 50 miles in 1 hour, how long will it take to do 66 yards? As 88,000 yards : 66 yards :: 3,600sec. to answer = 2·7sec. Again, if B does 40 miles in 1 hour, how long will it take to do 66 yards? As 70,400 yards : 66 yards :: 3,600sec. to answer = 3·375sec. Now take the average time they would do 66 yards in.

3·375
2·7
2)6·075sec.
3·0375 = average time.

As the two trains are running in opposite directions, it would only take half the above time for the vans to clear.

2)3·0375
1·51875sec. answer;

or, roughly speaking, 1½sec.—Solus.

[47433.]—**Portland Cement Floors in India.**—Possibly the Portland cement cracks:—(*a*) because the coat (¼in.) is not thick enough; (*b*) because the previous coat of plaster is allowed to get too dry before the cement is put on, or is too smooth to allow the cement to "grow" to it. The plaster surface should be roughened first, and then the cement put on, at least ½in. thick.—Hemisus.

[47433.] — **Portland Cement Floors.** — The experience I have of Portland cement as a finish to concrete floors is that ¼in. is not sufficiently thick. The soundest floor is that in which no difference is made between the finishing coat and that immediately beneath—in fact, there should be no finishing coat; but the whole floor, for 1½ to 2in. thick, should be homogeneous; and this, as it sets under the trowel or float, will be fined by the coarser sand settling to the bottom; 1 to 3 will be found a better proportion than 1 to 1, which is too *fat*. One cause of a thin skin separating, is the neglect of putting a fillet of wood along one side and one end of the apartment, to be removed as soon as the cement begins to set, for on this taking place, the whole mass expands in every direction; consequently, the centre of least resistance is heaved up, only to be speedily destroyed by traffic over it. The water-flooding is an excellent expedient if it is not used too soon.—C. I. B. F.

[47433.]—**Portland Cement Floors in India.**—In Calcutta, where I had a great deal to do with cement floors, we used to proceed thus:—The substratum having been laid, with bricks on edge set in mortar, or with concrete, we then spread a layer of about 4in. of a composition which is made of pounded bricks and freshly-slaked lime. The bricks are to be pounded into pieces about the size of a pea or a little larger; or what is called "soorkee siftings" may be used, which is simply the larger portions of the pounded bricks which will not pass through the sifting screen. A mortar is then made of one part by measure of lime to about two parts of the siftings, with a small proportion of finely-powdered bricks. This mixture is well mixed with water, and laid over the substratum to a depth of 4in.; a row of women and boys is then set to work, who beat it with little wooden mallets; this beating must go on for some days, until the layer is thoroughly consolidated, and by that time the layer will have become reduced in thickness to about 3in. It is better to allow it to set for some days before laying on the cement. The floor in this stage will have a somewhat rough appearance, which is all the better, as the cement will stick to it better than if it were smooth. The sand used for mixing with the cement was a coarse, sharp sand, dug from pits (not river-sand). About one and a half to two parts of sand are to be mixed with one of cement, and not too much water. This should be spread over the floor to a thickness of not less than ⅜in., and well levelled. A little dry cement is then to be powdered over the surface, and rubbed in with a mason's trowel; by this means a hard skin is produced when set. There is no use in flooding with water. The natives of India are very expert in making a hard shiny surface to these floors, by rubbing with the trowel slightly moistened. In England, where pounded bricks would be costly, probably gravel and sand would do as well.—M.I.C.E.

[47433.] — **Portland Cement Floors.** — "A Melting Mechanic" never will succeed in the way he proceeds. Bricks set on edge give no bite to the cement, and he has practically only a ¼in. flag on his floor, which cannot possibly stand any weight without cracking. Let him break up his bricks, stones, or sharp clinkers into small pieces, the largest no bigger than walnuts. Keep these free from mould or dirt—clean sand will not hurt: mix these in the proportion of one bucket of best Portland cement to seven or eight buckets of his hard material; put these on a board stage about 6ft. square; mix well together whilst dry. When mixed, get one man to pour water very clean out of a fine-rosed water-can on to a part, whilst another turns the same portion over on to a free portion of the wooden stage. This goes on until all is turned over. It must be then turned back again, more water being added, if necessary; but it is better to add enough the first time. If not mixed sufficiently it may be turned over a third time. It is then ready to be placed in a barrow, and taken to the spot where it is to be laid. A third man should lay it while the first two are making a fresh lot. A layer of 2½in. to 3in. is thick enough for garden walks or inside houses. As it is laid it should be well rammed, and the surface made as level as possible with the slope or fall it is intended to have permanently. When finished the surface will present a honey-combed look, with plenty of little holes to bind the next coat. Allow it to stand a week or a fortnight before finishing, watering the surface from time to time, and, if obliged to walk on it, place boards across it. It is now ready to finish in this manner: Pure cement and water are mixed together of the thickness of cream, and well worked on to the surface with a plasterer's trowel, putting on as thin a coat as possible, and working the cement into all the holes and crevices, and leaving a smooth surface. This should not be walked on for at least a week, and should be often watered whilst setting. A layer of sawdust renders this easier, as it retains the water longer; but sawdust must not be put on the first coat, as it would fill the little holes which give the bite or key to the final coat. If this be well done, a floor will be made which will practically last for ever. New cement is not good for forming concrete. It should be at least a month old, and kept in a dry place, being turned over occasionally, so as to expose the whole to the air. If fresh cement is used it is apt to crack. It is also important to have everything clean — bricks and stones clean and free from vegetable matter, the water quite pure.—E. H. Roe.

USEFUL AND SCIENTIFIC NOTES.

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A Jointed Axle for Tramcars.—A tramcar axle has been recently patented by a Dane, the object of which is to allow the wheels to pass round sharp curves without grinding. For this purpose the axle is divided in the centre, the end of one half having a hollow, and that of the other a corresponding projection, somewhat similar to a ball-and-socket joint, the necessary stiffness being given to the axle by a tube which surrounds the axle and extends between the naves of the wheel, against which it bears by gun-metal collars. At the centre, between the tube and the axle, is a gun-metal bearing, in which the axle can revolve. The wheels act in such a manner that in running along a straight line the wheels and axle turn together, as in an ordinary pair of wheels, but on passing round a curve the axle slips round in its joint, so that the wheel on the inner radius of the curve is retarded and the outer wheel accelerated in proportion to the sharpness of the curve, great smoothness being obtained in the vehicle, and less wear and tear of the tire and rail.

A New Use for Old Tin Cans and Scrap Tin.—According to the *Berg-und-Huettenmannische Zeitung*, a better method for utilising old tin cans than simply to melt off the solder has been devised. E. Rousset first heats the tin, old or new, in an oxidising flame, which burns up all the pure tin and that combined with iron. When this is stopped the scraps of iron are seen to be covered with a brown and brittle crust, the upper layer consisting of oxide of tin, the lower of magnetic oxide of iron. It is passed through rollers and then forms a powder that contains both oxides. The iron that remains after sifting out the powder makes good wrought iron or cast iron, but is particularly fitted for precipitating copper. The oxide of tin, although mixed with oxide of iron, can be easily worked into tin, and the metal obtained from it is free from sulphur and arsenic. But will it not contain traces of lead?

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last C. E. Stretton has replied to 46980.

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47123.	Electroplating, 316.
47134.	Bicycle-making, 316.
47135.	Compressed Gas, 317.

QUERIES.

[47434.]—**Lathe.**—Will Mr. J. H. Evans, or any other kind reader of "E. M.," inform me how to Babbitt the mandrel bars, rest, &c., of lathe illustrated in No. 876? What am I to put on mandrel, &c., so that they will not be fast when Babbitted? How am I to chamber the holes in standards? How is Babbitt metal made? Would white metal answer as well?—MINER.

[47435.]—**Magic-lantern Mechanical Slides.**—Would anyone who is in possession of the choreutoscope or the chromodrome, give a drawing of each part separate with sections? He would, I think, be conferring a favour on many amateurs. There are a number of magic-lantern manuals published which appear to be merely commercial puffs brought ought by shopkeepers to recommend their own apparatus. Can anyone say if Mr. Samuel Highley is still alive? I made his acquaintance in 1866, and got a good deal of information from him on magic-lantern matters. Nothing published on the subject, so far as I am aware, equals his papers on Lantern Optics, published in Cassell's "Technical Educator." He gives full constructive details for lantern-fronts—useful alike to the shopkeeper who employs journeymen brass-fitters to make up apparatus, and to the amateur who essays to construct his own.—GEREB ADMI.

[47436.]—**Pain in the Bowels.**—Will Dr. Edmunds kindly advise in my case?—I have been subject for quite ten years to sudden attacks of violent pain in the bowels, which nothing will relieve until my bowels are moved; the pain lasts about four or six hours, leaving afterwards great soreness, especially on the right side of the stomach, so much so that I can scarce walk upright for several days. I am a printer by trade, 28 years old, and a moderate liver. I have sometimes thought it was lead-poisoning, caused by my trade; but the symptoms do not agree with what I have read on the subject.—W. B.

[47437.]—**Steam-Pipe.**—Would anyone kindly tell me the standard "pitch" of threads used for steam-piping, from, say, 1in. up to 3in.?—NEW QUERIST.

[47438.]—**Astronomical.**—"F.R.A.S.," in letter 20150, p. 326, states that one of the necessary conditions for dividing Delta Cygni with a four-inch glass is twilight. Does the remark apply only to this particular object? If not, the inference is that twilight is the best time for certain delicate observations. The point is of interest to observers. Will "F.R.A.S." kindly explain?—RIGEL.

[47439.]—**Cement.**—Can any correspondent furnish me with a recipe to make the above to resist 300° of temperature that will not crack, and be durable and inexpensive?—W. R. H. R.

[47440.]—**Converting Peat into Charcoal.**—Will some reader give particulars of the process of converting peat into charcoal?—JAS. SMITH.

[47441.]—**Minute Photography.**—With what kind of lenses were the French despatches reduced during the siege of Paris, and what kind of collodion was employed? I have tried to photograph a newspaper with the objectives of a best microscope, but I do not succeed.—E. B. F.

[47442.]—**Bicycle Touring in Scotland.**—Will some of your many bicycle correspondents give a description of a bicycle tour in the south of Scotland, say, from Newcastle to Edinboro', and if it is practicable to visit the country about Loch Lomond (and the places which should be avoided), so as to take the advantage of train or boat where convenient; and any information about the preparing for such a tour: hotels, fare, scenery, and the disposing of luggage, &c., &c., will be most thankfully accepted.—TOURIST.

[47443.]—**Medical Coil.**—To MR. FRED. WALKER.—Please say if correct sizes of above are given in "E. M." for June 9th, as I have made a reel $2\frac{1}{4}$in. dia., 3in. long, and $\frac{1}{2}$lb. c.c. wire would only be about 4 layers. Also, if every third helix means every third layer, and oblige a—MONGERIL.

[47444.]—**Boiler Corrosion.**—Can any of our readers inform me how I can make a cheap and efficient water-filter large enough to supply a six-horse Cornish boiler? I pump the water from a well into a cask. It flows from the cask to one of Hancock's inspirators, which forces it into the boiler. The water has a large quantity of lime in it (so I am told), and I get a large amount of corrosion on the boiler-plates, which I am anxious to stop.—E. M.

[47445.]—**Electrical.**—Can any of your correspondents give me a reply to the following questions?—What is the electromotive force of a Sutton secondary cell, and how is it calculated? What is the internal resistance of the battery? How many cells would be required to keep a 10-candle Swan lamp in action? How is the electromotive force of a Faure cell calculated theoretically?—NAVAL ARCHITECT.

[47446.]—**Photographic Enlarging.**—Will some reader kindly give the best method for making enlargements on paper of a good tone by means of artificial light?—J. NOON.

[47447.]—**Repolishing or Redipping Sheet Brass for Labels on Tinwork.**—I use a great quantity of sheet-brass for labels, and to make it soft for stamping on I put it in the fire, which takes the brightness off it. Would any kind reader let me know what to dip it in to give back the brightness to the brass?—BLOOD STOCK.

[47448.]—**Induction Coil.**—In my "E. M." for Sept. 9, 1881, there is a drawing of a coil made by Ritchie, of Boston, with tube curved, and a number of divisions like "Inductorium's" of some years back. The core and primary are, however, said to be inclosed in a "heavy glass tube closed at the ends." How would the battery be connected with the primary, and what kind of a contact-breaker could be used under such circumstances? The correspondent sending sketch, &c., was "Roi Ne Puis," &c.—B. H.

[47449.]—**Induction Coils.**—I am sorry to trouble Mr. G. Tolman; but I cannot find out the meaning of a sentence he used when kindly replying to query 46603, p. 288. He says (apropos of a primary of two layers of No. 16), "two layers of 16 only short-circuits the cell," and advises 3 of 18 or 2 of 20 instead. I cannot understand the "short circuit": does it mean that 2 layers of 16 do not offer sufficient resistance to the battery to give proper effect? I suppose the 2 layers of 16 represent about $\frac{1}{2}$lb., and that has a resistance of about 1-10th of an ohm. What the resistance of a bich. is I don't know, as the books I have (Jenkin and Deschanel) leave out the single-cell bich. altogether. If I am right in my supposition as to the meaning of the sentence, may I ask why a comparatively unchecked flow of electricity does not work up the energy of the core as much as a restricted flow? Of course, I see that you would get more coils, and thus more excitement, with the smaller wires; but I should not have thought this difference in a 9in. coil would have had much effect.—B. H.

[47450.]—**Repairing Mirrors.**—We have several large French plate mirrors that have scratches, frosty-looking, and other spots which spoil the glass. Can any of your readers tell me how to proceed in the matter?—D. C. MUKER, 321, Larimer-street, Denver, Colo., U.S.A.

[47451.]—**Improving Definition of Telescope**—I would like to ask Mr. Lancaster or any one able to give the desired information (if the same can be given). Denver is located about 12 miles from the foot-hills of the rocky mountains, making the altitude 7,000ft. above the sea. The snowy range is from 50 to 100 miles distant from the city. We have a dark blue atmosphere around the mountains; at times it will assume a grey misty colour even on clear bright days. This, so far, has obscured definition with the telescope, that it cannot be used. I have tried powers of 24—49, 88—130, 240, none of which gives satisfaction. My o.g. is $4\frac{1}{2}$in. aperture, 62in. focus. Now what I want to know, is there any way, under reasonable circumstances, to improve the definition?—D. C. MUKER, 321, Larimer-street, Denver, Colo., U.S.A.

[47452.]—**Pleurisy.**—To DR. EDMUNDS.—About a year ago, I (aged 18) fell ill with pleurisy in the left lung, and according to medical instructions, I applied iodine dissolved in spirits of wine to the side mentioned. For some time I appeared to be progressing favourably; but just as I was congratulating myself that I had recovered, the pains returned in full vigour. All through last winter I was never free from pain for more than a fortnight at a time, and during the same time my temperature was always above 100°. Thinking over the circumstances of the case, it struck me that the iodine might be injuring, instead of helping, my recovery, and many little circumstances then came to my recollection, which made me almost certain that it was so. Since the beginning of March I stopped using it, with the doctor's permission, and from that time till now my recovery has been most surprising.—Is it usual in cases of pleurisy to apply iodine, continually, for such a length of time (8 months), and may I not, with some justice, lay the blame of my protracted illness on the use of iodine?—ANONYMOUS.

[47453.]—**Varnish for Clay Pipes.**—Could any of your readers kindly give me the information as to what wash or varnish is used to give that glossy appearance to clay pipes? I have tried several different solutions, but when the pipe is hot it becomes sticky, and has an objectionable smell.—S. T. B.

[47454.]—**Bleaching Old Willow Baskets.**—Can any correspondent inform me how to restore to their original whiteness baskets that have become discoloured and turned yellow by the sun and weather? I mean the ordinary willow baskets.—F. T. MILNER, Bishop Auckland.

[47455.]—**Boiler-Tube Piecing.**—Will any one give a description of apparatus for brazing loco. boiler-tubes by gas; and if superior to coke-fire brazing, to state wherein it consists?—J. G.

[47456.]—**Canvas Boat Making.**—Which I am about to start, is intended to be about 12ft. long. How broad and deep should it be for safety? How strong should the ribs be, &c.? How long should the mast be?—would bamboo be best? What shape should the sail be? All information and diagram (if possible) would be of great help.—L. NELSON.

[47457.]—**Injector.**—My injector (a Friedmann's, Class 6), after three seasons' use, suddenly fails to work. I have taken it apart and cleaned it without avail. One-half the water comes out at the overflow. The passages are all clear, and the cones, as near as I can judge, are quite in line with each other. The water is full of mud and sand, as it always is at this season of the year, and the temperature is about 52° Fahr. Steam-pressure 50 to 75lb. There is no obstruction in pipes or check-valve between boiler and injector. As it is used on a steamer a filter is inadmissible. Is there a remedy?—BACKWOODSMAN.

[47458.]—**Reeds for Jacquard Loom.**—Could any of the readers of the "E. M." inform me if there are any improved reeds for a jacquard loom which spring out after the shuttle has passed, so as to make the weft cross the warp in a circular form, or rather in the form of a half-circle? Or if there are any reeds, or any other means of making weft cross the warp in the above manner?—A. T. J.

[47459.]—**Silvering Looking-glasses.**—Can any one inform me if Brashear's process is suitable for silvering ordinary looking-glasses (not specula), and if so, kindly give its method of application?—C. H.

[47460.]—**Weight of Dynamite.**—Can some reader give the weight and explosive strength of dynamite, as compared with gunpowder.—J. C., Pera.

[47461.]—**Black Transfer Paper.**—Which is the easiest method of preparing black transfer-paper?—J. C., Pera.

[47462.]—**Legal.**—To MR. WETHERFIELD.—Will you kindly say what I can do in respect to the following?—I bought a £1 2s. petroleum oil cooking-stove at an ironmonger's under the impression that it would bake, boil, cook, &c., as set forth in the circular to do; but found, when I came to try it, that I had been deceived. In fact, it is quite useless: taking $4\frac{1}{2}$ hours to bake a small tart enough for two persons, and over 1 hour to cook $\frac{1}{2}$lb. of steak. Have taken it back and tried it in the shop, but is no better; nor can it be made so, as the thing appears entirely wrong, not being heat enough. The proprietor of shop refuses to refund money, or even let me have other goods to the value of £1, and says the thing is no good to him, and that I am bound to keep it. I cannot afford to lose the money. Can I legally get the money refunded, or goods to the amount.—F. W.

[47463.]—**Change-wheels for Screw-cutting.**—Can any reader tell me how to calculate what change-wheels to use for any particular screw? For the common screws I know which wheels to use; but for any odd screw I am puzzled. The only way I can manage is to try, try, try again until I hit on a combination which will suit, and as out of 24 change-wheels taken four at a time, there are about 50,000 combinations, the chance of hitting on just what I want is, I feel, rather remote. Surely there must be some direct method of calculating this. What plan is used in engineers' shops?—TRY AGAIN.

[47464.]—**Wood Shrinking.**—I have to make a number of wood wheels about 2in. dia., and encircle each end with an iron ring about $\frac{1}{2}$in. wide. These wheels have to run at a great speed; and I find after shrinking the wood by putting them in a hot place for a couple of days, then driving on the ring, in a short time the wood closes in still more, leaving the iron ring quite slack. Is there a method of making the wood hard and tough, and shrinking it to its utmost, previous to driving on the rings? Any information respecting the above would be gratefully received by—ANXIOUS TO KNOW.

[47465.]—**Faded Daguerreotype.**—Can any one tell me if it is possible to restore a faded daguerreotype, and also where to get it done? The figures are just visible if held in a certain light.—F. E. B.

[47466.]—**Iron.**—What is the strength (elastic and ultimate) of wrought iron at a bright red heat, and what is it at temperatures intermediate between that and 212° Fahr.?—CASMORE.

[47467.]—**Observatory on House.**—I have a fixed telescope in my observatory, on the Romsey plan, in the country; but owing to my not living there regularly, I find it very inconvenient to make observations as often as I would like. Often the prospect is for a clear night, and when I get there it clouds up; and then again, when I do not go out on account of unfavourable indications, it clears up when it is too late; so I have been thinking of removing my telescope to the City, where my residence is more permanent. If I do, it will have to go on top of the house, as, owing to the surrounding buildings, there is too little sky from the ground. Now I should like the opinion and advice of some of your readers upon this point. I know that on general principles the top of a house is a bad place for a telescope, unless upon a pillar from the ground up; but situated as I am, it would be much more convenient to have it there, provided the tremors are not too great. In one of the back Vols. of the MECHANIC, I noticed where Mr. G. F. Chambers had such an observatory, and he said that it worked very well; but he gave no directions how to put it up. My telescope is a 4in. equatoreal, by Cooke, with driving clock, &c. There is no heavy driving in the immediate neighbourhood, an open square being in front, and after eight or nine o'clock very little of any kind.—AMERICAN.

[47468.]—**Transit of Venus.**—Would "F.R.A.S.," or any other of our astronomical correspondents, kindly advise me as to the following?—I propose going to Jamaica for the purpose of seeing the Transit of Venus in December next. I wish to observe the optical phenomena only, without reference to anything else, and would like to know the chances of a clear sky and good definition at the time; also, the local times of contacts as nearly as possible, and the elevations of the sun at the beginning and end of Transit at Kingston. Would it be better to use a fine $3\frac{1}{4}$in. Cooke refractor, or a 5in. silver-on-glass reflector with double sun diagonal in either case?—JAMAICA.

[47469.]—**Galvanising.**—Can any reader tell me how to prepare wrought and cast-iron to be galvanised, and what are the tanks made of to resist the action of the chemicals? Also, will glazed stoneware stand fire?

Perhaps "Jack of All Trades" could assist me. Expense is no object.—T. J. R.

[47470.]—**Watch Repairing.**—To "A FELLOW-WORKMAN" OR "ALFOJOE."—Would you say how to hold the cylinder while punching in the bottom pivot? I have a cylinder plug tool which is very good for punching them out. The material dealers have cylinder pivots partly shaped. If I were to get a gross assorted, could I select one ready for putting in cylinder, and then commence to turn in pivot?—X. Y. Z.

[47471.]—**Watch Repairing.**—Would "A Fellow-Workman" or "Alfojoe" kindly give a hint with regard to the best way for turning in foot or cock jewel-holes, also, cock jewel-covers? Do material-dealers supply minute-wheels with their pinions in them, or should I require to fit pinion in? Does the hour wheel hold the socket for the canon pinion? Instructions on the above will greatly oblige.—X. Y. Z.

[47472.]—**Indian Workmen, &c.**—Will "Gereb Admi" favour us with an account of some of the devices used by Indian workmen, to which he alludes in letter 20114?—O. V.

[47473.]—**Gas for Laboratory.**—I have obtained this by displacing air in a barrel by water, and bubbling it through petroleum spirit. The barrel soon fills, and I want a gas-jet burning the greater part of the day. I have a 1in. pipe running water all day at a pressure sufficient to throw a jet 20ft. Could I utilise this for driving a small Root blower. What would be the cost of the plant? What would be the best way to saturate the air with petroleum vapour?—D. B.

[47474.]—**Astro.-Eyepiece.**—To "ALDEBARAN."—I have made a very satisfactory positive eyepiece by following your instructions, and I have tested my object-glass in the way described by you. A faint, but perfectly-steady picture of the gas-flame was shown on the screen, no matter how rapidly or in what way the card was moved about. Your kind replies and evident desire to "teach the young idea how to shoot" tempt me to ask you to explain the use of what appears to be a raised ring about 1in. diam. round the centre of the o.g. It can be clearly seen by looking down the tube when the eyepiece is removed. Also, please tell me which is the focal length of the o.g.—viz., the distance (29½in.) from the field-glass of astro. e.p. when focussed to the o.g., or the distance (41in.) from the o.g. (with e.p. removed) to the screen upon which the picture of a gas-flame is sharply defined. In calculating the power, it would, of course, make a material difference which measurement is used.—TYRO.

[47475.]—**Sidereal Indicator.**—Would some kind reader give sketch and explanation regarding sidereal indicator? and much oblige.—D. Mc.

[47476.]—**Legal.**—To MR. WHETHERFIELD.—On taking a house I agreed to pay and keep paid a week in advance, and signed a document to that effect. I have not been able to keep the week paid in advance, but have paid every week as became due. On tendering the week's rent due last Monday, it was refused, and a notice served, demanding the week's rent in advance or threatening proceedings for recovery. What proceedings can be taken for the week in advance? Can the landlord distrain, or what? Can I be legally compelled to pay the week's rent which has been tendered and refused?—THREE YEARS' SUBSCRIBER.

[47477.]—**Waves.**—Can any of your numerous readers recommend me a reliable book on the height of waves and the numbers of waves running a minute with different winds in different localities?—THE SEA.

[47478.]—**Induction Coil.**—To MR. LANCASTER.—I have made reel-ends, and have also procured all wire, &c. I propose making the reel 8in. long, using two layers of No. 18 primary wire, and ¼lb. secondary No. 36 gauge—would it be enough? Would you kindly tell me what the diam. of core should be, and when finished? What length of spark should I get, and also what kind of battery would be the best to use? Could I use Bunsen or bichromate?—A YOUNG BEGINNER.

[47479.]—**Legal.**—To MR. WETHERFIELD.—A man in good circumstances makes a will, leaving so much to his wife, and so much to his son and daughters, with legacies to his two executors. At his death some years afterwards, things have changed, and he dies ostensibly in debt. Under these circumstances (the affairs being in great confusion) the two executors sign a paper foregoing their legacies, as they are told they might be responsible for debts; but shortly afterwards assets flow in, and the widow (the son being under age) to be able to get the money paid to her, takes out letters of administration, and signs herself sole executrix. Now what claim has the son upon the estate (he being now of age), and can the mother will away all the money as she likes at her death? Has she a legal right to the whole after the son comes of age? Was not the will rendered null and void, and, therefore, the son sole heir at age?—ADOLESCENS.

[47480.]—**L. & N.W.R. Compound Locomotive Experiment, F. W. Webb's Patent.**—Are the results of the indicator-diagrams taken lately on the above engine on her up journey likely to be given forth in a short time, and where? Also, are any further modifications or improvements contemplated?—V.

[47481.]—**Colouring Gold Jewellery.**—Will some correspondent inform me how to get gold a good dead colour without showing the soldering marks?—S. D. C.

[47482.]—**Telephone.**—Which is the best form of telephone transmitter and receiver to use, so that the sounds reproduced may be audible throughout a room? Have no "E. M.'s" before 1881.—CHURCHMAN.

[47483.]—**Mining Queries.**—1. What should be the dimensions of an engine suitable to raise 1,500 tons of coal in 10 hours in a 40° slope and 1,000ft. long? 2. What will be the area of three airways that will divide an airway passing 100,000 c. ft. of air per minute, the same velocity being maintained in the splits? 3. The total quantity of air passing in a mine is 18,000 c. ft. per minute with two airways to pass along of equal lengths and area 36 sq.ft., one a square, and the other a circular. What quantity will pass in each? 4. Show why a single airway half a mile long offers the same resistance to a given current of air, as do two airways of the same size, but one mile long? 5. A fan 30ft. in dia. making 40 revos. per minute. What amount of air would it exhaust, and what is the probable water-gauge area of airways 40ft.? 6. How would you calculate the size of a fan to be erected for a certain required ventilation? 7. What proportion should the upcast airway of a shaft be to be downcast? What should the limited number of splits or airways in a mine be, supposing the seam to be giving off a large quantity of gas?—CARBON.

[47484.]—**Bennett's Battery.**—Can any of your readers explain what are the best conditions of this useful battery? I want to know whether the iron borings or the caustic alkali solution should be in the larger proportion. For example, I have a number of tin-plate cans, some tall and narrow, others broad and shallow. If I use the former, the borings will, of necessity, be packed in a deep narrow annulus around the porous pot, which will have no great capacity. If I use the latter, the borings will be in a shallow broad annulus, and the porous pot will, or may, stand up from the centre to any convenient height. Could Mr. Lecky, or perhaps Mr. Bennett himself, say which arrangement is calculated to work best?—P. W. R.

[47485.]—**Legal.**—Would Mr. Wetherfield or other kind correspondent answer the following?—An old man dies, and with the exception of a few small legacies, leaves his property to charitable institutions. His nephews and nieces contest the will, and, as a consequence, the leaseholds are saved to them. The leaseholds put up to auction in several lots, and all but one sold. Some of the nieces are married. Marriage settlements having been executed with the usual clause about increments of property of £200 and upwards, if succeeded to "at one and the same time from the same source," following the original trust. Now, the total of those sold by auction will yield more per share than £200, but each lot, taken separately, will not. Is there any good ground upon which to take action on the plea that (as it is not by virtue of the will, but on the contrary) the separate amounts realised by the separate lots as sold to different people are not as from the same source, and, therefore, do not follow the original trust? I think this a point upon which many at some time during their lives may desire enlightenment.—MARRIED AND DONE FOR.

[47486.]—**Euclid's Axioms.**—Dr. Bain, in his "Logic," Vol. II., p. 209, says that Euclid's axioms 3 to 7 are not true axioms, because "they are all very easily deducible from the two first." How can they be so deduced?—A. J. SMITH.

[47487.]—**Translation.**—Can any of your readers tell me whether Dr. Pinner's "Repertorium der Organische Chemie" has been translated into English?—H. J. E.

[47488.]—**Dryness.**—Will Dr. Edmunds kindly give advice for dryness of mouth? My mouth is always very dry. Very little saliva, and that little thick and frothy—sometimes worse than others. I am a cornet-player, and so find it a drawback. Age 23; non-smoker, and moderate drinker, and always enjoy good health. The dryness is as bad in winter as in summer. Whether I play cornet or not, drinking water has no effect on it.—CORNET.

[47489.]—**Storage Battery.**—Could any reader kindly give me the formulæ for the chemical reaction in the secondary cell in its various stages, and oblige?—ERIN-GO-BRAGH.

[47490.]—**Loco. Engine with Broken Crank-Shaft.**—I saw an engine brought in from the main line, broken down, and she was running on leading and trailing wheels only, her driving-wheels being lifted about an inch above the level of the rail. On asking what was wrong, I was told that her crank-shaft was broken. Will any reader of the "E. M." explain to me the way in which they lift the drivers clear of the metals, and oblige?—A YOUNG MECHANIC.

[47491.]—**Magic-lantern Slides.**—Will any one accustomed to the work kindly inform an amateur how photographs taken on glass can be painted so as to serve for magic-lantern slides?—A. B. C.

[47492.]—**Moon's Line of Apsides.**—20260, page 426, "Her line of apsides goes right round the heavens in a little less than nine years." Will "F.R.A.S." kindly say when the moon was last apogee in Taurus? Also, when perigee last in that sign? And (if the calculations are made) when the moon will again be perigee in that sign?—W. M. GARDNER.

[47493.]—**Velocity of the Wind.**—In the ENGLISH MECHANIC of July 7, page 413, I observe that you give the pressure of the wind on a sq. foot at 50 miles per hour, as 49½lb. In Molesworth's pocket-book I find that the pressure at this velocity equal 12·304lb. per sq. foot, and at 100 miles per hour the pressure is given as 49·21b. How is this difference to be accounted for?—OCTURUS.

[47494.]—**Speed of Small Steam Vessels.**—Can anyone give me one or more reliable rules for finding the speed of steam launches from 30ft. to 80ft. long?—OCTURUS.

[47495.]—**Gun-barrels.**—Will someone inform me how the polish is put on gun-barrels after the process of browning? And how long should the barrel be kept warm after the browning solution is applied?—SPORTSMAN.

[47496.]—**Power of Batteries for Coils.**—Will any of our competent correspondents kindly tell me by what rule you can tell what amount of battery power you can safely use with a coil without injury to it, so as to bring out its full force, length of spark, &c.? Or what indication is given when you are using too strong a battery?—W. R. C.

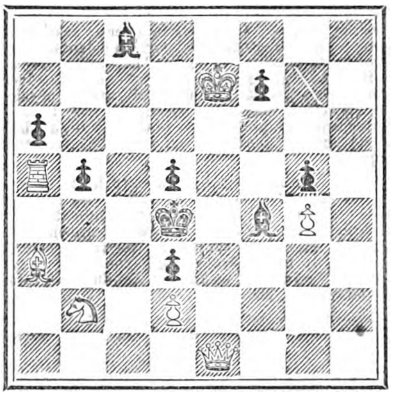
THE old Colony, U.S., Railroad people claim to carry in one of their trains running to Plymouth and wayside stations the largest number on the round trip of any train out of Boston. From 1,200 to 1,400 passengers are carried daily by this train. Boston has such thickly settled suburbs that the local trains on the roads entering it are no small part of their revenue.

CHESS.

ALL Communications for this department must be addressed to the Chess Editor, at the office of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCLXV.—By C. CALLANDER.

Black.



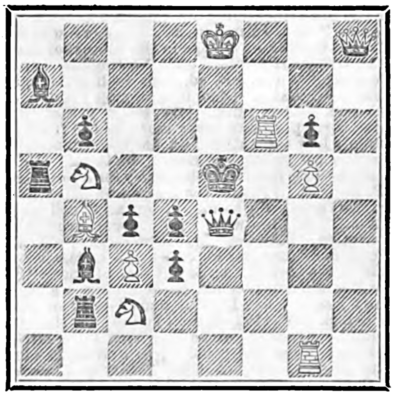
White.

White to play and mate in four moves.

PROBLEM DCCLXVI.—By S. LOYD.

From "Chess Strategy."

Black.



White.

White to play and mate in three moves.

RESPECTING problem 766, the author writes:—"A pleasing and somewhat curious way of preparing against a discovered check is shown here. I have employed it as a contingency in case the defence uncovers a check. The problem is carefully elaborated and rich with ideas and variations."

SOLUTION TO 761.

White.	*Black.*
1. Q to K B 5	1. Kt takes Q (a)
2. B to K 4 (ch)	2. K takes B
3. Kt mates	
	(a) 1. P takes Q (b)
2. P Queens, &c.	
	(b) 1. P to Kt 5 or B moves
2. B to B 4 (ch), &c.	

SOLUTION TO 762.

White.	*Black.*
1. Kt to K Kt 4	1. Anything
3. Mates accordingly	

In this position a P was accidentally omitted at Q R 4.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 759 by Celsus and Schmucke; to 760 by Celsus; to 762 by Schmucke.

Wells' Comet Seen at Mid-day.—Successful observations of the Wells comet were made at the Dudley Observatory, Albany, N.Y., June 11 and 12, at the meridian transit. The comet was seen to have a bright, perfectly-round, and sharply defined nucleus. The apparent diameter of this nucleus is about three-quarters of a second, or, after allowing for irradiation, about 200 miles. The observation, June 12, shows that the comet was still increasing in brightness, and that the vapours which surrounded the nucleus were becoming more dense and abundant. The observations also proved the Dudley Observatory ephemeris to be remarkably accurate.

ANSWERS TO CORRESPONDENTS.

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*** *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, July 19, and unacknowledged elsewhere :—

G. WILLIAMS.—R. A. Lee.—W. Kitney.—Mottershead & Co.—J. Wood.—R. Mills.—P. C. Vendryes.—P. A. Fothergill.—G. Pearson.—G. R. Miles.—Albo Carbon Light Company.—Dr. Doberck.—Rev. J. M. Perry.—Counter Tenor.—Cornet.—W. R. C.—Neo.—Beta.—Rural.—Indigestion. —A Subscriber.—Blackwater.—Semper Fidelis.—A Fellow of the Royal Astronomical Society.—H. S. Frost.—E. L. P.—F. Walker.—Scotch Working Mechanic.—E.

ERRATUM. (By a more than usually stupid blunder, the address in Messrs. Lee and Hunt's advertisement in our last issue was altered by the printer from "Nottingham" to "Birmingham." Readers will kindly note that there is no change in the address of the firm, which is still Arkwright Works, Nottingham, as heretofore.)—ROGO. (2d. and 4d., can be had through any agent.)—J. LANE. (Too late to stop; better correct next week.)—GEO. LUFF. (We, too, wish that our geological correspondents came more to the front; they certainly lack the enthusiasm and persistence of their astronomical and microscopical brethren. We have heard nothing from Mr. Skertchley for a long time.)—T. P. BARKAS. (Thanks for the note on hailstones, but the forms are hardly so uncommon as to call for illustration.) A. RIDGWAY. (We have received the description, but not the illustration.)—E. WEBB. (We do not know, but we expect all engagements are made on the ground. An advertisement under "Situations," in the Sale Column, might bring you a reply.)—BLACK FACE. (See Dr. Edmunds's letter on acne, in No. 881, p. 513.)—IVANHOE. (You can try the effect of warmth, but it must not be employed in the shape of hot irons. Turn the table down in front of a fire.)—FIXUS LECTOR. (You will find plenty in *Engineering*. See the No. for May 12, for instance.)—H. G. (Directions for making medical coils have been given many times, the last so recently as p. 313.)—NORMAN COLLINS. (We really cannot devote space to an illustration of a Bunsen burner with a cap of platinum gauze. They are so common, they can be seen at almost any gas-fitters. In its simplest form it is a tube with air inlets at the bottom, just where the gas-jet enters; the gas passing along draws air in, and the mixture is ignited about 6in. or 8in. from the point of commingling.)—VERDENT. ("House Painting," by E. A. Davidson. Crosby Lockwood and Co., Stationers' Hall-court, E.C., 6s.)—T. H. B. (Heat the tube carefully along the side, tapping gently end on until all the air is expelled. Perhaps the tube is not clean, and the mercury hangs to the sides.)—A FACTORY LAD. (See p. 313, and read future numbers. He has promised to give details. If you intend using it upon yourself without proper advice, you had better let it alone.)—H. J. N. (It is usually done with gum.)—ELECTRICIAN. (Put it in the lathe and guide it with the hands; or, if you have not a lathe, mount it on a spindle with a crank and coil it that way, guiding with the hand.)—HIGHLANDER. (Surely you have no idea of the largeness of your query. To make useful analyses of soils involves considerable knowledge of chemistry, and the briefest instructions would of necessity occupy considerable space. If it is only one kind, it would be cheaper to send a specimen to an analytical chemist; but if you want to set up as an adviser, and an analyst, there is nothing for it but to study practical chemistry. In Vol. XXVI., p. 483, and Vol. XXVII., p. 72, you will, however, find the rudiments, or a "rough outline.")—ONE WHO IS ANXIOUS TO KNOW. (Your question is simply a sum which can be answered by a reference to any book on arithmetic.)—MATER. (You will find full particulars on p. 401, Vol. XII.; but the secret consists in adding white wax to the starch, and using it warm. At the place cited it is stated that the shirts are starched, then dried, then starched again, and ironed with ordinary irons; the finish is put on with a special iron, called a polishing-iron, which has a bevel at one end, and it is this bevelled iron, aided by the wax, that brings up the glaze. The proportions of wax stated are 2oz. to the pound of starch.)—JUMBO. (What you ask for has been given many times, though possibly not all at once. You must look through back numbers; see pp. 87, 111, 224, 289, 336 of this volume, for instance.)—VESTA. (Directions for making wax matches on p. 636, No. 416; vesuvians or fusees on pp. 202, 207, No. 346.)—FRANGIPANI. (You must state the "scents" required, for they are prepared as essences, oils, spirits, and waters. There is a book on the subject, we believe, by Piesse.)—ELECTRO. (Directions for making electric bells have been given over and over again, and as to a battery, see p. 6 or p. 308 of this volume.)—ONE IN NEED. (You mean one of the graph processes. See query 47286, p. 387, and reply on p. 410. Special inks are used. For full particulars, see p. 545, No. 750.)—WAVERLEY. (See p. 380, 386, Vol. XXXIII.; also replies 47278, p. 410, No. 902.)—W. Ll. (Are not the instructions given on p. 407 sufficient? If not, specify the difficulty.)—M. OLLINER. (1. Immerse in a solution of nitric acid, one to three parts water, and clean with a brush and bathbrick, using plenty of water. 2. Any good dictionary answers this question. 3. It is a tonic if anything, and should be taken before meals; but only a few drops at a time in water.) L. E. J. (Stanford, Charing Cross, publishes some useful handbooks giving an account of British Industries.)—THANKS FOR REPLY. (Consult the indices. Query answered many times.)—HOINOS. (Try aniline black.)

H. E. HUSSON—JAVELIN. (Your queries can appear only in the "Sixpenny Sale Column.")

W. H. R.—Nihil.—Tria.—Mitchell, Newcastle, and others have replied to queries already similarly or adequately answered.

THE Commission appointed by M. Ferry to report on the construction of the rotating dome for the large refractor of the Paris Observatory has held numerous meetings at the Conservatoire des Arts et Métiers, Colonel Laussedat, director of the establishment, being in the chair. Only two projects have been reserved for final choice. M. Eiffel proposes to use a saline solution in a horizontal circular channel placed on the wall to diminish the weight of the rotary roof.

THE preliminary surveys for the proposed reclamation of the Zuyder Zee have been finished, and the work of building the walls will soon begin. A dike about 24½ miles in length will be constructed of sand and faced with clay, reaching 16ft. above the level of the sea, which will make it about 6½ft. above the highest tide. The thickness of the dike will be such as will enable it to resist the heaviest seas. Operations will begin at four different points, and the calculation is to have it completed in from seven to ten years, at a cost of 46,000,000 dols.

DR. HERTZ has recently made experiments on the vapour-tension of mercury. The vapour-tension was measured at high temperatures, and values were obtained which likewise were smaller than Regnault's, but greater than those found by Dr. Hagen. From his values, Dr. Hertz calculated a formula, according to which he produced a curve of the vapour-tension of mercury with varying temperature; its zero point being at absolute zero —273 deg. C.—For low temperatures, 0 deg. C., 10 deg., and 20 deg., the values he deduces from his formula are under those obtained experimentally by Dr. Hagen for the same temperatures.

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OUR EXCHANGE COLUMN.

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The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

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Photographic Apparatus (complete) wanted for Halse's ten-guinea Galvanic Machine, in good working order, for curing rheumatism.—WILLIAM ANDERSON, 3, Brookdale-avenue, Ilfracombe.

Wanted, portable **Dry-plate Camera,** background, and Camera suitable for copying, &c. Many useful offers, or part cash.—BETA, Belbroughton, Stourbridge.

10 by 8 Sliding **Camera,** dark slide, rising front, &c. Maker, Dallmeyer. Good condition. Exchange for Hickory Trolling Rod and Tackle.—W. B. GANNON, Baddow, Essex.

Patent **Weighing Machine,** no weights required, ½ oz. to 4 cwt. Makers, Hart and Co. Cost £10 10s. Sell for £7, or accept useful offers. Suit grocer or merchant.—37, Northcross-road, East Dulwich.

Safe, capital fire and thief proof, 24 by 18, with patent lever powder-proof lock. Cost £8 8s. Sell for £5, or would accept provisions, &c., in exchange.—37, Northcross road, East Dulwich.

Vertical Galvanometer, handsome Cylinder Machine, large Leyden Bunsen Batteries, Bellows, Camera, all fittings. Wanted, small Incandescent Lamps; handy form good Battery, small motor; Wire. Sell exceedingly cheap.—ERNEST CLOVER, Springfield, Sudbury, Suffolk.

"Cassell's Popular Educator," six volumes, bound in three new and unsoiled. Cost £2 5s. Offers in Electrical Batteries, Telescope, &c.—CONYNGHAM, Jun., Mahony's-avenue, Cork.

Wanted, **Fossils,** Coins, or any natural objects for a small collection of genuine Stamps, Monograms, &c., some rare.—J. BAILEY, Free Library, West Bromwich.

I have a large liver-coloured **Dog,** with fine tail, length from tip of nose to tail, 60in.; height, 24in.; straight coat, most excellent house dog. Very fond of water. Not 12 months old. Still growing. Will exchange for good Musical Box or Electric Apparatus.—Letters only, W. D. J., 78, Viaduct-street, London, E.

Photographic Apparatus, with all accessories. Lens by Dallmeyer. Equal to new. Cost over £10. Exchange for Tricycle.—D. S. ANDERSON, Chemist, Forfar, N.B.

Wanted, the first volume of the "**English Mechanic,**" unbound. Exchange.—27, Mount Pleasant-road, Lewisham.

Gun-metal **Slide-Valve,** cylinder bored 1in., 2in. stroke, one turned crank shaft 3½ inch stroke, one gun-metal pump casting. Exchange.—L., 31, Fairfield-road, Bow.

Electrical Machine preferred. "Bedford's Easy Method" of Learning Banjo, Piano, Violin, with or without learning music. Cost 9s each.—17, Shirley-street, Cliftonville.

Treadle Lathe, all iron, and **Watchmaker's Throw.** What offers?—11, Queen-street, Belgrave Gate, Leicester.

Good old **Violin,** bow and case, complete, £3 10s., or exchange to £5. Offers.—HEWSON, 11, Great Crown-court, Haymarket, London.

Quantity professionally-made **Organ Fittings,** nearly a complete organ. Keys, pipes, soundboards, &c. Cost £7. What offers in exchange?—TANNER, Rusham-road, Horsham.

Whole-plate **Camera** and Portrait Lens, cost eight guineas. Would take Lancaster's "Le Meritoire," half-plate size, in part exchange.—TANNER, Rusham-road, Horsham.

Wanted, ¼-plate **Camera,** with focussing and dark slides. Give in exchange a 5 mm. Revolver, six-chambered, in walnut case, fittings complete.—"SIGMA," 69, Albert-street, Crewe.

I have a gentleman's Silver Geneva **Watch,** cost 30s. What offers in exchange for it?—36, Lea-road, Luton, Beds.

THE SIXPENNY SALE COLUMN.

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Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

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For Sale.

"The Night-light Clock." Illustrated and described on page 370, No. 848. Price, carriage free, 5s. 6d.—P. ROBERTSON, 13, Greek street, Soho, W.

The English Mechanic
AND
WORLD OF SCIENCE AND ART.

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FRIDAY, JULY 28, 1882.

SCIENCE AT SOUTH KENSINGTON.

THE general public, whose ideas of science teaching at South Kensington are mainly derived from the newspaper reports of the field-days at that remarkable institution, would probably experience a feeling compounded of surprise and indignation were they permitted even the briefest peep behind the scenes, at the wonderful Brompton focus of jobbery and place-making. To read the fulsome way in which "the butter-boat" is passed between Mr. Mundella and certain of the most prominent and leading spirits among the vast staff of hangers-on of the "Department," could scarcely fail to impress the conviction upon the uninstructed outsider that great and valuable educational work in science was being performed at Brompton, at a relatively insignificant national cost; and that the oft-reiterated complaint that the British artificer was wofully behind his Continental confrère, was in a very fair way, indeed, of being speedily remedied. Now, *in limine*, the total amount distributed in the shape of grants to successful candidates, may be taken roughly to amount to £40,000; a sum which the nation need scarcely grudge, were it devoted to a legitimate end. The total annual cost of the Science and Art Department, however, is £337,181, and if we halve the sum devoted to these subjects jointly, it needs but very rudimentary arithmetical acquirements, indeed, to deduce the fact that three-quarters of the sum annually voted by the State for teaching sciences is swallowed up by the staff of leeches who batten on this most singularly constituted establishment. But, even then, do we get our "hapor'th of bread" in connection with this "intolerable quantity of sack"? We wot not. Artificers proper are extremely scarce among the competitors; and such subjects as machine construction and applied mechanics are taken up by a totally insignificant proportion of the competitors. Pupil-teachers are the people who figure most conspicuously among the candidates, for a reason which must be at once apparent to all school managers and others having anything to do with the administration of the Education Code. To meet this state of things, there has arisen a wretched system of cramming from a series of textbooks (many of them compiled by members of the overgrown and overpaid staff at Brompton themselves), by the aid of which a considerable percentage of candidates contrive to pass in various fancy subjects in the elementary stage. Should one of them manage, by dint of more than usually energetic cram, to pass in the advanced stage, he forthwith receives a certificate entitling him to teach the subject in which he has gone out; and so hordes of scientifically blind teachers of the blind are scattered broadcast over the country. We cannot better illustrate the kind of information communicated by this most faulty system than by quoting a series of actual answers given by various students in the new-fangled subject of "Physiography"—a subject expressly invented to create a berth at Brompton for one of the creatures of the department. We have received them direct from a quondam examiner, and pledge ourselves as to their absolutely genuine character and literal transcriptions (1.) "The negro race have a very thick skull, at which the back of the head goes quite straight up to the forehead. Their hair is of a black, woolly colour, and their perplexion (*sic*) is rather black. The part of the world in which they live is India. The negroes are very strong, and if you wanted to kill one of them, the best place to hit them would be in the body. The tenderest place of the negro is the back of the leg, just below the knee." (2.) "Climates are those vast plains which are very cold and frosty." (3.) "On the west coast of Europe the climate is very cold compared with the east of America. This is owing, in some measure, to the Ural Mountains." (4.) "The chief rainless districts are Europe, Asia, and Africa. They are caused by the sun shining so much on the countries, and, therefore, draws up more water." (5.) "During an eruption the crater gradually gets lifted up until it reaches the top and flows over the side of the volcano." (6.) "A great circle must be something that we cannot see the end of, like a rainbow, which when it is seen in the heavens appears to reach from one end of the sky to the other." (7.) "A great circle is called an oblate spheroid." (8.) "The Equator is the line showing the centre of the Earth," and (9.) (Finis coronat opus) "The increase of civilisation of the British Island is rectified by the many indentations in the coast, which proves the commercial pursuits carried out; for the ships coming in gradually wears the coast away. Africa has the least indentation in its coast, and is the most degraded." Such are, *verbatim et literatim*, a few of the replies given at some tolerably recent Science (?) Examinations at South Kensington. We do not, of course, pretend that those who penned them passed, even in the elementary stage. Our purpose in quoting them here is to invite a careful perusal of them in connection with that of certain notorious textbooks, in order that the reader may see for himself just how and where such astonishing blundering has had its origin; and exactly how the miserable examinees have muddled up the ill-digested mass of facts which have been crammed into them from these compilations. Such a comparison will show that, in a large proportion of cases, the very words of the textbooks have only been sufficiently distorted or misapplied to just make nonsense of the answer. This, then, is the outcome of the system of cram and sham, for which the British nation is annually called upon to pay such an exorbitant sum. Even did the cost of the staff bear some reasonable proportion to that of the actual grant, a system which encouraged such a form of scientific education (Heaven save the mark!) as all this indicates, must stand self-condemned. Mr. Mundella may flatter Professor Huxley, Professor Huxley may flatter Colonel Donelly, and the gallant Colonel may "pass it on" to Mr. Mundella again; but the day must come when all this sham will be found out. Then will an indignant public learn that all these examinations, certificates, scholarships, et id genus omne, are but an excuse, cloak, and blind for the maintenance of an enormous horde of overpaid hangers-on and parasites at Brompton; and that if a clean sweep were made to-night of the entire party, British Science could not fail to be in an infinitely sounder, healthier, and more prosperous condition for it.

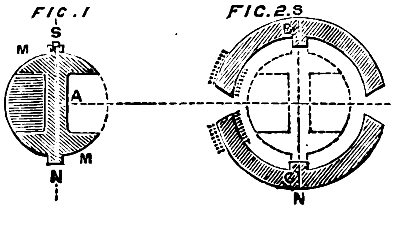
THE BOILER EXPLOSIONS ACT.

THE Act which is "to make better provision for inquiries with regard to boiler explosions," came into force on the 12th instant, and within an hour of its coming into operation a case occurred which will show how the Act works in practice. The term "boiler," as used in the Act, includes any closed vessel in which steam is generated or water or other liquid is boiled, or any vessel into which steam is admitted; but the Act does not apply to boilers used exclusively for domestic purposes, or to those on board ship or used in mines, or on railways, because, except in the case of domestic boilers, special provision has been made for inquiries into explosions in those classes by separate Acts of Parliament. The fact that the Bill was about to become law created considerable excitement, not so much perhaps amongst boiler owners as amongst boiler insurance and inspecting companies. As our readers are aware, there are rival associations, some of which merely inspect and report the condition of boilers, while others inspect and insure the owners against loss by explosion. The latter class, it will be understood, stand on a similar footing to fire-insurance companies; it is their interest to receive premiums and have as few losses as possible; but it is not unlikely that in their desire to secure premiums they are not so strict in their requirements as societies which merely inspect and report to the owners; or, if as strict, the work of periodical inspection is perhaps often neglected, the expenses being heavy and the "risk" slight, when spread over a large number of boilers. From July, 1864, to the end of last year, the number of boiler explosions in the United Kingdom amounted to 865, by which 1,034 persons were killed, and 1,718 were injured more or less seriously. The numbers for last year were respectively 34, 40, and 47, figures which it will be seen are below the average for the preceding 17 years; but still far too high to be contemplated with equanimity. The number of explosions during the past five years averaged 38·2 per annum, while in the preceding five it was 58·2, so that it is permissible to hope that the decline was due largely to the exertions of the different societies, and to the greater care exercised by non-insuring owners. So long, however, as steam-boilers are used, there will always be some liability of explosion; for though the boilers themselves may be safe, it is impossible to entirely eliminate the element of carelessness. Of the 34 explosions which happened last year no fewer than 10 are attributed to negligence or mismanagement: that is to say, they would not have occurred if ordinary care and skill had been used; but many of the other explosions were also caused by negligence indirectly, because corrosion and other sources of disaster were allowed to go on unheeded. In one case, it may be remembered, 16 persons were killed and 11 injured, and as the evidence disclosed gross negligence on the part of the owner, he was convicted of manslaughter and sentenced to twelve months' imprisonment. That case is exceptional for its common-sense verdict; for if coroners' juries had some years ago brought in verdicts of manslaughter, or at least, something different to "accidental death," Mr. Hugh Mason would not have found it necessary to bring in his Bill, and would scarcely have passed it if he had. The provisions of the new Act, which it will have been seen from an advertisement in our columns, is supplied gratis to users of steam-boilers, are peremptory in some of the sections; for instance, on the occurrence of an explosion the owner or user of the boiler shall, within twenty-four hours, send notice thereof to the Board of Trade, and give certain particulars, which are set forth in the schedule, under a penalty for neglect of a fine not exceeding £20. On receiving the report, the Board of Trade may appoint competent engineers to make a preliminary inquiry, or without such inquiry they may institute a formal investigation, which is to be made by a court consisting of not less than two commissioners appointed by the Board of Trade. This court will have all the powers of a court of summary jurisdiction, and in addition will either as a body or in the person of its officers have full power to enter and inspect any place or building which appears likely to throw any light on the explosion. The court may also summons and examine any persons it thinks necessary, and may require and enforce the production of all books and documents it considers important. The court will administer oaths, and require witnesses to declare the truth of their statements, such witnesses being paid on the scale usual if attending a court of record; but the court may order the costs and expenses of the preliminary inquiry or of the formal investigation to be paid by the person summoned. The court making a formal investigation will report fully and clearly to the Board of Trade the causes of the explosion, and all the circumstances attending the same, adding any observations which it may deem necessary on the evidence. The Board of Trade, whether a formal investigation or merely a preliminary inquiry is made, will make the report public in such manner as it thinks fit. The two commissioners appointed by the Board of Trade are to be respectively a competent engineer and a competent lawyer, and one of them is to be president of the court. The notice of the boiler explosion is to be given in the terms indicated by the schedule, one item of which is the name and address of any society or association by whom the boiler was last inspected or insured. It will be noted that, with the exception of the penalty for not giving notice, no fines are specified by the Act, but the court may order the expense of the investigation to be paid "by any person summoned before it." To say the least, that is a very large power, for literally, it means that the court may order anyone to pay the expenses. No doubt it means, as will be found in practice, that the court will order the owner, or the person intrusted with the boiler, to pay the cost and expenses; and as even that will not clear the user of the boiler from the clauses of the Employers' Liability Act, an explosion will be found to be a rather expensive disaster—much more costly than several repairs, and a great many inspections. Added to the loss occasioned by damages to the premises, and the liability to conviction for manslaughter, these provisions of the Act should be sufficient to prevent wilful carelessness; but looking at the wording of the Act, it would appear that the court may order a boiler-tenter to pay the costs of an investigation if any disaster occurs which can be clearly traced to his neglect. The working of the Act will be watched very closely, especially by those owners of second-hand boilers who do not insure, and who, for reasons well understood, decline to call in the inspectors. The case above-mentioned is not a very important one; but from the facts already published it is an example of many explosions which, it may be hoped, will not often occur when the Act becomes known. The boiler in question exploded at Facit, near Rochdale, was at once reported to the Board of Trade, and Mr. Traill and Mr. Carlisle were appointed to make the investigation. The boiler was of the vertical type, 4ft. 8in. in diameter, by 8ft. 6in. in height, worked at a stated pressure of 60lb. The shell tore the base-plate, through the ring seam of rivets, and after soaring up to a considerable height, fell at a distance of 120 yards. Other pieces were scattered in different directions, the smoke-tube having rent across at the root of the flange attaching it to the fire-box crown, at which part it was grooved to a depth of one-eighth of an inch. In such a case, occurring, perhaps, in a busy neighbourhood, it is clear that considerable damage might be done by the flying shell, to buildings as well as to individuals; but experience teaches that not one coroner's jury in a thousand would bring in any other verdict than "accidental death," which is tantamount to saying that the explosion could not have been prevented. We shall see what report the court makes to the Board of Trade as to the cause of the Facit explosion. It may not be easy to discover, but, at least, we expect some reasonable explanation; for although it may be impossible to altogether prevent boiler explosions, a study of their history reveals the fact that with proper precautions they would become sensations by their rarity. That "insurance" does not mean proper precautions is very clearly shown by the report of an expert sent down by the Board of Trade to inquire into the Radcliffe explosion which happened on May 1st. The expert was Mr. T. J. Richards, who, in his report to the Home Secretary, writes: "Thus, during the whole time the boiler was insured, about fifteen years, no thorough examination had been made to ascertain if it was safe, notwithstanding the fact that during the last five years at least it was known that the boiler was subject to the effects of dampness." "The owners of the boiler cannot be excused of neglect, in omitting to give the insurance company facilities for making a thorough examination; but, on the other hand, although the insurance company were, as shown by the letters, aware of the damp state of the flues, we find no intimation to the owner that any further delay in making a thorough examination was dangerous; but, on the other hand, the insurance of the boiler was continued." Mr. Richards says also, "there appears no reason to regard the case of the Radcliffe exploded boiler as an isolated one"—an opinion which we are afraid is unfortunately correct. In this case, three men were killed, and the coroner's jury found a verdict of accidental death; appending to it, however, an opinion that compulsory examination of steam-boilers once a year by certified inspectors should be enforced by the Government. In some respects, this Radcliffe explosion is unique, for the insurance company appear to have been quite aware of the risk, and wrote letter after letter to the owners, and at last, when the latter were prepared for a thorough examination, the company's officers could not attend, as the notice was insufficient. A few months afterwards the explosion happened. Users of boilers ought at least to know something of them and of their defects; but it is perhaps excusable if a busy firm puts off the thorough "inspection" when they find the company willing to continue the insurance. They are apt at least to think that there is no serious danger, and work their boilers until something goes wrong, which too frequently culminates in a verdict of "accidental" death. It is probable that, but for more pressing matters, the question would have been taken up by the Government, and something larger than Mr. Mason's Bill would have been passed. As it is, however, that measure will help to make both users and insurance companies cautious, and should any explosion unfortunately occur, the reports of the court will afford valuable facts upon which to base further legislation.

GRISCOM'S DYNAMO-MACHINE.

We have previously given general descriptions of Griscom's little dynamo-machine, which has, however, been chiefly exhibited as a motor driving sewing-machines, lathes, &c. Some improvements have been recently patented in this country, and the descriptions, with the illustrations, will afford useful information to those who wish to construct small dynamos or electric motors. The invention relates to improvements in armatures for magneto-electric and dynamo-electric machines and motors, and has especial reference to armatures of the type known as Siemens; but it is applicable to the poles of all other magnets or armatures. It consists in dividing the bipolar extremities of such armatures into two or more sections concentric with each other, one or more of such sections being at such a distance as to utilise the magnetic lines of force which fill the space between the two poles of the field-magnets, whilst the other section or sections are arranged so as to pass in close proximity to the poles of the field-magnets, and thus utilise the powerful attraction between the poles of the armature and magnet as the one approaches the other.

Figs. 1 and 2 represent a transverse section of a magneto-electric dynamo or electro-magnetic armature and a field-magnet constructed according to the invention. Referring to Fig. 1, A is an armature of the before-mentioned type having its bi-polar extremities divided into two or more sections concentric with each other, one or more of such sections M revolving or working at such a distance within the field-magnets B and C (see Fig. 2) as to utilise the magnetic lines of force which are generated and disseminated in the magnetic field or space between the two poles of the magnets.



The other section or sections P before referred to, are longitudinal ribs or projections concentric with, but extending or protruding above or beyond, the peripheries of the other sections M, so as to pass, when the armature is revolving, in closer proximity to the poles of the field-magnets B and C than do the sections M, so as to economically utilise the lines of magnetic force between the poles of the field-magnet. The interior surfaces of the field-magnets B and C are formed or provided with projecting ribs or pieces arranged so as just to clear the projections P upon the armature A when it is revolving. In this manner the poles are caused to utilise certain magneto- or electro-inductive influences upon the extremely close approach of iron to iron, while the polar surfaces are arranged for utilising the induced lines of force extending across the magnetic field of the magnets B and C. The size and quantity of wire coiled on the armature and field-magnets obviously depend on the dimensions of the machine to a certain extent, and absolutely on the resistance, &c. The best size and number of coils will therefore be a matter of calculation and experiment; but possibly some of our readers can give the results of practical trials.

ASTRONOMICAL NOTES FOR AUGUST, 1882.

The Sun.

Day of Month.	Souths.				At Greenwich Mean Noon.								
					Right Ascension.			Declination. North.			Sidereal Time.		
	h.	m.	s.	p.m	h.	m.	s.	°	′	″	h.	m.	s.
1	0	6	4·57	,,	°	46	3	17	59	51	8	39	58·19
6	0	5	38·94	,,	9	5	20	16	40	32	8	59	40·97
11	0	4	59 02	,,	9	24	23	15	14	27	9	19	23·74
16	0	4	5·23	,,	9	43	12	13	42	16	9	39	6·51
21	0	2	58·30	,,	10	1	48	12	4	39	9	58	49·28
26	0	1	39·53	,,	10	20	12	10	22	17	10	18	32·05
31	0	0	10·73	,,	10	38	26	8	35	49	10	38	14·81

The Method of finding the Sidereal Time at Mean Noon for any other Station will be found on p. 390 of Vol. XXXIV. The usual indications of Solar Activity are now both permanent and abundant

Occultations of (and near approaches to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.		°	°	h. m.		°	°
2	B.A.C. 8276	6½	‡8 33 p.m.	Bright.	41	2	§8 51 p.m.	Dark	1	322
2	22 Piscium	6	9 55 ,,	Bright.	136	98	10 49 ,,	Dark	271	235
9	B.A.C. 1733	6½	1 19 a.m.	Bright.	107	69	2 13 a.m.	Dark	262	222
23	B.A.C. 5954	6	10 50 p.m.	Dark	56	86	‡11 39 ,,	Bright.	320	354
25	B.A.C. 6658	6	†6 46 ,,	N. by W.	190	169				
28	c^1 Capricorni	4½	4 7 a.m.	Dark	53	90	‡4 35 a.m.	Bright.	352	30
29	κ Aquarii	5	1 26 ,,	Bright.	101	116	2 30 ,,	Dark	313	337
29	B A.C. 8152	6½	†7 55 p.m.	N.N.W.	202	165				
30	15 Piscium	6½	1 30 a.m.	Bright.	104	111	2 37 a.m.	Dark	311	330
30	λ Piscium	5	†5 21 ,,	S.S.E.	23	59				
31	51 Piscium	6	1 56 ,,	Bright.	193	194	2.13 a.m.	Dark	220	225

† Near approaches. ‡ Stars below the horizon. § Star rising.

The Moon.

Enters her Last Quarter at 4h. 13·0m. a.m. on August 6th, and is New at 9h. 10·0m. on the night of the 13th. She will enter her First Quarter at 54·8 minutes after midnight on the 21st, and be Full at 9h. 18·6m. p.m. on the 28th. High tides may be looked for about the 29th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	17·2	1 20·7 a.m.
6	22·2	5 48·0 ,,
11	27·2	10 9·3 ,,
16	2·6	1 48·0 p.m.
21	7·6	5 30·6 ,,
26	12·6	10 7·2 ,,
31	17·6	1 49·9 a.m.

The Moon will be in conjunction with Saturn at 2 a.m. on the 7th; with Jupiter at 6 a.m. on the 9th; with Mercury at midnight on the 13th.; with Mars at 6 a.m. on the 17th; and with Venus at 10 o'clock on the same night.

Mercury

Is a Morning Star during rather more than the first third of the month; but comes into superior conjunction with the Sun at midnight on August 14th, after which he becomes an Evening Star. He is too close to the Sun to be satisfactorily observed, is nearly round, and his diameter varies very little from 5″ during the entire month.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	7 47·5	21 37·4	11 7·7 a.m.
6	8 29·1	20 19·1	11 29·5 ,,
11	9 11·4	17 58·1	11 52·1 ,,
16	9 51·8	14 50·2	0 12·6 p.m.
21	10 28·9	11 14·6	0 30·0 ,,
26	11 2·8	7 26·5	0 44·1 ,,
31	11 33·9	3 36·2	0 55·5 ,,

Starting thus from the confines of Gemini and Cancer, Mercury will cross the latter constellation and the greater part of Leo. He will be a little south of γ Cancri on the 5th, and south of Regulus on the evening of the 17th. He will be in conjunction with Uranus at 8 p.m. on the 28th.

Venus

Is an Evening Star during the whole of August, and is becoming an interesting telescopic object. Her angular diameter increases from 14·8″ on the 1st to 19″ by the 31st. She is still slightly gibbous, and will not be dichotomised (or present the appearance of a half moon) until next month.

Day of Month.	Right Ascension.	Declination	Souths.
	h. m.	° ′	h. m.
1	11 20·5	5 13·0 N.	2 40·1p.m.
6	11 41·3	2 41·6 ,,	2 41·1 ,,
11	12 1·8	0 8·4 ,,	2 41·9 ,,
16	12 22·1	2 25·2 S.	2 42·5 ,,
21	12 42·3	4 57·9 ,,	2 43·0 ,,
26	13 2·3	7 28·5 ,,	2 43·4 ,,
31	13 22·4	9 55·5 ,,	2 43·7 ,,

Thus Venus travels from Leo into Virgo. She will be about 1½° South of η Virginis on the 14th, and rather more than 1° North of Spica Virginis on the 30th. She will be in conjunction with Mars (only 5′ North of that planet) at 11 a.m. on the 2nd.

Mars

Has left us until 1883.

Jupiter

Will scarcely be visible, for the purpose of the ordinary observer, until next month.

Saturn

Is a Morning Star, but he rises soon after 11 p.m. at the beginning of August, and between 9 and 10 o'clock at night towards the end of the month, so we resume our Ephemeris of him. He will be in quadrature with the Sun at 10 p.m. on the 18th. His angular diameter increases from 15·8″ to 16·8″ between the 1st and the 31st. No sensible change in the opening of his rings will be noted since he disappeared in the Sun's rays in February.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	3 32·6	16 53·8	6 53·4 a.m.
6	3 33·8	16 57·2	6 35·0 ,,
11	3 34·8	17 0·0	6 16·4 ,,
16	3 35·8	17 2·1	5 57·6 ,,
21	3 36·5	17 3·7	5 38·7 ,,
26	3 37·1	17 4·6	5 19·6 ,,
31	3 37·4	17 4·9	5 0·3 ,,

The very short path of Saturn this month lies wholly in that blank region in Taurus to the south and slightly to the west of the Pleiades.

Uranus,

Like Mars, has departed until next year.

Neptune

Is in quadrature with the Sun at 3 p.m. on the 11th; but it will be useless for us to furnish any Ephemeris of him until October.

Shooting Stars

Are more numerous this month. We need scarcely remind the student of the shower of August 10th, which has been known from remote antiquity. Mediævally, the Irish Roman Catholics designated the meteorites "St. Laurence's Tears." They are now somewhat more scientifically called the Perseids, from their apparent radiation from a point in the constellation Perseus, and have been shown by Schiaparelli to be connected with (or to fill the orbit of) a brilliant Comet which appeared in 1862. Watch should be kept on the nights from the 9th to the 11th inclusive.

Greenwich Mean Time of Southing of Nine of the Principal Fixed Stars on the Night of August 1st, 1882.

Star	Souths. h. m. s.	
α Ophiuchi	8 48 5·85	p.m.
γ Draconis	9 12 25·91	,,
Vega	9 51 24·58	,,
ζ Aquilæ	10 18 23·03	,,
Altair	11 3 18·33	,,
α^2 Capricorni	11 29 43·13	,,
α Cygni	11 55 32·67	,,
α Cephei	12 33 48·24	,,
ε Pegasi	12 56 21·69	,,

The Method of ascertaining the Local Instant of Transit of either of the Stars in the above List, as also that of determining the Greenwich Mean Time of its Meridian Passage on any other night in August, wlll be found on p. 392 of our XXXIVth. Volume.

THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURAL, AND LODGMENT.*

By JOHN WATSON WARMAN,

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A FEW *Remarks* must now be made on the Advantages and Defects of the eight foregoing points of difference between the present and the first Treatment given.

Difference 1 (this and the two which follow it are stated at *m*, ante, 1st parag.) The *Advantages* of this are that less Workmanship is involved; and that for the Great-Organ a Backfall can be employed instead of two Squares, *without* necessitating the front-ward and so less accessible posit of the Pallett-Pulls (see *l*, ante, 3rd parag.)

The *Disadvantage* is that the Player is brought closer to the Pipes. In the present Instrument, however, the Manual Soundboards are kept well up,—viz., at 6ft. above the Platform-top, measuring to the under-face of the Wind-chest beneath the Soundboard (see 43, *k*). [By this it is not meant that the Faringdon Organ was faulty in such respect; for, confined as was the height in that case (see *l*, ante, 4th parag.), the corresponding dimension was made only 2in. under the said 6ft.]

Difference 2. This may be regarded as an *unmixed Advantage.*

Difference 3. This, though still leaving the *Pipe Order* of the Swell Org. defective (see *q*, next, 2nd parag.), may yet be looked upon as an *absolute improvement*; for the Swell Tone is—as will just have been seen—now less obstructed, the Conveyancing to the Front Pipes is at least *not more* extended than it was before, and the "Whole" Roller-Board rendered necessary partly cuts off the Pallett-Pluck from the player's touch (see *l*, ante, 3rd parag.). As connected with this last point, it may be just mentioned that the Manual Palletts in the present Instrument are of the *Boat* (Flexible-Face) kind; but that such Type affords no palpable relief until a [Soundboard] Groove is reached which is of a certain sufficient width: see fully on this matter in *Department* WINDCHEST.

Difference 4 (this and the four which follow it are stated at *m*, ante, 2nd parag.). The *Advantages* of this are;—that less workmanship is involved in the Backfalls and their Beam; that the two Roller-Boards can be of exactly the same Sett and Make; that it becomes practicable to employ the Wire-driven Form of Coupler Man.-to-Man. (see again *m*, ante, 2nd parag.),—which Form is, on the whole, superior to that necessitated in Nicholson's Instrument (see next parag. but one); and that a Clear Coupler (see *r*, next, 2nd parag., and on) is rendered possible, because the keeping of the Great-Org. Backfalls parallel will allow the Great-to-Ped. Stickers' being Wired into *them.* [In this last case the Backfalls of the said Great-to-Ped. will be a little extended at their rear ends, and the said Stickers—carried by such ends—will run straight up between the Noses of the Squares which rest on the Swell Key Tails,—such Stickers being set at the areal point which would otherwise be occupied by the Driving-Wire of the Man.-to-Man. Coupler (see *m*, ante, 2nd parag., Diff. 5), such Coupler being, of course, now compelled to be of some form which is placed between the two Manuals. (Still, however, there will exist the obstruction afforded by the feet of the Great-Org. Stickers; see on this point at *q q q q*, next, 4th parag.)]

The *Disadvantages* of Diff. 4 are; that a second Whole Roller-board becomes inevitable; and that, owing to the Keys of one Manual having been Skewed out of agreement with those of the other, it is necessary to employ a second Skew in one of the Key-Actions, in order to restore such agreement. If this last be not done, then the advantage is sacrificed of having both of the Manual Roller-boards set-out and made just alike.

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Difference 5. The chief *Advantages* of this Wire-driven Form of Coupler Man.-to-Man. are;—that Friction is lessened,—that at the Sticker-Block having of course departed along with the latter itself; that there is less chance of an unbidden Sounding through the warping of a Backfall or a Sticker; that the absence of the Sticker-Block just mentioned favours the taking out of such Sticker itself; that there is no necessity for Skewing either the Key, or any portion of the Action of it or of Coupler; that a slightly shorter Coupling-Backfall suffices; and that the Front Regulation of such Coupler becomes quite practicable without employing any special tool, or, with a simple Modification to be directly (at *p*, next, 4th parag.) described, quite practicable without a Tool at all,—and with using but one hand.

The chief *Disadvantages* of this Form of Manual-to-Manual Coupler are;—that Retention of its Regulation becomes impracticable on the taking of its Mechanism apart (such Retention, however, being *partly* secured when the *Modification* just spoken of is employed,—see *p*, next, 7th parag.), because the Driving Wires cannot well be Number-marked; that such taking apart is itself rendered more difficult (though here again the said Modification assists, —see *p*, next, 6th parag.); that a Regulating Button on the Great-Org. Sticker Top will, when used, not only disturb the Regulation of the present Coupler, but may, by destroying the interchangeability of such Stickers, still further injure its Retention of Regulation just stated, (it is quite true that *these* Stickers can be easily *numbered*, but this obviously will involve more labour, in respect of such numbering, and of the care required to avoid inserting a Sticker into its wrong place); that this Form of Coupler cannot be used with Fanned Backfalls; that the Skew of the Coupling Backfall is of an *anomalous* amount,—*i.e.*, that of a *fraction less* that the Half Semitonal Key-tail distance, because such Backfall commences at a little way along on one of the lines of two Actions that are converging to one same point; and that the extra workmanship of the Wire and its two Buttons will probably slightly overbalance the gain by abolition of the Block on front Sticker and Button on rear Sticker.

[It will be noted that all these objections are more or less trivial;—in particular, the Regulation at the Great-Organ Sticker will directly be seen to be unwise under the present—which may be regarded as almost a *Normal*—Arrangement; and Fanned Backfalls are not generally to be recommended unless Space is really restricted (see at *l*, ante, 3rd parag.).]

Difference 6. Here also we may consider that we now have nothing but *Advantage*,—as follows:—The shortening of the Sticker slightly lightens the Key-Action, besides giving practically more vertical room for the [Whole] Roller-board of the same Manual (see at *u u u*, next, 3rd parag.). The absence of the Driving-Block from the Sticker has already been seen to facilitate the Removal of the latter. The widening of such Stickers at the point of their passing through the higher Manual (the absence of the Driving-Block obviously rendering such a widening unnecessary at the upper part of the Sticker) is another of those little things which show Willis' complete mastery of his Profession (here see at *h*, ante, 5th and 7th parags.): and the trifling additional length of the Notching in the Key side does not involve any palpable increase of workmanship, and is not in such a direction as to weaken the Key body. The absence of the Regulating Button from the Great Org. Sticker, which at first thought appears to be a defect, is really an evidence of the very greatest sagacity; for any Regulation made at the top of this Sticker has already been shown to disturb the Regulation of the present form of Manual-to-Manual Coupler, and it has been also seen that such disturbance will be aggravated if such Stickers, which inevitably become, in use, of non-uniform virtual length, do get interchanged in their positions. Remember also that the Front Regulation of the *Swell* Manual is already almost sure to be sacrificed (see *g*, ante, 2nd parag.); and this being so, and such Key-board therefore having to be Regulated from the inside of the Organ, it is just as well that the Great Org. Key-board likewise be Regulated at the same time;—for the two Manuals are almost certain to require such Adjustment together. And yet again, observe that the difficulty as regards the Inside Regulation of the Great-Org.-Keys which was exhibited in the Faringdon Organ is not existent in the present Instrument. Yet once more,—the saving of the Screw and Button is a consideration, and so is the avoidance of the trouble of numbering the [Great-Org.] Stickers, and of observing such numbering in putting latter in place. In this connection note also that the provision of a Clear Coupler, as just indicated (at *m*, ante, 8th parag.), will obviously demand that the Wire at top of the present Sticker be a smooth, and therefore an un-Tapped, one.

Difference 7. This, though so essentially good in itself, as allowing the easy removal of the Swell Org. Keys (see 89, *e*), is *not*, in the Hoddesdon Organ, an *unalloyed advantage*, because, while the want of Participation of the Coupling Swell to Great is there *retained*, the Participation of the Coupling Swell to Pedale is *sacrificed* (see here for how to be recovered,—ref. *p*. next, 3rd. parag.). There is also a decrease in the approximation to Key-length Uniformity (see 89, *g*): but this is a comparatively trifling matter.

Difference 8. The *Advantages* of this have already been seen to consist of a diminution in the chances of an unbidden sounding of the Instrument, and the avoidance of any possibility of the Great-Org. Key's being *fore-lifted* in its actuations by the Pedals.

The *Disadvantages* are; that such a posit of the Square-Nose is not favourable to its access, should its treatment for Regulation be desired; and that either the Backfall or the Key of the Great-Organ becomes lengthened, because there is now more overlap of the one by the other.

n. We must now definitely indicate the actual blemishes exhibited in the Hoddesdon Manual Treatment. Those points which are matters of General Arrangement,—viz., Differences 1, 2, and 3, have already been considered in Detail (at *m* ante, parag. 4 and on), and will be virtually summarised in the succeeding Treatment No. 4 (at *q*, next, 1st. and 2nd. parags.).

Among the *Differences* 4, 5, 6, 7, and 8 we find existent the following five real Defects:—

1: Non Participation of the Swell-Org. Key in its Coupling either to the Great or the Pedale Section (see *m*, ante, 11th parag.)

2: Impracticability, *without* the Modification mentioned, (des. at *p*. next, 4th parag.), of Regulating the Coupler Swell to Great without at the same time employing something to prevent the turning round of the Wire by which such operation is performed (see *m*, ante, 10th parag.). This is sometimes very inconvenient.

3: Impossibility of Removing the Backfalls of this last-named Coupler without first taking out all their said [Driving] Wires (see *m*, ante, 11th. parag.) This point, however, is not of very great moment.

4: Certainty that, in the act of such taking out of Coupler Wires, their adjustment to Regulation will be destroyed, (see again at *m*, ante, 11th parag.).

5: The Skewing of one of the Manuals. This is here objectionable because the Pipe-Order and the Soundboard length are *alike* in the two Manual Sections; and it therefore becomes desirable to avail oneself of the opportunity so afforded for making one Set-out serve for both of their Roller-boards, and so simplifying the labour; and this in its turn calls for correspondence as regards right and left in the Tails of the two Manuals (see *p*, next, 8th parag.) And here, remember, there exists no Crossing of the Manual Actions to furnish a reason for such Skewing of the Keys. See, however, at this point, what is said (at *q*, next, 2nd parag.) with reference to the *general* undesirableness of having both of the present Sections planted in one same Pipe-Order.

The absence of Front Regulation for the Swell Manual of course continues in the present Treatment. See for this at *g*, ante, 2nd parag.; and for the obtaining of it at *h*, ante, 9th parag. and on.

As a *Summary* of this No. 3 *Treatment* we may say that it is certainly, on the whole, a very excellent one, and that the five points just stated are, all of them, of only inferior importance; but that they still are of sufficient weight to render it unadvisable to ever copy the Design in its unaltered entirety. For the Corrections of the same we proceed now to the next *Treatment*.

o. [See, however, first with respect to the Coupler Swell to Great being made of the *Part* kind (ref. *qqqq*. next, 1st parag. and on),—what is there said applying equally in the present case.]

p. *No.* 4 *Treatment*.—This consists, as just intimated, in the Correction of the Five Defects last stated.

The Arrangement and Structure of the Organ itself are assumed to be exactly as in the preceding Treatment No. 3,—as shown in the Differences 1, 2, and 3 (given at *m*, ante, 1st parag.).

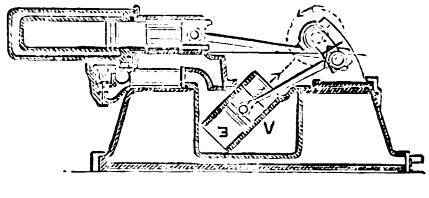
Defect No. 1 (stated at *n*, ante, 3rd parag.). This is cured exactly as before,—viz., by Forking the Tails of the Swell-Org. Keys, and inserting into them the Noses of their Action-Squares (see 89, *o*), the Stickers of the Coupler Swell-to-Pedale of course remaining Wired into such Squares (see 89, *p*).

Defect No. 2 (stated at *n*, ante, 4th parag.). The present writer's device for obviating this defect—and at the same time getting rid of the two following ones (stated at *n*, ante, 5th and 6th parags.)—consists simply in forming the lower end of the Coupling Wire into a longish square Loop or Stirrup, for carrying the Coupling-Backfall Nose within it (instead of treating such Wire as is described at *m*, ante, 2nd parag. Difference 5). The clear inner [horizontal] width of this *Nose-Stirrup* will be $\frac{1}{4}$in., and its clear inner height not less than 1in. The Fore-Nose of the Coupling Backfall will be left, in the first process of making, at the vertical width of not less than $\frac{7}{8}$in.; and will, at its proper Driving point, receive (instead of a Piercing) a vertical *Cut*, extending from its under edge to within about $\frac{1}{4}$in. of its upper edge. (The posit of the Fulcrum center of this Backfall will of course be made to correspond with such top finish of the Cut, so that the Stirrup contact will properly cross the line of Centers; see for this in *Departments* COUPLING-ACTION and KEY-ACTION.) Into the said Cut will be hitched the bottom portion of the Nose-Stirrup, and the Coupling-Wire will thus, when in action, do its work (as usual) by lifting the Coupling-Backfall Nose, and, when out of action, be free to ride up and down inside the Cut,—of course without being able to release itself from the latter. The width of the Cut should be such, that when it is lined with suitable *Cloth*, the actual space existent will just accommodate the Wire (No. 15) of the Stirrup, while yet allowing to such Wire a perfect freedom for the *riding* just spoken of. The said Cloth will be cut to almost the full width of $\frac{1}{4}$in.: and the fore Nose of the Backfall should be thinned to only a trifle over $\frac{1}{8}$in., so that the edges of the Cloth will be slightly *projectant*, and thus keep the Stirrup from actually touching the sides of the Nose. If preferred, the latter may be also *slope-cut* away on each side of the Cut proper, so as to prevent its end of the [Coupling] Backfall from being too heavy.

(*To be continued.*)

IMPROVEMENTS IN THE OTTO GAS-ENGINE.

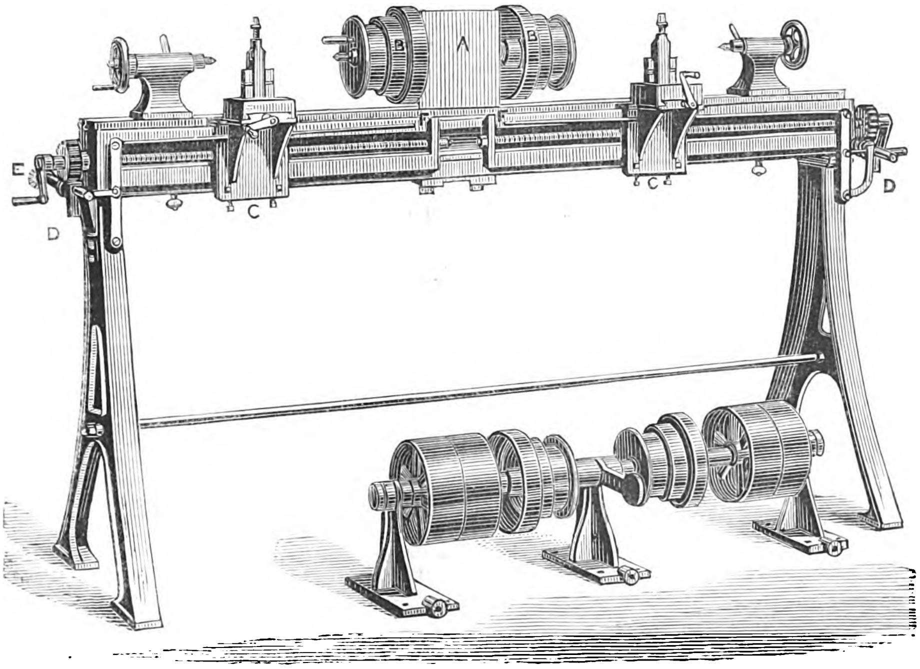
SOME improvements in the Otto Gas-Engine have been recently patented by Mr. F. W. Crossley and Mr. H. P. Holt, of Manchester (5469, 1881), the value of which are fairly shown by the diagram annexed. The invention relates to modifications in the construction and arrangement of the well-known Otto-Crossley gas-engine, by means of which during one complete revolution of the engine the combustion of the charge,



the expulsion or withdrawal of the products of combustion, and the introduction and compression of a fresh charge of air and gas are effected. The invention also consists of an apparatus for regulating the supply of the combustible. An exhaust pump or cylinder E is placed at a suitable angle in the bed of the engine, and is worked in the usual manner by a connecting rod and piston driven by the crank-shaft. The cylinder has at the side a port governed by valves (not shown in the Fig.), worked by the usual arrangement, which are so proportioned and moved that as the piston approaches the completion of its outstroke, the cylinder is put into communication with the vacuum chamber V, which is just being rapidly exhausted by the quick movement of the piston in the exhaust pump E. Simultaneously with this withdrawal of the products of combustion, just as the piston is finishing its outstroke, the gas and air supply valves admit a fresh charge at the other end of the cylinder, which, as it were, follow up the outgoing products of combustion, and fill the cylinder with a fresh charge. The ports next being closed, the piston makes its instroke and compresses the charge, which is then fired in the usual way, and another outstroke is made. There is thus an explosion for every outstroke of the piston. The supply of gas is regulated by means of a cam actuating a tappet on a lever connected to the governor, and also to the supply valve. The drawing shows the principal feature of the invention, the base acting as a water tank in connection with the casing around the cylinder.

LATHE WITH DOUBLE-HEADS FOR SLIDING TWO SHAFTS AT ONCE.

WE give an illustration of a lathe, made by the Britannia Company of Colchester, with double-heads for sliding two shafts at once. It is a very economical tool, and will, the makers assure us, soon save its cost in any shop where quantities of shafts are required.



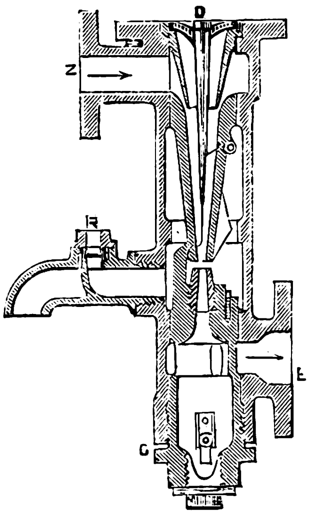
A is a square cast-iron box containing two pair gear-wheels, which drive the back shaft E E, which is connected with the leading screw which drives the rests. B B are the driving pulleys. C C traversing rests, resting upon a double-V slide on the front of lathe-bed. D D handles for working the rests back. E E back shafts. F F are two rods upon which slides run, which can be fixed at any distance, so as to stop the traverse of the tool. As the rests press against them, it withdraws a pin, causing the feed at D to be thrown out of gear.

COLOURING GOLD.

THE following directions for colouring gold alloys are given by Herr E. Schlosser, of Vienna:—

Gold alloys, particulary those containing copper, acquire through repeated heatings during their manufacture, an unseemly brown or brownish black colour, caused by the oxide of copper, to remove which they are boiled or pickled in very dilute sulphuric or hydrochloric acid, according to the colour they are to have. If we have an alloy containing only gold and copper, either sulphuric or hydrochloric acid is employed, for gold is not attacked by either of them, while the oxide of copper dissolves so easily that after the pickling the articles have the colour of pure gold, for the surface is covered with a thin film of gold. If the alloy consists solely of gold and silver, the liquid employed is nitric acid, and the articles are left in it a very short time; the acid dissolves a small quantity of silver, and the articles acquire the colour of gold. If the alloy contains both copper and silver, besides the gold, the method of pickling can be varied to suit the colour it is desired to give to it. If, for instance, it is put in sulphuric acid, the copper alone is dissolved, and the colour obtained is that of an alloy of gold and silver, for the surface consists of the two. If nitric acid were used, both copper and silver would be dissolved, and in this case the colour obtained would be that of pure gold. The articles are gently heated and allowed to cool again before boiling. The object of the heating is to destroy any grease or dust that adheres to it. If they are soldered with soft solder, they cannot, of course, be heated, and must be cleansed from grease and dust by first putting them in a strong lye, then washing with water and putting them in the acid. The acids are used dilute, usually in the proportion of one part of concentrated acid to forty parts of water. The articles are laid side by side in a porcelain or earthenware dish, and the dilute acid poured over them. From time to time one is taken out to see if it is yellow enough. When the proper colour has been reached they are washed in clean water and dried. While this pickling is merely to bring out the colour of the gold, the colouring of gold has for its object the imparting to inferior goods of the appearance of fine gold. Different mixtures can be employed for colouring gold, two of which are given below as giving very good results. Mix together two parts of saltpetre, one part of table salt, and six parts of alum, with six and a half parts of water, and warm the mixture in a porcelain vessel. As soon as it begins to rise add one part of hydrochloric acid, and bring the contents of the vessel to a boil, stirring in the meantime with a glass rod. The articles to be coloured, suspended on hooks made of strong platinum wire, or of glass, are first dipped in sulphuric acid and then put in the slowly cooking solution last described and moved to and fro in it. In about three minutes they are taken out and dipped into a large vessel of water so as to see what colour they are. If the desired shade is not yet attained they are dipped in again as often as necessary until they do have it. In the subsequent dippings they are only left in the liquid for one minute. Articles coloured in this way have a light yellow colour, but matte appearance. They are repeatedly washed in water to remove the last trace of the liquid, and then dried in soft sawdust that has been warmed. Instead of drying in sawdust they can be dipped in hot water the last time and left in there a few seconds, and when taken out the water that hangs on them will evaporate almost instantly. The second method of colouring gold alloys is by means of a mixture of 115 parts of white table-salt and 230 parts of nitric acid, with enough water added to dissolve the salt. This is boiled down to a dry mass of salt. The salt is put in a porcelain dish and 172 parts of fuming hydrochloric acid poured over it and heated to boiling. As soon as the suffocating odour of chlorine is perceived the articles to be coloured are dipped in, and the first time they are left eight minutes in the liquid. In other respects the treatment is the same as above described. Articles polished previously do not require polishing again. Care must be taken not to inhale the dangerous gas; the operation must be conducted under a draught or out of doors.

AN INJECTOR WORKED BY EXHAUST STEAM.



SUCCESSFUL attempts to utilise exhaust steam in working injectors have been made in this country, but in practice we believe a portion of live steam is used with them. *The American Machinist* gives the following account of an injector which forces water of 175° Fahr., and needs only the exhaust steam. By the aid of the sectional view we will describe its parts and their operation. The working parts are inclosed within a case open at both ends and provided with a water branch Z, and a sealed overflow R. The combined steam and water pass through the delivery branch E to the boiler. The usual check valve is interposed between the injector and the boiler. The reader will observe that this injector consists of three fixed jets or nozzles: a steam nozzle, a mixing nozzle and a receiving nozzle. The mixing nozzle consists of two parts. The fixed part being divided longitudinally for about two-thirds of its length and a short part hinged to it. The injector standing in a vertical position, the loose part falls aways from the fixed part when the injector is not working. The reason for this arrangement is substantially this: the large opening thus created permits the free entrance of a large body of water to condense the steam and insure the automatic starting and working of the injector. As soon as the injector starts, this hinged nozzle closes to its fixed size shown. The exhaust steam pipe connects with the upper end D of the injector. This injector will not *draw* water, but will work positively under a head of one foot. The water supply to the injector is regulated by the water regulator, which is permanently set when the working conditions are once ascertained. The exhaust steam pipe is connected with the exhaust pipe as near the cylinder of the engine as possible, in order to utilise all the available heat of the exhaust steam. *No live steam from the boiler is used*, so this injector catches and utilises the waste power of the engine as it is about to escape into the open air. This injector is of special value where exhaust pipes are of insufficient capacity to convey away the exhaust steam. Many instances of this kind may be found in our cities. If there is a back pressure in the exhaust pipe, as soon as the injector starts the back pressure will be greatly reduced, and in many cases a partial vacuum be produced, the injector acting as a jet condenser. To make this clearer we will refer to certain experiments, with their results, which we recently witnessed with this injector at the works of William Sellers and Co., Philadelphia, where they have a No. 6 exhaust steam injector in practical operation. The feed water showed a temperature of 64° when the exhaust steam valve was opened. The back pressure of steam in the exhaust pipe was was half a pound per square inch. Steam first came out of the overflow, then water, after which the injector went to work forcing water at a temperature of 168° to 175°, against a boiler pressure of 65 pounds. Immediately upon the starting of the injector, the back pressure in the exhaust pipe disappeared, and the vacuum gauge indicated half an inch to one inch of vacuum in the pipe. By repeated trials it was found that the injector would break and start automatically with a vacuum of one inch in the exhaust pipe, forcing water against a boiler pressure of 68¾ pounds. Upon trial, it was found that the injector would work against as boiler pressure of 98 pounds before the steam broke. It then started automatically. For higher pressures, from 75 pounds up to 150 pounds per square inch, a second steam nozzle is introduced, and a very small quantity of live steam is used from the boiler to help out with the exhaust. It will be understood that this injector at once takes the place of a heater and feed pump, the power to operate it costing nothing. It, moreover, increases the available power of the engine, to which it is attached by its action as a condenser in removing the back pressure. We noticed, at the trial alluded to, that the vacuum gauge several times indicated a vacuum of 4in. in the exhaust pipe before the steam broke. This experiment was repeated several times. Another and equally interesting experiment tried was to turn on the water at 8 pounds' pressure in the feed pipe, and upon opening the throttle the injector went to work reducing the pressure in the the feed pipe to 2 pounds. The feed water was turned into a tank, having a head of one foot. The overflow from the tank and the injector were about equal. As soon as the injector started, the overflow from the tank ceased, proving that about double the quantity of water passed through the injector when working that could escape from the overflow when it was not working. The injector with which these experiments were tried was a No. 6, with a steam pipe 2½in. in diameter; overflow, 1¼in. delivery, 2¼in., feed water, 1¼in.—throwing 600 gallons of water per hour.

An injector known as the Binary is made by a Manchester firm, but as its name implies, boiler steam as well as exhaust is invariably used.

THE GEOGRAPHY OF PLANTS.*

EXPERIMENTS made to prove or disprove spontaneous generation reveal the fact that vegetation may be said to be almost ubiquitous; wherever soil, heat, light and moisture are found, there the plant will appear; the very bodies in which we dwell, nay, even the bread intended to nourish them, is not unfrequently converted into a field teeming with vegetable life. On the earth, however, although plants may be said to grow everywhere—in tropic heat and arctic snow—their kinds, number and size depend on certain conditions resulting from the varying proportions in which soil, solar influence and moisture are supplied to them. Of these, the effect of a change of soil was probably first observed; the influence of the solar rays, varied by proximity to mountains, or distance from the equator, could not long escape observation, and, finally, moisture and atmospheric influences would be noticed. These together with human and animal agencies constitute the causes of vegetable distribution, but, in attempting to form a conception of the present appearance of the terrestrial flora, we must not lose sight of the principle of community of origin, the real key to geographical distribution, which tends to *aggregate* groups of related forms, as the former agencies tend to segregate, to disperse, or, as Darwin says, to modify.

The first question that suggests itself to him who attempts to trace the distribution of plant-life on the globe, a task, to some extent impossible, because of the immense tracts of land—and those with the most varied and copious vegetation—of the natural products of which our knowledge is still most deficient, is this: What was its origin? Were plants *created* where they grow, or did they spring up from seeds brought to their present locations by accident or design? If the former, all attempts at accounting for their appearance there are vain; but if the latter, the question arises, whence were they first brought? What shall we regard as the centre of creation, the home of the vegetable world? Closely connected with these inquiries is the question of the origin of species to our knowledge of which Darwin has contributed so much. Accepting the prevailing interpretation of Gen. i. 11, "God said, Let the *earth* bring forth grass," &c., we see no difficulty in accounting for the appearance of plants wherever the conditions of soil and climate are favourable; and Creative Wisdom would call only those that are adapted to any district, or to the conditions of the earth at large into existence. Hence the essential likeness of vegetable forms would be in proportion to their degree of proximity, and we would expect to find well-defined areas of vegetation distinguished by similarity of features—of form and appearance, as we find a certain resemblance among the inhabitants of the same region. Such we may suppose to have been the case in the beginning; but the earth has undergone changes, and these have modified the existing forms. Geologists speak of ages, and they also speak of America as the "old world." A close comparison of the Flora of the Arctic regions might lead to the belief that it is American in origin, whence it spread westward to Asia and Europe, for, as we travel from Northwestern Europe toward and through Asia, we find its traces getting stronger and stronger, notwithstanding that Scandinavia would according to older rules have been regarded as the centre of creation for the Arctic lands, and may now be termed the chief centre of preservation within the Arctic circle. The influence of physical and genetic causes has produced of this great northern, three secondary floras. Of these, the Arctic-Alpine Flora (consisting chiefly of plants of small stature, slow growth, and limited means of dispersion, compensated by long lives and great powers of endurance), is perhaps the most interesting. Hooker, estimating the whole Arctic flora at 762 species, found that 379 belonged to Arctic America, of which 269 are common to Scandinavia. Arctic Europe contains 616 species, and of these 586 are Scandinavian. The icy temperature of the glacial epoch would attract this flora towards the equator, but with the genial warmth of succeeding ages, an orderly retreat towards the poles would begin. Not all the species, however, would regain their original home; some would find congenial abodes even on the hills and mountains of the tropics, so that the remarks of Hooker, that "the Scandinavian flora is present in every latitude of the globe, and is the only one that is so," is found to be literally true.

Descending to an examination and description of the vegetation constituting this flora, we find it composed almost entirely of cryptogamous plants, mosses, lichens, and fungi. Among the mosses, the pioneers of vegetation, the polytricha are used for mattresses by the Laplanders, and the plains of Siberia have put on a dense cloak of these cosmopolitan, interesting little evergreens, to protect them against the Boreal blasts. The lichens, those beautiful children of nature sunning themselves in the dazzling rays that illumine Tropical Chimborazo, and clothing the icy surface of the Polar regions with a garment convertible in rainbow hues or healing balms; or into the staff of life for Tartar or Laplander for Sir John Franklin and his unfortunate companions. The fungi, or mushrooms, proverbial for wonderful rapidity of growth — puff-balls have been known to grow 6in. in diameter in a single night—unlike other plants, absorb oxygen and exhale carbonic acid. They abound in Sweden, which has produced more species upon a given area than any other known locality, except perhaps the Southern U.S. The larger fleshy forms, presenting an endless variety of graduated tents, exhibit, on being broken, beautiful changes of gorgeous hues. They are used as food and intoxicants by the inhabitants of Northern Europe and Asia, and as delicacies in more Southern climes. These, together with stunted forms of the willow birch, Azalea, and rhododendron, constitute the flora of the Arctic regions, adapted to prepare the soil for the production of grasses and herbs; for where now the tall sons of the forest joyously rear aloft their leafy coronals, the humble lichen lately clothed the naked rock. But, look beyond the lowly heads of the dwarfish Alpine shrubbery that forms a gloriously tinted border-land: a race of giants now approaches, and the flora of Irkutsk, richer than that of Berlin, presents a varied vegetation of mixed origin and most extended geographical range. Forest and prairie in delightful alternation constantly vary the prospect, and the Conifers—wholly confined to the Northern hemisphere—the pine, the spruce, and the fir, whose perpetual green enlivens the landscape, declare to the people of the North, that though snow and ice cover the ground, the inner life of plants, like Promethean fires, is never quenched. At their base is found the flax, the rice of the Indians, and oats, and the currant, the cranrasp and strawberry; the meadow grass, the prairie, "the gardens of the desert, for which the speech of England has no name."

The temperate zone, at which we next arrive, with its mean annual temperature varying from 40° to 60°F., extends from 35° to nearly 60° N., embracing the Northern U. S., Europe, from the Alps to St. Petersburg, and Asia between the Himalaya and the Altai mountains. This is the zone of deciduous trees, and of the food-plants of civilised nations. The most numerous of the remaining characteristic orders are the umbelliferæ and the cruciferæ, of which the latter are almost confined to the Northern hemisphere. Here abound "The monarch oak, the patriarch of the trees." Here, too, is found the weeping willow, named the Salix Babylonica.

The numerical proportion of 500 species of phænogamous plants, collected by Clauss and Gœbel on the steppes of Southern Russia, was: grasses one-eleventh, compositæ one-seventh, and crucifera one-ninth; the glumaceæ are one-seventh, the compositæ one-eighth, and the crucifera one-eighteenth of all German phænogamous plants.

The warm zone, the zone of winter foliage, is situated between the temperate and the tropic of Cancer, and has a mean temperature of from 60° to 72°F. Its characteristic vegetation consists of trees and shrubs which retain their foliage throughout the year, though their growth is interrupted during the winter. The leaves are in general tough, stiff, and glossy, but lack the delicate tints which adorn the foliage of deciduous trees in spring and summer, and the more gorgeous hues of autumn. Here are found the live oak, myrtle, laurel, and oleander, and the box, invaluable in the arts: with the cotton, the mulberry, and the olive; the tea of China, the cup that cheers, but not inebriates. The rice, originally from India, was introduced to Europe by the Macedonians, and is now successfully cultivated in our Southern states. Characteristic of this region are the fig, the orange, the pomegranate, the almond, and the choicest varieties of the vine. This is the zone of the Southern U.S., Southern Europe and Northern Africa, that is, the shores of the Mediterranean, between the Alps and the Atlas, and Southern Asia. This is the vegetation that accompanies, and and always has accompanied, the flower of art and civilisation.

But we must hasten to cross into the tropics, the zone of palms and bananas, whose mean annual temperature varies from 72° to 82° F. Luxuriance of growth, great development of foliage, and immense variety of species distinguish the vegetation of this equatorial belt. The frail and delicate ferns of our acquaintance assume the proportion of trees rivalling the palms in the beauty of their crown of foliage; the grasses of the temperate zones here become the sugar-cane, and the gigantic bamboo whose hollow stalk furnishes the principal building material. Grasses with joints at intervals of 17ft., palms attaining an altitude of 180ft., to which belong the palmettos of our Southern states, the most interesting in the vegetable kingdom, whose towering stems and enormous foliage impress a peculiar grandeur on the landscape of the countries they inhabit; bewildering in its fecundity, a single spathe of the date-palm contains about 12,000 flowers, and another species has been computed to have 600,000 flowers upon a single individual. Nor must we forget the cocoanut-palm of the East Indies. The Cingalese builds his house of its trunk, and thatches the roof with its leaves; his children sleep in a rude hammock made of the husk of the fruit; his meal is scraped cocoanut, boiled over a fire of cocoanut-shells and husks, and is eaten from a dish of its leaves with a spoon of its shell. In his canoe, made of its trunk, he carries a torch of its leaves, and fishes with a net of its fibre; with its juice he quenches both his natural and artificial thirst, and dances to the music of cocoa castanets. He anoints himself with cocoanut-oil, and cures himself with medicine made from the tree. Yea, over his cradle, and over his grave, a bunch of cocoanut blossoms is hung to charm away evil spirits. The comparative exuberance of their foliage may be understood if we conceive our white and fragrant water-lily transformed into the Victoria regia, whose leaves, from 6ft. to 12ft. in diameter, afford a sure footing for aquatic birds watching for their prey, and whose flowers measure from 12in. to 16in. across, and of their fruit, from the Talipat-palm, whose leaves are 30ft. in breadth, and whose single crop of fruit feasts a whole country.

Especially striking is the variety of plants growing in the same locality; the forests are not composed of single families like the pine or the oak of the temperate zones, but rather of a matted vegetation of forest trees, bamboos, coarse grasses, creeping and climbing plants, o'ertopped by columns of graceful palms, waving to and fro, a forest above a forest.

Time will permit me merely to glance at a few general facts touching the distribution and migration of individual plants:—I. The present condition and distribution of terrestrial vegetation is the result of previous geological changes in the condition of the earth, modified by changes introduced by the agency of man, the lower animals and the elements. Lichens in the North and portulaca in the tropics clothe the naked rock and form layers of vegetable mould to be succeeded by grasses, herbs, and shrubs, until at last the majestic oak or the slender palm lifts up its head, thus exhibiting a most striking parallel to the sucessive stages of society, and clearly showing how the superior civilisation rests upon and grows out of the successive inferior. The extent of the habitat of plants depends on the degeee of cold they can endure. Perhaps the best exemplification [illegible] this can be found in the humble grass Trisetum [illegible]bspicatum, which is found from 54° S. to 72° [illegible]N., or in a range of 127° latitude extending [illegible] Terra

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* Part of a paper read before the Lancaster Plant Club, by Prof. R. K. Buehole, of Lancaster, Penna., U.S.A.

Del Fuego, along the Andes and Rocky Mountains to Iceland and across Europe, along the Alps, and the Altai in Asia to Kamtschatka. But this seems to be equally and the only inhabitant of the opposite polar regions. Its counterpart is furnished in the range of the peach transported by the agency of man from China through Asia and Europe to California, or of the wheat cultivated B.C. 2700 by the Celestials, and now belting the two Continents until its harvests in the golden state surpass in value the product of its auriferous mines.

An idea, although inadequate, of the modifications of the existing flora which man has produced, may be had if we consider, not only the changes in individual plants brought about by cultivation, but more especially the utter annihilation of the forests and prairies of our own country, and the consequent occupation of the soil by the cereals. Can we realise the thousands of species thus destroyed? And this war of extermination has continued at least since the dawn of history! Nor has the destruction been limited to those directly exterminated, but others dependent upon these have also perished; moreover, the destruction of the forests has materially changed the climate, and this in its turn has brought death to others: thus man's destructive agency may well be called unceasing, and the whole creation groaneth and travaileth until now, waiting for its redemption.

II. This brings us to the fact that the forms of organic beings are mutually dependent, hence if in any particular locality, the number of species of a certain family, as of the compositæ, is known, an approximate conclusion can be formed of the number of any, and of all the phænogamia; that is, the number of the compositæ determines the number of the leguminosæ, and so of the rest, and of all. The numerical proportion of seven large families in the temperate zone is as follows:—Glumaceæ, including the grasses one-eighth (grasses alone one-twelfth); compositæ, one-eighth; leguminosæ, one-eighteenth; labiatæ, one twenty-fourth; umbelliferæ, one-fortieth; amentaceæ, one forty-fifth; cruciferæ, one-nineteenth. In examining the increase or decrease of any particular form of plant life, the rate must also be taken into account. Thus the leguminosæ decrease from the equator towards the north pole, in the first 10° they stand at one-tenth, between 45° and 52° at one-eighteenth; 67° and 60° one thirty-fifth. The rubiaceæ, the euphorbeaceæ, and the malvaceæ decreased the same direction, while the glumaceæ, the ericaceæ, and amentaceæ decrease in the opposite direction. The compositæ, labiatæ, umbelliferæ, and cruciferæ decrease from the Temperate Zones, both directions, towards the pole and towards the Equator, the umbelliferæ and cruciferæ most rapidly towards the latter. The cruciferæ are three times more numerous in Europe than in the United States. The labiates are represented by one, the umbelliferæ by two, and all the phænogamia by 315 species.

III. As we recede towards the limits of vegetation, whether in latitude or altitude, the order seems to be trees and vines, shrubs, herbs, grass and cryptogams, mosses and lichens. Of pharenogamous plants, the grasses are the outposts everywhere, and they reach 18½° nearer the North than the South pole. Dr. Eights, visiting the South Shetland Islands, latitude 62° S., found a small grass, the Aira Antarctica, the most Southern flowering plant known. Cockburn Island, 64° 12′ S., which produces only cryptogams; mosses and lichens seem to be Ultima Thule of Antarctic vegetation. There is also a difference in the number of species belonging to Antarctic phænogamous vegetation at equal latitudes. Iceland has five times as many phænogamous plants as the southern Lord Auckland and Campbell's Island group; but Antarctic plant life, though more uniform, is richer in sap and more luxuriant. In the most northern portion of the plain of Siberia, the northernmost limit of trees and shrubs, of coniferæ and amentaceæ, is found on Admiral Wrangel's beautiful chart at 67¼° North latitude; but towards the west at the Lena at 71°, and Walden island 80½° North, has ten species of phænogamous plants.

MEASUREMENT OF CURVATURE AND REFRACTIVE INDEX.[*]

By C. VERNON BOYS, A.R.S.M., Demonstrator of Physics at the Normal School of Science, South Kensington.

OF the methods best known for measuring the curvature of surfaces, that depending on the spherometer is both accurate and convenient in the case of surfaces of sufficient diameter and where the curvature is not too small. The reflection-test, depending on the observation with a telescope of two images projected on a scale, is certainly not convenient, nor is it capable of giving very accurate results. While endeavouring to find some more satisfactory way of examining the curvature of the surfaces of lenses that would be both accurate and simple, I discovered the method which I am about to describe. Though, from its great simplicity, I can hardly expect it to be new to every one, yet I have never heard of its being employed, nor do those to whom I have shown it remember to have seen it before. Therefore, even if it should be shown that this method is not new, it is certainly so little known that I think it worthy of attention.

The centre-of-curvature test known as Foucault's test, which is used to examine the figure of the mirrors of reflecting telescopes, gives, perhaps, the most delicate means of examining form that exists. By its means the expansion by heat of a portion of the surface produced by touching it with the finger is rendered evident, as an apparent mountain standing out of the glass, which takes from five to fifteen minutes to disappear; and the warm air leaving a hand held between the centre of curvature and the surface has the appearance of flames of fire. In each of these cases no other system of observation could show in so striking and conspicuous a manner effects depending on so slight a cause.

The examination at the centre of curvature is carried out in this way:—The mirror is placed in a convenient support so that its surface is vertical; and in front of it is placed a lamp with an opaque chimney, through which some pin-holes have been made. If one of these holes is near the centre of curvature, the light leaving it and reflected by the surface is brought to a focus on the other side of the centre. This focus is then found; and the lamp is moved till the focus is as near the chimney as will allow of its observation. A piece of thin sheet-metal, with a straight edge, is then placed so that it may be moved to or from the mirror or laterally. Now, if the edge of this is sufficiently on one side to let the light pass the focus, an eye immediately behind the focus will see the mirror filled with light; but if it is gradually moved across while the eye still watches the mirror, the illumination of the latter will appear to die away in the same direction as, or in the opposite direction to, the movement of the edge, or uniformly, according as the edge is between the mirror and the focus, or between the eye and the focus, or at the focus. By this means, and by this means only, can the different radii of curvature of the successive zones of a parabolic mirror whose radius of curvature is twenty times its diameter be accurately measured. The close contact between the parabola and circle is due to the fact that it is one of the third order. I think it worth mentioning that the formula given by Dr. Draper in the 'Smithsonian Contributions to Knowledge,' vol. xiv. (1865), for testing the true parabolic form, gives only half the deviation from the sphere, as was pointed out by a correspondent of the ENGLISH MECHANIC who signs himself "Orderic Vital," and was confirmed by Mr. E. H. Liveing and myself.[*] I have gone thus fully into the Foucault test, as my method involves the same general principle—viz. making the rays return along the path whence they came.

Before considering the general case applicable to any kind of lens, I think it best first to show the simplicity of the method in a particular and common case—that of a thin equiconvex lens. Fix an ordinary spectacle-lens in a clip, with its principal plane vertical; in front of it place a card with a small hole in it; and illuminate the hole with a candle-flame. It will be found that, when the lens is at a certain distance from the card, there is an inverted image of the hole formed on the card. When this is the case, the light leaving the hole and meeting the front surface of the lens is refracted and meets the back surface normally: most of the light passes through; but a small portion is reflected back along the path whence it came, and is sufficient to produce an image easily visible in the day. This distance of the card from the lens, which is the apparent radius of curvature of the back surface seen through the front surface, is throughout this paper called f. The true focal length, F, of the same lens may be observed in the usual way; but it is more conveniently found by fixing a plane surface of glass behind the lens, when it will be found that another image may be produced when the lens is about twice as far from the card as it was before. Since an image is produced, the light must have returned along the path whence it came, and must therefore have struck the plane surface normally—that is, have left the lens and returned to it as a parallel beam; therefore, the card is at the principal focus. For a plane glass surface a piece of plate glass blacked at the back, or the surface of a prism may be used. The observations of the distances F and f can be easily and accurately made; then the radius of curvature may be found from the formula

$$R = \frac{Ff}{F - f},$$

as I shall presently show.

Before doing so, however, I think it well to describe the most accurate method of observing the distances F and f. The card with the pin-hole is convenient; but it is difficult to find the place with great accuracy where the focus is most sharply defined, and to measure the distance when found. All difficulty is completely avoided by the following plan:—Take a piece of thin sheet-metal, of the size and shape shown in Fig. 1, and fix in front of it, in the position shown by the dotted line, a small reflecting prism, so that when a small bright flame is placed on one side of the prism a beam of light leaves the slit in the plate. Replace the card by this plate and prism, and move the lens till the aërial image of the slit is formed in the corner, close by the edge of the prism. To examine the position of the image with greater precision, an ordinary positive eyepiece will be found convenient. When the image and the slit are equally distant from the lens, there will be no relative movement on moving the eye; if there is relative movement, the distance between the lens and the plate must be increased or diminished according as the plate or the image appears to move with the eye. When the distance has been properly adjusted, it is easily measured by resting a scale on the continuation of the lower edge of the slit, and moving it till it touches the surface of the lens. The position of the edge of the prism or of the slit may then be read with great accuracy; and it will be found that, on repeating the observations several times, a discrepancy more than a tenth of a millimetre between any of the measures need not occur.

Instead of observing the position with an eyepiece, the Foucault plan may be adopted. Place the eye immediately behind the edge of the prism, so that all the light forming the image enters the eye. Move the prism laterally towards the image, which, of course, moves to meet it, and observe whether the light which fills the lens dies away uniformly, or whether it seems to retreat from one edge of the lens. If the retreat is in the same direction as the movement of the prism-plate, the distance is too small; if in the opposite direction, too great. Either of these systems will give accurate results; I prefer the first, as tiring the eye less and being, especially with snall lenses, the more accurate.

A convenient support for the lens is made by boring a hole, with a less diameter than the lens, in a piece of thin parallel-sided wood. The lens may be slipped under two clips, so as to rest against the edge of the hole on one side of the wood. On the other side a piece of plate glass, blacked at the back, is cemented or held in a similar way by clips. If this piece of wood is fixed vertically on a horizontal slide, it may be moved away from the prism-plate, and the distances f and F determined in a few minutes. Fig. 2 is a horizontal section of the arrangement when the principal focus F is being determined. The dotted line shows the position for f.

If instead of a lens a single surface only is to be measured, there is, of course, no difficulty in the case of a concave surface; but a convex surface may have its curvature determined in the following way:—Arrange the prism-plate and flame as before. At a distance in front of the prism-plate, more than its focal length, fix a converging lens, preferably achromatic. Observe the position of the aërial image on the other side of the lens, and make it coincident with the edge of a plate of metal, m. The positions must be so adjusted that the distance of m from the lens is greater than the radius, of curvature of the given surface. Now place this surface between the metal plate and the lens, and move it till an image is formed accurately by the side of the prism. Then the light impinging on the convex surface has been reflected back along the path whence it came, and has, therefore, struck that surface normally; therefore, the place m, where those rays would have met had they not been intercepted, is the centre of curvature of the convex surface. Its radius of curvature can, therefore, be measured by suitably-formed callipers. Fig. 3 is a horizontal section of the arrangement.

I have stated above that $R = \frac{Ff}{F - f}$ in the case of a thin equi-convex lens. This must now be proved, and the more general case of any kind of lens treated next. First, consider that the lens is so thin that any normal to either surface cuts each at points appreciably equally distant from the axis. Since the image which is produced is partly formed of rays which are near the axis, these rays meet the axis at angles so small that the tangent, the sine, and the arc are convertible terms. If the lens is large and not of very long focus, this will not be true of rays from near the edge of the lens; but as these rays are not necessary for the image, the central ones alone may be employed, and by them the curvature of the whole surface, if spherical, determined.

On the front surface take any point p, and through it draw a radius mR of the back surface. Join p with f, the apparent centre of curvature of the back as seen through the front surface. Draw also through p a radius ab of the front surface and a line dc parallel to the axis. Then the angles mpd, dpb, apc are equal to one another. Call these angles θ. The angle $apf = \mu \times$ angle $mpb = \mu 2\theta$; therefore, the angle $cpf = \mu 2\theta - \theta$. But the angle $ep\mathrm{R} = \theta$;

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[*] From the *Philosophical Magazine.*

[*] ENGLISH MECHANIC, Vol. XXXI., pp. 89, 184, 207.

$$\therefore \frac{\mathrm{R}}{f} = 2\mu - 1, \text{ or } \mu = \frac{\mathrm{R} + f}{2f}.$$

By the property of equiconvex lenses, $\mu = \frac{\mathrm{R}}{2\mathrm{F}} + 1$;

$$\therefore \frac{\mathrm{R}}{2\mathrm{F}} = \frac{\mathrm{R} - f}{2f} \text{ and } \mathrm{R} = \frac{\mathrm{F}f}{\mathrm{F} - f}$$

or, in a thin equiconvex lens, the radius is equal to the product divided by the difference of the principal focal length and the apparent radius of the back as seen through the front surface.

It might be expected that, as this formula has been deduced from a specially simple case, a more complicated one would be necessary if the two sides of the lens were not equally curved, or if one surface were plane or concave. But such is not the case; the same formula applies in every possible case, though, as will be shown, experimental difficulty occurs in the case of a diverging meniscus.

The proof of the formula in the case of a thin lens which is not equiconvex is similar to that already given. Make the same construction as before, and let R_1 R_2 be the centres of the surfaces 1 and 2, and f_1 the apparent centre of 1 seen through 2. Also let $\mathrm{R}_1 = n\mathrm{R}_2$. Call each of the angles mpd, $cp\mathrm{R}_1$, θ; then the angles $dp\mathrm{R}_2$ and apc will each equal $n\theta$. As the angle $apf_1 = \mu \times$ angle $mp\mathrm{R}_2 = \mu(1 + n)\theta$, $\therefore$ angle $cpf_1 = \mu(1 + n)\theta - n\theta$. But angle $cp\mathrm{R}_1 = \theta$;

$$\therefore \frac{\mathrm{R}_1}{f_1} = \mu(n + 1) - n.$$

Substitute $\frac{\mathrm{R}_1}{\mathrm{R}_2}$ for n, and it will be found that

$$\mu = \frac{\mathrm{R}_1(f_1 + \mathrm{R}_2)}{f_1(\mathrm{R}_2 + \mathrm{R}_2)} \quad \ldots\ldots\ldots\ldots\ldots(1)$$

A similar proof will show that

$$\mu = \frac{\mathrm{R}_2(f_2 + \mathrm{R}_1)}{f_2(\mathrm{R}_1 + \mathrm{R}_2)} \quad \ldots\ldots\ldots\ldots\ldots(2)$$

By the property of lenses,

$$\mu = \frac{\mathrm{R}_1\mathrm{R}_2}{\mathrm{F}(\mathrm{R}_1 + \mathrm{R}_2)} + 1, \quad \ldots\ldots\ldots\ldots(3)$$

where F is the principal focal length.

By combining (1) and (3),

$$\frac{1}{\mathrm{R}_1} = \frac{1}{f_1} - \frac{1}{\mathrm{F}}, \text{ or, } \mathrm{R}_1 = \frac{\mathrm{F}f_1}{\mathrm{F} - f_1} \quad \ldots\ldots(4)$$

By combining (2) and (3),

$$\frac{1}{\mathrm{R}_2} = \frac{1}{f_2} - \frac{1}{\mathrm{F}}, \text{ or, } \mathrm{R}_2 = \frac{\mathrm{F}f_2}{\mathrm{F} - f_2} \quad \ldots\ldots(5)$$

By combining (1) and (2),

$$\frac{1}{\mathrm{R}_1} - \frac{1}{\mathrm{R}_2} = \frac{1}{f_1} - \frac{1}{f_2} \quad \ldots\ldots\ldots\ldots(6)$$

It is not a little surprising that, whatever the refractive index of the material of the glass, or the curvature of the front surface, the curvature of the back surface can always be obtained from an expression in which both apparently are omitted. They are both, of course, involved in each observation, F and f, which accounts for the possibility of their being eliminated.

It is interesting to follow the changes which occur between the two extreme limits of form—a double convex and a double concave lens. Take a double convex lens, and suppose one of the surfaces to be gradually pushed in; when it has become plane we have the first particular case—a plano-convex lens. Call the flat surface 1 and the convex surface 2; then, by (4),

$$\frac{1}{\infty} = \frac{1}{f_1} - \frac{1}{\mathrm{F}};$$

$\therefore f_1 = \mathrm{F}$, or the apparent centre of curvature of the flat surface seen through the round surface is at the principal focus. By (5),

$$\frac{1}{\mathrm{R}_2} = \frac{1}{f_2} - \frac{\mu - 1}{\mathrm{R}_2},$$

since $\mathrm{F} = \frac{\mathrm{R}_2}{\mu - 1}$; $\therefore$ $\mathrm{R}_2 = \mu\, f_2$, or the apparent radius of 2 is less than the true radius in the ratio of μ to 1.

If the pushing-in process is continued, the surface 1 will become concave. Four observations can then be made—F, f_1, f_2, and R_1; therefore, R_2 may be found by either of the equations (5) or (6). As the surface 1 becomes more concave, its apparent centre on the other side of the lens will retreat to an infinite distance; and then the concave side will appear flat when viewed through the convex surface. This is the case when $\mathrm{R}_1 = -\mathrm{F}$, as may be shown by making $f_1 = \infty$ in (4), or as is obvious from a diagram. When R_1 becomes less than this, f_1 becomes an imaginary point on the other side of the lens, such that, if rays were sent so as to converge upon it, they would return as though they had come from it. Its position could be determined experimentally by the method given for a convex surface; but as the true radius can be determined directly, there is no necessity to find this imaginary apparent radius.

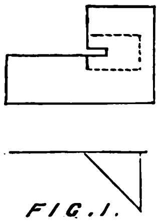
FIG. 1.

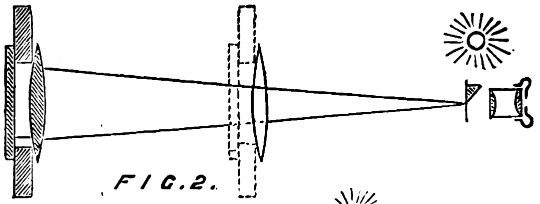
FIG. 2.

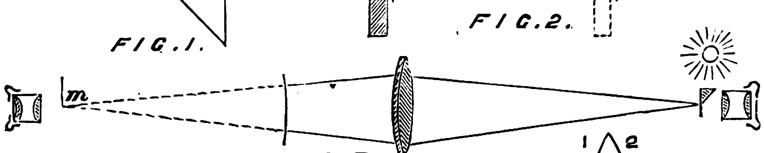

FIG. 3.

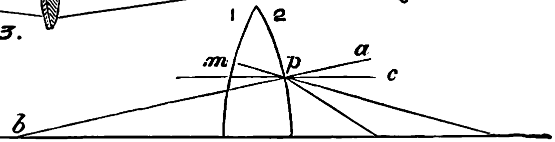

FIG. 4.

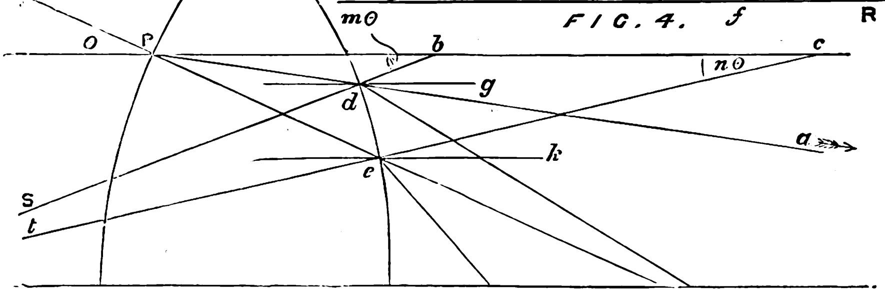

FIG. 5

Let the concavity of surface 1 increase; the next particular case is that of a watch-glass, where $\mathrm{R}_1 = -\mathrm{R}_2$. Then F becomes infinite, and the two points f_2 and R_1 become coincident. When the surface 1 becomes still more concave, F becomes negative and virtual, and R_1 and f_2 pass one another. The experimental determination now becomes more difficult; for neither can F or f_1 be observed directly; but still the equations (5) and (6) hold. They may each be found by the method for a convex surface, which is less convenient than the direct method.

If the concavity of the surface 1 continues to increase, another limit will be reached, at which f_2 becomes infinite. This is obviously the case when $\mathrm{R}_2 = -\mathrm{F}$; that is, when the focal length has been so shortened by the increasing concavity as to be equal to the radius of the convex surface. When this is the case, the surface 1 seen through 2 appears plane. When the concavity passes this limit, f_2 becomes negative and imaginary, and the experimental difficulty is still further increased, for R_1 only can be directly observed; but still the equations (4), (5), and (6) are true. No further increase in the concavity of 1 will produce any new conditions. Now, the curvature of 1 remaining constant, let 2 become flatter; when it has become plane, there is no occasion to observe F. f_1, or f_2 to determine the form of the surfaces. When 2 becomes concave also, the curvature of each surface can be directly measured; and all difficulty is removed. Every possible case has now been considered; and though the equations are always true, experimental difficulty only occurs in the two classes of diverging meniscus.

If a parallel beam of light falls on the lens, it will be refracted at the front surface, partly reflected from the back, and again refracted at the back surface, and be brought to a focus at a distance from the lens equal to half the apparent radius.

As the light, in its passage to and from the apparent centre f_1, is twice refracted by 2 and once reflected by 1, it would seem at first sight that the value of f_1 might be obtained by combining in the usual way the expression for twice the focal length of an equiconvex lens with surfaces having the same curvature as 2 and the radius of 1; thus

$$\frac{1}{f_1} = \frac{1}{2\mathrm{F}} + \frac{1}{\mathrm{R}_1}.$$

But this operation, depending on a false assumption, leads to an erroneous result. It makes $f_1 = \frac{\mathrm{R}_1\mathrm{R}_2}{\overline{\mu - 1}\,\mathrm{R}_1 + \mathrm{R}_2}$, instead of $\frac{\mathrm{R}_1\mathrm{R}_2}{\overline{\mu - 1}\,\mathrm{R}_1 + \mu\,\mathrm{R}_2}$. The error arises in this way:—When a double convex lens is employed, either to bring or to hurry light to a focus, the bending-powers of the two surfaces depend on the angles they make with the ray in the lens. Now, if one of these angles great, the other must be small; so that, as a combination, they have the same focus-shortening power, however the light falls on them. But when a ray passing from and returning to the apparent centre f strikes the front surface, that surface makes an angle with the ray in the lens which is greater than the mean in the ordinary way; therefore the surface produces a greater diverting effect; and hence the distance f is less than it would be if the supposition made were correct.

All that has been shown at present is only true when the thickness of the lens is inappreciable. When this is not the case, rays, whether from the principal focus F or from an apparent centre f, will not cut the two surfaces at points equidistant from the axis. First, consider the case of an equiconvex lens. Let Fig. 5 represent a portion of a thick equiconvex lens. As before, since the central rays are sufficient to give an image, arcs, sines, and tangents may be considered identical. On one surface take any point p. Through it draw a radius $p\mathrm{R}$, and the line pbc parallel to the axis. Now a ray of light parallel to the axis, meeting the surface in the point p with an angle of incidence equal to θ, will be refracted so that the angle dpe is equal to $\frac{\theta}{\mu}$; therefore the angle $bpd = \theta\,\frac{\mu - 1}{\mu}$. Therefore the line pd continued will meet the axis in a point a such that

$$pa = \frac{\mu\mathrm{R}}{\mu - 1} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

But this ray is diverted at the point d, and bent down so as to meet the axis at the principal focus F. It is required to find the length $d\mathrm{F}$, or, shortly, F—that is, the distance of the principal focus from the surface. Since the line pa has cut the front surface at a point d nearer the axis than p, the inclination of the normal, bs, at d will be less than θ, and will equal $m\theta$ if

$$m = \frac{pa - t}{pa} \quad \ldots\ldots\ldots\ldots\ldots(2)$$

t being the thickness of the lens. Now the angle pds = the angle dbp + the angle $bpd = \theta\left(m + \frac{\mu - 1}{\mu}\right)$; therefore the angle $bd\mathrm{F} = \mu\theta\left(m + \frac{\mu - 1}{\mu}\right)$, and the angle

$$gd\mathrm{F} = \mu\theta\left(m + \frac{\mu - 1}{\mu}\right) - m\,\theta = \theta\,(\overline{1 + m}\,\overline{\mu - 1}) \quad \ldots\ldots\ldots\ldots(3)$$

Since the lines $d\mathrm{F}$ and da leave the same point d with different inclinations, they will meet the axis at distances which are inversely as these angles. Therefore

$$\frac{da}{\mathrm{F}} = \frac{\overline{1 + m}\,\overline{\mu - 1}}{\frac{\mu - 1}{\mu}} = \mu\,\overline{1 + m};$$

therefore

$$\mathrm{F} = \frac{pa - t}{\mu\,(1 + m)} = \frac{\mathrm{R}\left(\frac{\mu\mathrm{R}}{\mu - 1} - t\right)}{2\mu\mathrm{R} - t\,(\mu - 1)} \quad \ldots\ldots(4)$$

by (1) and (2). This is the distance of the principal focus from the surface of the lens.

The distance ef of the apparent centre from the surface may be found in a similar way. The normal at e makes an angle $n\theta$ less than θ, such that

$$n = \frac{R - t}{R} \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

The angle $pet = (n + 1)\,\theta$; the angel $cef = \mu\,(n + 1)\,\theta$; and the angle $kef = \theta\,[\mu\,(n + 1) - n]$. Therefore

$$\frac{ef}{R - t} = \frac{1}{\mu\,(n + 1) - n}, \text{ and } ef = \frac{RR - t}{(\mu - 1)\,(R - t) + \mu R} \quad \ldots\ldots\ldots (6)$$

This is the distance of the apparent centre from the surface. By (6),

$$\mu = \frac{(R + f)\,(R - t)}{f\,(2R - t)}.$$

Substitute this value of μ in (4); on simplifying, it will be found that

$$R^2 - R\left(\frac{f^2}{F - f} + 2t\right) = \frac{Ff^2}{F - f} - t^2, \ldots\ldots (7)$$

from which R may be found if F, f, and t are given. If t is made equal to 0, equation (7) gives

$$R = \frac{Ff}{F - f}, \text{ or } -f.$$

The first result is the same as that already found for a thin lens; while the value $-f$ seems to have no physical meaning.

If the thick lens is not equiconvex, there are five observations possible—the distances of the two apparent centres from the surfaces, the distances of the two principal foci from the surfaces and the thickness; but there are only three things to be determined—the two real radii and the refractive index: therefore the equations for R_1, R_2, and μ must be capable of solution. The following are the expressions which may be found by a similar treatment of Fig. 5 to that already employed in the case of the equiconvex lens, if it be remembered that all the angles made by surface 1 are $\frac{R_2}{R_1}$ times those made by surface 2 at the same distance from the axis. They are

$$F_1 = R_2 \frac{\frac{\mu}{\mu - 1} R_1 - t}{\mu\,(R_1 + R_2 - t) + t},$$

$$F_2 = R_1 \frac{\frac{\mu}{\mu - 1} R_2 - t}{\mu\,(R_1 + R_2 - t + t},$$

$$f_1 = R_2 \frac{R_1 - t}{\mu\,(R_1 + R_2 - t) - (R_1 - t)},$$

$$f_2 = R_1 \frac{R_2 - t}{\mu\,(R_1 + R_2 - t) - (R_2 - t)}.$$

The first two of these equations give

$$\frac{F_1}{F_2} = \frac{\mu - R_1 t\,(\mu - 1)}{\mu - R_2 t\,(\mu - 1)};$$

and the second two give

$$\mu = \frac{\overline{R_2 + f_1}\;\overline{R_1 - t}}{f_1\,(R_1 + R_2 - t)} \text{ and } \mu = \frac{\overline{R_1 + f_2}\;\overline{R_2 - t}}{f_2\,(R_1 + R_2 - t)}.$$

By these μ may be eliminated. The solution for R_1 and R_2 I have not obtained; but I do not think there is any difficulty.

The following application to the case of liquids of the principle of making the rays return along the path whence they came, forms a neat though impracticable method of determining their refractive index when greater than $\sqrt{2}$:—Replace the cross-wires of a telescope by the prism-plate, as already described, but in which the slit is longer and adjustable. Fix opposite the object-glass a piece of parallel-sided plate-glass, with its plane at right angles to the optical axis. The correctness of this adjustment may obviously be determined at the eyepiece. Let the glass plate form the bottom of a trough in which the liquid may be placed, and let there be under this a dish containing mercury. Now, there is a certain inclination of the telescope at which the beam from the illuminated slit, rendered parallel by the object glass, is refracted at the free surface of the liquid, and again at the surfaces of the glass plate, so as to leave the latter vertically; then, striking the mercury, it returns along the path whence it came, and may be viewed by the eyepiece. Under these conditions the beam of light on either side of the prism is at right angles to the opposite side; therefore they make equal angles with the adjacent sides, and the prism is at minimum deviation. Calling the inclination of the telescope θ, we have $\sin.\,\theta = \mu \sin.\,\frac{\theta}{2}$; therefore, $\mu = \sqrt{2\,(1 + \cos.\,\theta)}$. The telescope may be first inclined on one side and then on the other, and half the angle moved over taken as θ. I have found it utterly impossible to get the sodium-line to keep still for a moment, or to be even fairly defined, as every movement in the neighbourhood produces a tremor on the surface of the liquids, which in the Science Schools at Kensington at any rate, is so continuous as to make it impossible to observe with accuracy. I should have said that the top of the prism must be covered in with a glass plate, to prevent the evaporation and consequent superficial cooling of the liquid forming the prism, which causes striæ in the liquid, spoiling definition even more than the continuous tremor.

Helmholtz and others have shown that, during accommodation of the eye for near objects, the cornea does not change in curvature, the front surface of the lens becomes more curved and advances, and the back surface does not appreciably change. The proof given is that the images of a light produced by reflection from the cornea and from the back surface of the lens do not change, while that produced by the front surface of the lens advances and becomes smaller. Now, it would appear at first sight that these observations prove a flattening of the back surface of the lens during accommodation; for if it did not change in curvature, the rays of light passing twice through the more curved front surface would sooner come to a focus; but since they do not apparently sooner come to a focus, it would seem that a flattening of the back surface must have occurred to counteract the shortening influence of the more curved front surface. In the case of ordinary lenses this would be so; but it so happens that in the crystalline lens the focus by reflection is formed within it, and so the more curved front surface magnifies the smaller image, which therefore appears unchanged.

While on the subject of reflection in lenses, I think it worth while to mention that convex lenses silvered at the back make excellent and easily-constructed concave mirrors. Since both surfaces conduce to bring light to a focus, flatter curves may be used than are necessary for a plain concave reflector of the same focal length; also, since the two surfaces are not parallel, false images are not produced; so that the advantage of glass silvered at the back remains, without the usual disadvantage. A spectacle-lens of about 5in. focal length, silvered at the back and mounted, forms an eye-glass (I mean a glass for examining the eye) which every one who works in metal should possess. I have found by its means specks of metal thrown from the lathe, which were utterly invisible by other means, but which were nevertheless exceedingly painful.

RECENT ADVANCES IN PHOTOGRAPHY.—II.*

By Capt. ABNEY, R.E., F.R.S.

I NOW propose to bring before you another developer, which is also able to work without a restrainer; but before I do that, I should like you to take note of an improvement, which has been lately introduced by Mr. Berkeley, in the ordinary alkaline developer. With the pyrogallic acid solution is mixed four times the weight of sulphite of soda. The action, apparently, is this—the sulphite of soda absorbs the oxygen with greater avidity than does the pyrogallic acid, thus leaving the pyrogallic acid free to do its work, and, consequently, we have a developer which remains uncoloured for a very long period indeed. I hold in my hand a bottle which was presented to me by Mr. Berkeley, some time ago, which I read was made up on October 13th, 1881. This contains four times the quantity of sulphite of soda that it does of pyrogallic acid. Here is another bottle of pyrogallic acid, made considerably later—some time in January—and you will see the difference in colour between the two. The one is slightly yellow in tint; the other, a deep muddy brown. I consider that this introduction of sulphite of soda into the developer is one of the most remarkable improvements in alkaline development, and I hope that those practical photographers present will not hesitate to try the formula which Mr. Berkeley has lately published.

I now propose to show you the practical use of the developer to which I referred when I commenced. It is a new one, but has not been used to any very great extent, I am afraid, on account of the high price it used to fetch. I refer to hydrokinone; the first quantity I bought cost me 12s. a drachm; but, I am happy to say, it is now only 8s. an ounce, and one grain of it goes so far that it is as active as two grains of pyrogallic acid, for it is a much more powerful absorber of oxygen than pyrogallic acid; an advantage with it is, that you are able to use it without any restrainer. You can even develop chloride of silver without adding any soluble alkaline haloid to it, which photographers know is essential when using even a very weak pyrogallic and alkaline development. To illustrate this, I have an opal glass plate which is covered with a film of collodion containing chloride of silver. Until quite recently, this was a film which it was almost impossible to develop by the alkaline or iron methods; but, thanks to Dr. Eder, we are able now to develop chloride of silver exactly in the same way as we can bromide of silver. To save time, I gave the plate a short exposure just before the lecture. In this cell I have now simply dydrokinone and ammonia, and I think you will see that it develops the plate without the slightest trace of fog. I have taken the opal glass as the back-ground, so that you will be better able to see the result; it come out very gently and gradually. Thus you see that this new developer works without any restrainer whatever, even when such a troublesome salt as silver chloride is used. Not having any restrainer, it is able to give a better detail, and allow a shorter exposure in the camera than if the ordinary alkaline developer was used. This development is applicable not only for collodio-chloride, but for collodio-bromide plates, or for gelatino-bromide plates—in fact, any plate with which you work, even iodide. [The perfectly developed image was then shown.]

I promised last lecture that I would show you how very easy it was to develop iodide of silver with either the alkaline or the ferrous oxalate developer. You saw in my last lecture how we could develop the iodide with silver and gallic acid, but it becomes a very different thing—at least it was always so considered—when you have to develop a plate containing simply iodide with nothing but an oxalate developer, such as I have here. In this frame I have a paper which is coated with pure iodide of silver—not a particle of bromide or chloride in it; I will give it a slight exposure, and I propose to develop it on the screen before you. I will simply immerse it in water, and use some of the same ferrous citro-oxalate which I introduced to your notice last week. It will be apparent with what facility the iodide of silver can be developed. The paper, where viewed in the yellow light, is apparently colourless, although really it is yellow. If everything be correct, you will see that we get an image developing out rapidly, which is formed of pure metallic silver, produced from the sub-iodide at first, and then led, as it were, from the adjacent iodide. [The picture was fully developed.] We now have a practical demonstration that you can develop iodide just as easily as you can bromide, which is a desideratum when you come to consider the composition of gelatine plates, with which we may have to deal more fully in subsequent lectures. Having fulfilled my promise with regard to this, the next point I wish to call the attention of the meeting to is the action of sensitisers. I should like to explain to some of you who are not initiated in the mysteries of photography, what a sensitiser is. I will throw a diagram on the screen, and then you will be able to understand better what I mean. When you have chloride of silver, for instance, exposed to light, you have a new compound formed, which is called sub-chloride, or argentous chloride ($Ag_2\,Cl_2 = Ag\,Cl + Cl$), and chlorine liberated. This chlorine is a very obstinate thing to eliminate, if you do not give it something that can take it up; for instance, if you place perfectly dry chloride of silver in vacuo, without any trace of organic matter present, you will find, if it is exposed to brilliant sun-light for months, you get no darkening action. If such a white powder was submitted to you, to test by its darkening, you would say at once that it was not chloride of silver, because it was not darkened, since one of the tests of chloride of silver, amongst chemists, is, that it shall darken in the light. Here I have a little bulb of it which was prepared, dried carefully, and sealed up, the vacuum being made by means of a Sprengel pump. This tube has been exposed for months to light, and it is as pure a white as the very first day it was put into the bulb. Another experiment was made at the same time; a bulb was prepared, but in using the Sprengel pump, unfortunately, as I then thought, a small globule of mercury got in the vacuum, and was sealed up with the chloride; the consequence was, that the chloride of silver immediately darkened; although the mercury was not in contact with the chloride of silver, the chlorine flew to the mercury, and formed chloride of mercury. This is an instructive experiment, showing that merely in the presence of something that will mop up the chlorine, chloride of silver will darken. Here is another darkened bulb, which is chloride of silver, which was sealed up, not in *vacuo*, but in hydrogen. Now, hydrogen, as you are perfectly aware, can combine with chlorine to form a gas, which we call hydro-chloric acid, so, when the chlorine was in the presence of hydrogen, it combined with it, instead of returning to re-combine with the sub-chloride of silver.

$$Ag_2\,I_2 = Ag_2\,I + I.$$

On the screen is a diagram showing these reactions of the two other haloid salts of silver. I have already shown you the diagram of silver chloride, and its splitting up by light.

Silver iodide splits up into silver sub-iodide and iodine.

$$Ag_2\,Br_2 = Ag_2\,Br + Br.$$

Silver bromide, when exposed to light, splits up into silver sub-bromide and bromine.

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* Condensed from a series of Cantor Lectures delivered before the Society of Arts.

New, in order that there shall be a ready darkening of either of these, you must have something which will absorb the iodine or bromine (or in the case of the latter, allow it to escape), whichever you expose to the light. Now, the image which you just now saw developed on the iodide is, before development, precisely the same as the darkened image on the chloride; it is a matter simply of degree. Of course, if you took a few shot, and hid them in a bushel of flour, you would not be able to know that there was anything black in the flour; in the same way, if you alter two or three particles of iodide into sub-iodide, or chloride into sub-chloride, you do not notice it, because they are so mixed up with the particles that are not altered. It is these little altered particles that are the nuclei for the developed image. In order to show the use of sensitisers, I have prepared a sheet of paper, a quarter of which has been washed over with that vulgar beverage, beer; another quarter with potassium nitrite, and another quarter with gum, the fourth quarter has nothing on it. Now, all these are—but in greater or less degree—absorbents of iodine and bromine, and you will see, when I expose the paper and develop, that there is a decided increase of sensitiveness where those substances have been applied. You may say, "according to what you have said already, that the particles not coated with anything ought not to develop," but you must recollect that we are in contact with air, and air contains moisture, and if you have chlorine, for instance, in the presence of moisture, light is able to split it up into hydrochloric acid and oxygen, so that, in the case of a paper like this, you have a sensitiser present, but only a feeble one. This paper is the bromo-iodide paper that I introduced to your notice some little time ago. I have marked on the different quarters of it what is the sensitiser on each. I will brush it over with the ferrous citro-oxalate developer, and we shall see if there is any difference in the rapidity of coming out. The part coated with nitrite in coming out very rapidly, it has a very inordinate affection for iodine and bromide; the vulgar beverage beer does not seem to be doing its duty as it ought to be; now the gum is flashing out; now the beer is coming out. You see the nitrite came out first, then the gum, and then the beer, finally that in which the sensitiser was merely the air and the paper, and you will see, when the picture is finished, there is a vast difference in the amount of development. If there had been no moisture in the atmosphere, if it had been exposed in dry air, there would have been no action whatever where it was not coated with some sensitiser. Here, then, we have a proof that a sensitiser is necessary in order to give the greatest possible sensitiveness, and I hope that this will explain to you what I shall have to allude to further on.

I next have to call into use the spectrum. Here we have it on the screen, and I have produced it by the same arrangement of apparatus as if I were going to use it for photography. You will see that we have a tolerably clear spectrum. We have the light, A, and a lens, L, to throw the image on the slit B, and then the lens C, to make the rays parallel, then a single prism, D, then a photographic lens, E, which focusses the spectrum on the screen S. Now I want to point out to you not only that we have red, green, yellow, blue, and violet rays, but we have rays beyond the violet also which we cannot see, but which by an artifice I shall be able to show you. For instance, if I place this card on this screen, you see we have a vast extension of the spectrum beyond the violet, but if I take it away, it is absent. The reason of that is, that I have brushed on this card a solution of sulphate of quinine, which lowers the wave light of the ultra-violet rays, making them visible. I was anxious to bring this spectrum before you, for this reason, that it is the principal part of the spectrum which is useful to photographers, though I do not believe they are aware of it. When we expose one of these haloid salts of silver to the spectrum, it behoves us to know what part of the components of light it is that acts upon this haloid salt. Now, a very simple way is, of course, to place a film containing the haloid salt in the spectrum. But what I want first to point out to you is, that we must go upon scientific principles in dealing with the facts that come before us, and the main principle is the principle of work. When you have what you call light radiating from a source, be it the sun or be it a gas flame, it is only when its radiant energy is stopped or absorbed that you are able to get any work out of it all; that is to say, supposing you have a transparent glass plate, you know that the light, as you call it, passes straight through the plate, without leaving a very visible effect on the glass. But if you have a red glass, why does it appear red? Simply because a part of the rays have been stopped; but what becomes of those rays that are stopped? they must take one of two forms, or rather, the work they do must take one of two forms. The work they can perform may be shown by the heating the glass, or else the energy must be exhausted by doing chemical work upon the substance on which it acts. The effect, then, is this, if you have a haloid salt of silver, the principal part of the energy which is radiated, and which is absorbed, does chemical work, and it is only those regions of the spectrum which are absorbed which are capable of doing chemical work. I cannot show you a better example than I have upon the screen. The second part of the slide shows the whole spectrum, taken with a substance which I shall be able to show you by-and-by. You see the darkening caused by the light; at the far end we have the ultra-violet rays, and at the other end we have the red rays. In front of the slit of the spectroscope was placed a cell of bichromate of potash, and you see it cuts off, not only the blue and the violet, but a part of the green, and leaves the red and yellow intact (B, Fig. 2).

FIG. 1.

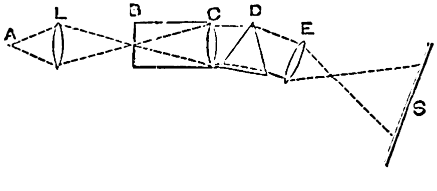
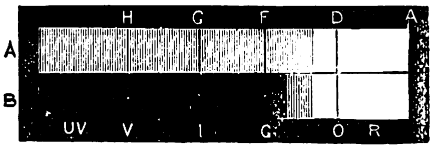
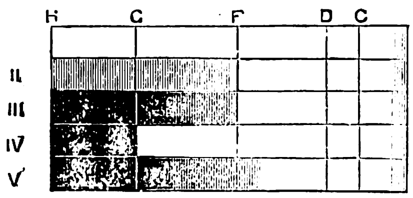


FIG. 2



Now, photographers know that those beautiful prints that go by the name of carbon prints depend for their manufacture on the fact that bichromate of potash is altered by light in the presence of organic matter. Here we have the spectrum taken on carbon tissue, in which you will see the absorption exercised by bichromate of potash exactly coincides with the work done on the bichromate (A, Fig. 2); notice that the part of the spectrum which is impressed ends exactly where the bichromate absorption begins. I think that is a very excellent illustration of the work done by radiation. I propose now to pass two or three films through the spectrum (I., Fig. 3), to see what kind of work we may expect to be done with them. First, we have a film of chloride of silver (II.), and you will see that the violet part of the spectrum towards the yellow is subdued, whilst the other parts pass through. Next, we have a bromide film (III.) in which you see some parts of the spectrum are cut off which before were visible. Next, I take iodide (IV), where you see the violet is cut off entirely, leaving a trace of blue, which was not the case with the bromide. Here, again, we have the bromo-iodide (V.) cutting out the blue, going right into the green. That is interesting, because I propose to show you next the fact that the absorption coincides with the work done on the films themselves.

FIG. 3



I have here a board with four strips of paper upon it—the first coated with chloride of silver, the second with bromide of silver, the third with iodide of silver, and the fourth with bromo-iodide of silver. I will expose each of them for twenty seconds to the spectrum, and develop them before you. In order to recognise the parts acted upon, there are strings put across the different parts of the spectrum. [The exposures were made, and the strips damped and placed on the developing board.] I brush each strip over with the ferrous citro-oxalate developer. [The prints developed rapidly, the chloride taking rather longer than the others to appear.] The chloride sometimes takes a little longer to develop, and I ought to have given it a little longer exposure because it is not quite so sensitive as the other salts. Here are the four spectra (Fig. 4). The maximum sensitiveness of the chloride, A, is about the line H on the spectrum. The iodide, C, goes as far as G; the bromide, B, half-way between G and F, and extends down as far as B; the bromo-iodide, D, extends as far as F in the spectrum. I think I can show you this more directly by photographs taken in the spectrum in a more accurate manner than is possible in a lecture experiment. When I passed the different silvers over the spectrum, I only passed the haloid salts in the state in which they are usually prepared photographically, but now I wish to show you how different coloured salts of silver can be obtained. Let me take bromide, for instance. Here you have the ordinary form of bromide, such as you saw developed on the screen—the red or orange bromide. By boiling it, as you do with gelatine emulsion, you can change the molecular condition into a grey blue form, such as you see here. From what I have told you of the principle of work and absorption, you will be quite prepared to learn that these particular forms are sensitive to different parts of the spectrum; so they are, but their maximum place of sensitiveness is but very slightly changed; that is a point worthy of attention. Again, we have two forms of chloride, the ordinary form, which, as a rule, is decidedly yellow by transmitted light; and the other is the blue molecular form, which is got by boiling. Once more we have the iodide in the yellow form, and also the blue form. Now, I will show you photographs which were taken to show the maximum of the different haloid salts (Fig. 5). The first one is the red form of chloride (No. 1), and you see that the maximum sensitiveness is half-way between H and *h* in the violet part of the spectrum; if we go to the boiled chloride (No. 2) you see it has the same place of maximum intensity as the orange, and that the intensity is very great as far down as the yellow line, D. We next come to the red form of bromide (No. 3), and we see that its maximum place of sensitiveness is half way between G and F. When we come to the blue form (No. 4) we have an immense extension towards the red, but still it retains nearly the same place of maximum sensitiveness between G and F. Next, we have the yellow form of iodide (No. 5), and it shows that it ends sharply at G. There is no spectrum impressed beyond G. In one case where I gave it a very prolonged exposure, I got what is called a reversal of the image, but still the iodide spectrum is cut off at that particular point (No. 6).

FIG. 4

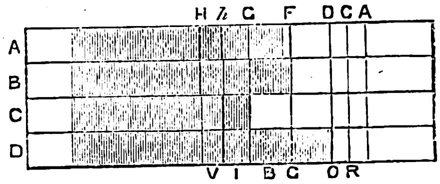
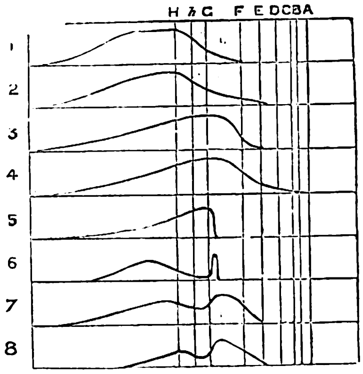


FIG. 5



(*To be continued.*)

The Electric Gas-Lighter.—The following description of Clarke's patent gas-lighter was given at a visit to the works:—It consists of a chloride of silver battery of novel and powerful construction; the chloride of silver being applied to the silver plate under great pressure. The induction coil, the wire of which, instead of being of copper as usual, is ordinary iron wire wound over a bobbin with interlayers of cotton thread, in place of the usual copper wire insulated with silk or cotton; this layer of wire is then covered with paper saturated in paraffin to produce more perfect insulation. The condenser is composed of discs of tinfoil and paraffin-paper. The whole is inclosed in an ebonite handle about a foot long; and from this a brass tube of any desired length is run, carrying the positive and negative wires. The current from the battery induces a current in the coil, which passes to the points of the spire, and by the pressure of a button on the handle, the spark which ignites the gas is produced.

SCIENTIFIC NEWS.

NEWS reached Cambridge on Saturday last that the recently-appointed Professor of Animal Morphology had been killed by a fall in Switzerland while mountain-climbing. Prof. F. M. Balfour was in the prime of life. He was a fellow and tutor of Trinity College, Royal Medallist in 1881, and President of the Cambridge Philosophical Society. He was a Fellow of the Royal Society, and an hon. LL.D. of Glasgow. Last term he was elected to the new chair of Animal Morphology. On page 270 of our last volume we reviewed the second volume of Prof. Balfour's treatise on "Comparative Embryology," a work which will prove a fitting monument to his memory, and an indication of the great loss which the scientific world has sustained by his untimely death.

Captain Gillies, of the R.M.S. *Neva*, reports to the *Buenos Ayres Standard* the observation of a comet on June 19, while in lat. 28° 48′ S., long. 48° 17′ W. The comet is described as bearing N. 60 W. (true) 10° above the horizon, with a tail about 5° in length, extending towards the zenith.

An ephemeris of the comet of 1812 (Pons), has been prepared by MM. Schulhof and Bossert, and is circulated by the Observatoire de Paris. By a new discussion of the observations, MM. Schulhof and Bossert find the most probable elements give a revolution of 71·7 years; and they have reason to believe that the comet will come again to perihelion about the middle of 1883. The uncertainty as to the period of revolution being about three and a half years, it is desired that systematic researches should be commenced at once.

From four observations of comet Wells, Herr Thraen, of Dingelstadt, Thuringia, has computed a set of elliptic elements which give a period of 3,617 years. Mr. L. Boss reports to the *Astronomische Nachrichten*, that on June 11, with a power of 180, the true nucleus was seen as a perfectly round and sharply-defined disc of moderate illumination. The nebulosity of the coma was quite uniform and faint, and about 10″ diameter. On June 12 the comet was a very easy object, but the nucleus proper could not be seen.

Under the superintendence of Prof. Van de Sande Bakhuijzen, director of the Leyden Observatory, have at last been published the observations of Mars made by Schröter at Lilienthal.

The Lens Committee have reported to the Council of the Photographic Society, recommending that the aperture of the standard unit diaphragm should have a diameter equal to one-fourth the equivalent focus of the lens, and that those with smaller openings should have apertures diminishing in area by one-half, and be marked 2, 4, 8, &c., thus indicating that if the unit stop needs an exposure of one second on any given paper, the use of a smaller stop would need a number of seconds corresponding to the number of the stop. Flanges and camera-screws are recommended to be threaded with a standard series. The Council have adopted the report, and have ordered the construction of a series of standard flanges and camera-screws to be kept in the custody of the Society.

Under the title of "Light: a Course of Experimental Optics, chiefly with the Lantern," Mr. Lewis Wright has issued, in a revised and enlarged form, his articles on "Optics with the Lantern," which appeared in Vols. XXXII. and XXXIII. The volume, which is illustrated by several coloured and other plates, besides numerous woodcuts, is published by Messrs. Macmillan.

Mr. Forney, at a recent meeting of the Master Carbuilders' Association of the United States, said that 1,500 railway employés are killed and 10,000 injured every year in the States. The committee on automatic couplers and draw-bars reported that out of 3,000 patents they were unable to select and recommend any of the devices as a standard.

The Belgian Academy offers a prize of 3,000f. for the best essay on the pollution of rivers and the destruction of fish. The essays should state what are the polluting matters; give a list of Belgian rivers which have been rendered uninhabitable by fish; indicate the means of purifying the waters; and give a special account of the causes of death of fish. The essays should be sent in before October 1, 1884.

It is stated that M. Jablochkoff has invented an electric motor which is very simple and powerful. The details are not yet available, as some of the patents have not been completed.

At the Trocadéro, Paris, an ethnological museum, containing about 44,000 specimens, has been organised; and the classification, which was undertaken by Drs. Gaudren and Hamy, is now nearly completed.

The velocity of chemical actions has been engaging the attention of a Russian chemist, M. Kœjœnder. His experiments consisted in dissolving marble or magnesium in water acidulated to various degrees with different acids. The curves of velocity of dissolution have a striking resemblance to those representing electric conductivity. The solubility increases with the quantity of the acid up to a certain point, beyond which it decreases. It is remarkable, too, that the velocity of the reaction referred to the proportions concerned is greater the lower the concentration. Thus 1 of sulphuric acid dissolves in a second more than half what 2 will dissolve, and still more than a third what 3 will dissolve. The phenomenon becomes more and more pronounced.

A new class of colouring matters has been described in the Berlin Chemical Society by Herren Fischer and Rudolph. It is based on the discovery that acetanilide under the influence of chloride of zinc at a temperature of 250° to 270 C., gives a beautiful yellow. The name of Flavaniline is applied to this new product, which shows a fine moss-green fluorescence, specially brilliant on silk fibres. The composition is $C_{16} H_{11} N_2$.

While the white of egg has various industrial uses, almost the only one for the yolk is the dressing of skins. According to M. Carles (*Jour. de Pharm.*), this industry finds the yolk as efficacious when in complete putridity as when fresh. The yolks are collected in wine-stores and manufactories of albumen (where they are rejected as useless), and brought in casks as "mucilage" to the leather-dresser. While the latter is indifferent to freshness, he attaches great importance to homogeneity and richness in fatty matters. The former is affected by various causes, but especially the action of air, which is not mere drying, but involves a chemical process. For remedy, some collectors of the yolk apply water, and, to raise the density (thus lessened), a few handfuls of marine salt; others have recourse to alkaline sulphates, alum, &c., to retard putrefaction. None of these matters seriously affect the skins; but they undoubtedly diminish the value of the mucilage by lowering the proportion of oil of the egg. To ascertain the purity of the mucilage measurement of density is of course fallacious. The presence of foreign salts is best detected by comparing equal quantities of typical yolks and of suspected mucilage. But the surest, if not the quickest, plan, is to determine successively, in a few grammes, the quantities of water, organic matter, and mineral salts; lastly, the proportion of fatty matter.

There is a general tendency at present (we learn from a German military paper) to adopt smaller bores for portable arms. Thus the Swiss rifle has a bore 10·4mm. (about ·416in.), and the rifles of the Servian and the Swedish infantry have a bore of 10·15mm. (·4in.) Prof. Hebler, of Zurich, goes still further, adopting for his rifle a bore of 8·6mm. (·344in.) The transformation of arms at present in service in Europe into arms on the Hebler system can be done by a simple tubage; the inventor has thus already transformed the Swiss Vetterli and the German Mauser. Experiments with these two altered rifles have proved clearly how false is the idea that a long and thin projectile must lack stability in the air. The cartridge is 86mm. long (3·4in.); the ball 32·8mm. (1·3in.) The weight of the cartridge (an important point) is only 35 grammes, and 96 Hebler cartridges weigh no more than 80 Mausers. Each (German) soldier might carry about 21 more cartridges than at present. The advantages of greater tension of trajectory, greater extent of the dangerous zone, and longer range, are distinctly proved for the Hebler rifle. The firing with it is more accurate. There is no reason to fear lack of penetrative force. Experiment is still desired as to whether solidity is not too much diminished, and cleaning rendered too difficult.

An interesting illustration of the general usefulness of electricity in these times is afforded by the new opera house at Frankfort-on-the-Maine. Besides bell-calls and signals throughout the building, there are no fewer than eight different services to which electricity is put: These are: (1) fire-alarm, (2) tell-tale arrangement with clock, (3) door-closing arrangement, (4) heat telegraph, (5) lighting the chandelier, (6) lighting the soffit-lights, (7) lift-counter of the ventilator, (8) time-beater. A detailed account of these arrangements, with illustrations, is begun in the *Electrotechnische Zeitschrift*.

The sand which is used in grinding glass plates, and so is mixed with glass-dust, is utilised by M. Motte, of Dampremy, near Charleroi, for production of keramic ware, such as solid or hollow bricks, simple building stones, or ornamental stones. These products have great firmness, a pleasant, unalterable colour, like that of French sandstone, and small specific gravity (under 1·5). They are produced by the ordinary method; the moistened sand can be easily moulded.

From a recent report by Herr Wienlig on a visit to ironworks in this country, it appears that while England shares to the extent of 47 per cent. in the whole pig-iron production of the world, Germany, with Luxembourg, figures with only 13 per cent. England consumes, per head of the population, about five times as much iron as Germany. The production of English iron ores is about four times the German. The English coal production is about 63 per cent. of that of the whole world. That Germany, with its unfavourable position for transport, and the great distances between the sources of coal and ironstone, should compete as it does with highly-favoured England in the world-market, is regarded by the author as a thing to be proud of.

We may here note some facts about the iron industry in Sweden. A review of the period 1860-80 shows, that while the production increased, the number of places of production (pits, furnaces, forges) decreased quite remarkably. From about 417,000 tons of iron ore in 1860, the production rose to about 775,000 tons in 1880. The number of workmen in 1860 was 5,249; in 1880 only 5,038. Thus, a workman in the latter year produced nearly twice as much as one in the former. This is attributed chiefly to improved means of blasting.

On the occasion of the fourth International Congress of Hygiene, an exhibition of objects of any kind relating to hygiene and statistics of population, will take place at Geneva from 1st to 15th September this year. Inventors, &c., of all nationalities are invited to take part.

The signal officer at the summit of Pike's Peak, Sergeant Day, has lately observed a curious phenomenon. On opening the door at 8.45 p.m., the line on the summit was seen distinctly outlined in bright light, which was thrown out from the wire in beautiful scintillations. These, seen nearer, had the appearance of little electrified brushes or inverted cones of light, with their points to the line, whence they issued in little streams about the size of a pencil lead of bright violet colour, while the cone of rays was of a brilliant rose-white. These cones pointed in all directions, and were constantly jumping about. There was no heat to the light, though one could not touch one of the little flames, for as soon as the finger was brought near, they would instantly vanish, or jump to another point of the line. Passing along the line with finger extended, these little jets of flame were successively "puffed out," to be instantly relighted in the rear. Every exposed metallic point or surface was similarly tipped or covered. The cups of the anemometer appeared as a solid ring of fire, with a loud hissing noise. On bringing the hand near the instrument, no heat was felt; but the hand instantly became aflame, and on raising it and spreading the fingers, each of the latter became tipped with cones of light. There was a feeling as of a current of vapour escaping, and a slight tingling sensation. Other parts of the body were lighted up also.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

*** *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

λ AND τ OPHIUCHI AND ξ URSÆ MAJORIS — RAILWAY SIGNALS — ANOTHER MAN OUT OF HIS ELEMENT — DEWCAP — PHYSICAL OBSERVATIONS OF JUPITER—THE TRAPEZIUM IN ORION — SMEATON'S BLOCK — FORECASTING THE WEATHER—OBSERVATION OF DOUBLE STARS IN TWILIGHT—HAZE AND TELESCOPIC DEFINITION — OBSERVATORY ON HOUSE – TRANSIT OF VENUS—"SIDEREAL INDICATOR"—MOTION OF THE MOON'S LINE OF APSIDES.

[20308.]—I am sorry that I cannot give Mr. Beaven (letter 20265, p. 427) any very recent measures of the three stars concerning which he asks in his concluding paragraph; but, judging from the last time I looked at them, I should say that the components of λ Ophiuchi must now be some 1·6″ apart; and those of τ, a little more widely separated. These are pretty severe tests for a 3in. telescope, which will probably show that they actually are double, and that is about all. ξ Ursæ Majoris is opening. The two stars must now be nearly 2″ from each other. Mr. Beaven's telescope certainly ought to split this pair. Assuming him, as he says, fairly to have resolved these three objects, I must congratulate him on the excellence of his instrument. After his description of what he has effected with it, his assurance that it is "not a five-pounder" partakes somewhat of the nature of surplusage.

Does Mr. Stooke (letter 20267, p. 427) propose that engine-drivers should carry protractors or clinometers to be held between the eye and the signal-post, while travelling at the rate of some 50 or 60 miles an hour? Because I have myself had very considerable personal experience in the measurement of angles; but I confess that I should not like to risk much money on my power of discriminating between an angle of 43° ("Danger"), and one of 47° ("Clear") as exhibited by a broad arm on a tall distant post, with nothing but my unassisted eye to guide me in the determination.

It is a great pity that the author of the cock-and-bull letter, quoted from the *Mining Review* by Mr. Romanes (letter 20278, p. 429) cannot be added to the quorum of the Committee on Solar Physics at Brompton. The narration of his experiment (?) is so thoroughly in the vein of certain quack advertisements of the splitting up of the elements in this country, that it seems a thousand pities that the originator of such announcements should be deprived of the aid of so valuable a coadjutor as "Dr. D. P. Kayner" would undoubtedly prove. "Taking certain proportions of the three baser metals, combining them with such other substances as would represent as near as possible nature's alchemy, luting the whole together .... to represent the confined state of minerals and gases in the earth." Who does not recognise in this peculiar phraseology—the "certain proportions," "nature's alchemy," et id genus omne—the true ring of the Brompton mendicant sham?

If "Tyro" (query 47406, p. 436) can use a soldering iron, he may very speedily make himself an effective dewcap. All he has to do is to buy a plate of thin tin, and out of it to cut a square piece which shall roll into a cylinder to fit tightly over the end of the telescope, and to project at least 8in. beyond it. Should the outside diameter of the end of his telescope tube be 3½in., then the plate for his dewcap may be 11⅛in. wide. This will allow about ⅛in. for overlap, which, with careful soldering, will make a neat joint. Finally, he must blacken the inside of his tube with any alcoholic varnish mixed with lampblack, leaving, of course, the outside bright, and his dewcap will be complete.

Observers of the planet Jupiter will welcome the republication, from the *Annales Astronomiques de l'Observatoire Royal de Bruxelles*, of the splendid series of observations made by M. L. Niesten during the opposition of 1878. N. Niesten employed the Merz equatoreal, of 5 9in. aperture and 8ft. 6in. focal length, which is mounted in the Eastern dome of the Royal Observatory at Brussels; using chiefly powers of 180 and 270, although on rare occasions of superlative definition he employed higher ones still. As a result, we have 47 minutely-accurate sketches of the planet, made during the period extending between July 16 and November 2 in the year referred to, and a 48th, constituting a kind of key-plan to the various regions on Jupiter's surface. 31 pages of letterpress give the most ample details as to the position angles of the various bands, the equatorial and polar diameters of the planet, and the intervals between the bands, &c., all micrometrically measured, together with notes of the colours of the various markings upon them. Four supplementary pages deal with observations of the famous Red Spot. The sketches of the planet, to which I have referred above, were all drawn directly on the stone by M. Niesten's own hand; and exhibit, as I have said, the most minute accuracy of detail. The publisher's name on the title-page is F. Hayez, of Brussels; but I presume that any of the foreign booksellers in London would be able to obtain it. Anyone personally engaged in the study of the giant planet will certainly do well to make the experiment of ordering M. Niesten's brochure forthwith.

Another recent work, too, which I have been reading with great interest is Professor Holden's excellent monograph on "the Multiple Star Σ 748" which forms appendix II. to the Washington Observations for 1877. The Star which forms the subject of this exhaustive essay is otherwise known as θ^1 Orionis, but is probably most familiar to a large proportion of your readers as the Trapezium in Orion. Visible to the naked eye, as one star of the fourth magnitude, it was split into three by Huyghens, who subsequently (January 8, 1684) saw the fourth star. Hooke, however, would really seem to have seen the fourth, and that infinitely more difficult object the fifth star, somewhat prior to this. Struve appears to have re-discovered the fifth Star; and the sixth was first picked up by Sir John Herschel on Christmas Day in 1832. That these two last-mentioned objects are variable I think that no one who has watched them for any length of time can doubt. Prof. Holden gives a list of observers who have seen these objects with instruments of small aperture; which (assuming that two alleged observations of the fifth Star were really objective ones) places its variability beyond any question. The chief part of the monograph is devoted to a very elaborate discussion of a most extensive series of measures in position and distance of the four principal components of this wonderful system, made by Prof. Hall at Washington in 1877 and 1878, with somewhat less numerous ones of its two more minute constituents. As a result of the exhaustive discussion of which I have just spoken, Prof. Holden pretty confidently predicates actual physical association among the members of this strange object.

Will Mr. Franks (letter 20289, p. 450) forgive me for pointing out that my sole object was to indicate the *principle* on which an equatorial movement was obtained by the aid of a bevelled block of wood, without entering into any details of construction? Had I intended to supply any, I should have given a copy of the engraving which appeared on p. 402, in the instructive letter (20242), by "Orderic Vital."

Without attempting to travel over the somewhat heterogeneous and disconnected series of arguments and assertions employed by Mr. Gardner, in letter 20305 (p. 453), it may suffice here to call attention to the fact that if the Moon really influenced the weather in the slightest degree by her power of attraction, weather-changes, like the tides, must be semi-diurnal.

In answer to query 47438 (p. 460), I may tell "Rigel" that all very close double Stars are much more easily resolvable in twilight than when it gets darker; inasmuch as the brightness of the background to a great extent obliterates the diffraction rings which in a dark sky envelop the components. In saying this, I am, of course, not referring to cases in which the companion to the larger star is very minute as well as close. In such a case, if the *comes* is to be seen at all, ex necessitate the night must be dark before it could even become visible as an isolated object.

Mr. Muker (query 47451, p. 460) may rest assured that the sole remedy for the impairment of the definition of his telescope by such an atmospheric haze as he describes is to take it up above the region in which that haze is formed. I perhaps may add, though, that some of the finest nights we ever get in England for telescopic purposes are those in which there is a slight mist rising from the ground. I have had most astonishing views of planetary detail under these circumstances.

If "American" (query 47467, p. 460) determines on erecting his telescope at the top of his house, let me urge him to have two massive beams of timber built into the opposite walls of it and a heavy stone slab laid across them as a foundation for the pillar of his equatorial mounting. If, then, he has the flooring of the room laid upon joists independently of this arrangement (in fact, so as not to come in contact with it at all), I think that his trouble from tremors will be practically nil.

I really cannot give "Jamaica" (query 47468, p. 460) any replies to his questions which would be worth his perusal, with the limited time at my disposal. Imprimis, I know nothing about the meteorological conditions obtaining in Jamaica, although the experience of Mr. Maxwell Hall would seem to point to its being a good observing climate. In the next place, the calculation of the times of contact of Venus with the Sun's limb is very much too operose to be performed currente calamo on the day on which his query appears. Any professional computer would furnish him with them, though, for a very small charge. As for the Sun's altitude at the beginning of the Transit at Kingston: taking this out in the roughest possible way on an envelope, I do not think that it can be much more than 29° or so. It will be about 2° less at the time of last contact. "Jamaica" should certainly employ his Cooke refractor for the kind of observations he proposes to make. He will find it more satisfactory than the reflector.

What does "D. Mc" mean (query 47475, p. 461) by a "Sidereal Indicator," and whence did he get the name?

Mr. Gardner (query 47492, p. 461) will find, on reference to the *Nautical Almanac*, that the Moon was in apogee in Taurus from October 3rd, 1879, to September 25th, 1880, at which date her apogee passed into the confines of Gemini. She was in perigee in Taurus from June 2nd, 1875, to January, 1876, when her perigee shifted into Gemini as before. The perigee performs one sidereal revolution accurately in 3232·575 days, or 8yrs. 310d. 12h. 29m.; but the motion of line of apsides is not equable through a lunar month: for when the Moon is in syzygies, the line of apsides advances in the order of the signs, but retrogrades in the quadratures. The line of nodes takes 6798·279 days —i.e., 18yrs. 223d. 15h. 58m. to make a complete sidereal revolution: whence it is obvious that it by no means follows that at the end of the period of which I have spoken, the line of Lunar apsides will point to the same stars in the sky. The Moon will again be in perigee in Taurus in May 24th, 1884, and the perigee will remain in that constellations until Dec. 2nd. It will have passed into Gemini by the end of the year.

A Fellow of the Royal Astronomical Society.

BIRMINGHAM'S NEW VARIABLE IN CYGNUS.

[20309.]—For some reason which I am unable to explain, I failed to detect this interesting object for some time after its discovery, about fourteen months ago, and subsequently it has either been extremely small, or concealed by the trees which limit the view from my telescope-house. But the sight which I had of it last night was so gratifying that I am induced to mention it for the sake of any amateur observers who may not as yet have made its acquaintance. It lies in a comparatively open space, about 3° (more accurately 2° 51′) N. of α Cygni, and will be at once recognised by its beautiful red tint, which during the short time at my disposal attracted my attention so much, that I took no especial note of its comparative brightness. I should suppose, however, that it would fall between 8 and 9 mag. (a common size, by the way, for some unexplained reason, for ruddy stars). The eminent and accomplished observer to whom we owe this discovery will, I hope, before long, be induced to favour us with another and enlarged edition of his most interesting Red Star Catalogue. **T. W. Webb.**

Hardwick Vicarage, July 20.

AN APOLOGY.

[20310.]—I have to apologise for having mistaken the planet Mars for a new object. I deeply regret that my note was not in time to stop the publication of my letter (No. 20286, page 449), which was sent directly I had received a reply from a gentleman (with whom I had communicated nine days previously), informing me of my mistake. I feel that it is due, Sir, to you and to your readers that I should offer some explanation of my conduct. When I swept this object into the telescope I thought it might be Mars, and not having an ephemeris within reach, I referred to the "Astronomical Notes" for July (page 369), where it is stated, "This is a month quite remarkable for the absence of the Major Planets from the night sky, Mars, Jupiter, Saturn, Uranus, and Neptune being none of them visible," and turning to the Notes for the previous month (page 254), this statement, "Mars is now too near the Sun to be fairly seen"; and so I concluded that as Mars was invisible, what I had observed could not be that planet, but a new object. In making these quotations I do not wish to clear myself from all blame, and I greatly regret that by attaching a meaning to the "Astronomical Notes" in this journal, which I believe they were not intended to convey, I have been the means of disseminating an erroneous statement by the aid of your valuable journal, for which I am very sorry, and can only hope that your readers have not been greatly inconvenienced thereby, and be assured that next time I announce a discovery it will be of something more recent than that of the planet Mars. **J. Lane.**

29, Wyvis-street, Bromley, E., July 22.

CATALOGUE OF SUSPECTED VARIABLE STARS.—IV.

(*Continued from page* 449.)

[20311.]—**Draco—Eridanus—Gemini—Hercules—Hydra—Lacerta—Leones, Major et Minor.**

	Draco.	h. m.	° ′		
147.	10 Draconis	13 47	+ 65 27	5	Franks.
148.	B. A. C. 5341	15 58	+ 53 20	6½	Franks.
149.	17	16 33	+ 53 10	6	Struve.
150.	μ	17 3	+ 54 38	4	Flammarion.
151.	42	18 25	+ 65 28	5	Franks.
152.	ε	19 49	+ 69 58		Webb; Johnson.
153.	P. xx... 257	20 30	+ 72 1	6½	Franks.
	Eridanus.				
154.	η Eridani	2 50	— 9 23	4 0	Herschel.
155.	5 ,,	52	— 3 3		Espin.
156.	ρ² ,,	57	— 8 10	Comes Var.	Burnham.
157.	12 ,,	3 7	— 29 28	4·3	Herschel.
158.	ε	27	— 9 52	4 0	Herschel.
159.	δ	37	— 10 10	3·8	Herschel.
160.	γ	52	— 13 51	2·5 Var. Spect.	Secchi.
161.	υ¹	4 28	— 30 1	4 3 — 5 0	Gould.
162.	64	54	— 12 44	4 6	Herschel.
163.	L. L. 9667	5 1	— 8 49	6·9 — 8·0	Gould.
164.	66	5 1	— 4 50		Herschel.
165.	68	5 3	— 4 38		Herschel.
	Gemini.				
166.	B. 121 Geminor.:	5 38	+ 20 32	7 — 8	Birmingham.
167.	B. 144 ,,	6 18	+ 14 47	6½ — 8	Birmingham.
168.	32 ,,				Herschel.
169.	33	6 42	+ 16 22	4·7	Herschel.
170.	35	43	+ 13 34	4 7	Herschel.
171.	τ	7 3	+ 30 26	4·3	Herschel.
172.	ι	18	+ 28 2	3·7	Herschel.
173.	76	36	+ 26 7	5 0	Herschel.
174.	κ	37	+ 24 41	Comes Var. 8½ — 14	Webb (?)
175.	B. A. C. 2472				Tebbutt.
176.	L. L. 14571				Tebbutt.
177.	II. B. 36	43	+ 33 32	6 — 7½ Var. Col.	Birmingham.
178.	φ	46	+ 27 5	5 5	Herschel.
179.		47	+ 22 20	11 — ?	Knott.
	Hercules.				
180.	15 Herculis			6·8	Herschel.
181.	κ	16 3	+ 17 22	4·3	Herschel.
182.		4	+ 19 48	11·2	Schmidt.
183.	28	26	+ 5 50	4 8	Herschel.
184.	33	31	+ 7 21	6 3	Herschel.
185.	97			4·8	Herschel.
	Hydra.				
186.	15 Hydræ	8 45	— 6 42	5·7 — 6·3	Gould.
187.	υ²	9 59	— 12 27	4·6	Gould.
188.	L. L. 20556	10 31	— 12 41	4·3 — 6·1	Birmingham. Gould.
189.	b³	47	— 19 27	5·4	Gould.
190.	L. 4540	53	— 33 4	5 7 — 6·3	Gould.
191.	L. 4623	11 3	— 31 41	5·6 — 6·1	Gould.
192.	L. 5013	59	— 34 59	5 9 — 6 6	Gould.
193.	ψ	13 0	— 22 18	6	Franks.
194.	γ	12	— 22 32	Var. Spectrum	Secchi.
	Lacerta.				
195.	B. 607 Lacertæ	22 8	39 7	4 — 7½ ?	Secchi.
	Leo.				
196.	10 Leonis	9 29	+ 7 30	4·4	Herschel.
197.		10 17	+ 14 39	9 — 12	Peters.
198.	49	28	+ 9 19	5½ — ?	Schmidt.
199.		46	+ 14 27	9 — ?	Peters.
200.	87	11 22	— 2 11	5·	Franks.
	Leo Minor.				
201.	16 Leon. Min.	9 40	+ 40 19	7·	Franks.

T. E. Espin.
W. H. Gage.
T. Read.

PTOLEMÆUS.

[20312.]—My thanks are due to Mr. E. S. Beaven (letter 20265, p. 427) and Mr. Herbert Ingall (letter 20288, p. 450) for their interesting communications on the subject. The floor of Ptolemæus is covered by a close network of light-streaks, and from the size and favourable position of this walled plain, special facilities are given for ascertaining their apparent nature. From numerous observations, extending over a period of more than a year, it seems quite certain that the streaks are elevations, which differ from ordinary ridges principally by their great breadth, compared with their very low elevation. This being the case, it will be clear that the spaces between the streaks will really be slight depressions, and more than half of the curious hollows shown in Mr. Ingall's drawing seem to occupy such situations. Several, however, are apparently right in the path of some of the brightest streaks.

None of these depressions, however, appear to be precisely the same as those seen by Schröter and myself. At the time of the observation of June 23rd, 1882, the two pits were nearly as conspicuous as the large crater A, and there was nothing else visible upon the floor at all resembling them. The appearance of the little crater B seems very curious; it always appears easy to me, even with the 2¾in. refractor. The floor also has never appeared to me *perfectly* smooth. The little mound N.W. of the crater A is probably the highest portion of a curved ridge, which incloses, with the other ridge, running north from A—a considerably depressed surface. Under a high illumination it appears as a bright spot.

Until lately neither of Schröter's large depressions had been seen, except under a very low illumination; but on June 25th, 1882, though the form of neither pit could be certainly traced, yet a little shadow was suspected under what would be the place of the west wall of the southernmost one; and on June 26th this pit was seen as a slightly darker patch, a little shadow being also suspected under the west wall; again, on June 27th, an ill-defined dark patch was seen in the place of this object.

Mädler and Kunowski saw the whole surface as if covered with low, short ridges; but sunrise on November 28th, 1881, gave the impression rather of an immense number of very minute peaks, in addition to the low elevations of some of the more prominent streaks. The floor of this fine formation is certainly deserving of very careful attention, for recent observations seem strongly to confirm the existence, not only of an obscuring medium, but also of real physical change. It is difficult to imagine that the temporary reduction of one of the brightest spots on the floor to the brightness of a comparatively faint one close by can be due to anything but actual change.

It may be remarked that Schröter's two principal pits have a very striking resemblance to Hyginus N., in form, size, and appearance.

A. Stanley Williams.

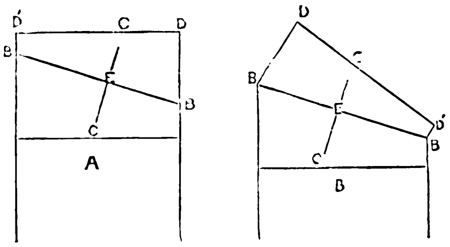
West Brighton, July 22.

SMEATON'S BLOCK.

[20313.]—In your No. 903, July 14, 1882, p. 425, I read: "Smeaton's block, concerning which 'J. C. A.' puts query 47294 (p. 387), is nothing in the world but a wooden cylinder with its top bevelled *at an angle equal to the co-latitude of the place of observation.*" Such a block is *not* Smeaton's block; it is a far more scientific thing than that which "F.R.A.S." describes. In Dr. Rees' "Cyclopedia," I read: "The plane of contact of the two halves of the block is so sloped as to make an angle exactly *equal to one-half of the co-latitude of the place of observation*, with a horizontal line, in which the underface of the block is supposed to be by its position." (Art. "Equatoreal.")

The Smeaton's block is this: The altazimuth position is A; the equatorial position is B; the planes of contact, "*whose angle is equal to one-half of the co-latitude*," are B B; the axis of rotation is C C. The telescope would, of course, be mounted on and above D D. Let our readers cut two pieces of cardboard to the angles of the above diagram, and run a needle through the centre of, and at right angles to, the line B B at E into the cardboard in the direction of its plane surface, as shown above. They will at once see, on reversing its position—i.e., turning it half-round from D′ to D without the dash — the beautiful principle of Smeaton's block. If the lower half is prolonged, and turned to the diameter of a gas or water-pipe —say 4in. inside and 5ft. or 6ft. long—and the pipe sunk into the ground, you have a compact, steady, and most useful stand, either altazimuth or equatoreal. **N. S. Godfrey, F.R.A.S.**

St. Bartholomew's Vicarage, Southsea, 15th July.



CHLORIDE OF NITROGEN.

[20314.]—In letter 20306, J. H. Huxley makes further comment on the properties of chloride of nitrogen. That principle which, more than anything else, science of the last 50 years has tended to establish—viz., conservation of energy—seems with Mr. Huxley to carry small weight. I confess that, to my mind, a perpetual motion is entirely unthinkable. I can in no way picture to myself such a combination. But, to come more closely to the subject of this letter, let us take the ordinary process of making chloride of nitrogen. We act on (say) ammonium chloride with chlorine gas. Now, ammonium chloride is a perfectly stable body; when, however, chlorine comes in contact with it, in virtue of its affinity for hydrogen, it tears away the hydrogen, and leaves the nitrogen and chlorine feebly linked together. Now, here is precisely a case of the rule quoted by Mr. Huxley in his letter: "Whenever we produce an elementary body it is necessary that an equivalent of some other body should be burned." We have, in fact, conferred the potential energy of free chlorine upon the loosely-linked compound NCl_3. Further, we may note that for decomposition to commence it is necessary to touch it with one of certain substances, nearly all of which contain hydrogen, which may start the decomposition by its affinity for chlorine. Similar cases may be found. I may mention one recently under my notice. I found that a plate covered with peroxide of lead, when placed in dilute acid with a plate of carbon, the circuit being complete, a galvanic couple is formed which is precisely opposite in its action to ordinary couples. In these one plate is oxidised, and free hydrogen liberated on the other, whilst in carbon and peroxide couple. free oxygen is given off at the carbon whilst the hydrogen combines with the peroxide. If we were to jump to a conclusion, we might say that here we had an anomaly; for, ordinarily, by oxidising a substance it develops heat; thus, we might say that heat was developed and work done by the lead being oxidised, whilst, by allowing it to deoxidise, further heat is produced in the electric circuit. By closer examination of facts, we find that work has to be done by some oxidising agent, in order to form lead peroxide, and that, when formed, it is sufficiently unstable to be reduced by sunlight.

I do not pretend that this explains everything with regard to nitrogen chloride; but, nevertheless, I believe that nature has no such anomalies, and that it is only owing to our imperfect knowledge that we cannot show the general laws to hold good in every case. **Ll.B.A.**

DAGUERRE AND HIS DISCOVERY OF THE DEVELOPMENT BY VAPOUR OF MERCURY.

[20315.]—In the account given in your last number, of Capt. Abney's description of M. Daguerre's "fluke" discovery of the process of the development of the Daguerrean image by vapour of mercury, there is some discrepancy which I would seek to amend. "Fluke" in a certain sense, no doubt it was; but the interesting part of the matter is left out by Capt. Abney, possibly through the quantity of material at his command.

First of all, I would call attention to the fact that, although mercury does throw off vapour at a comparatively low temperature, it is not sufficient to make the image upon the daguerreo type plate take a positive form. We must suppose, therefore, that the cabinet in which Daguerre kept his bottles was unusually hot, and, therefore, unfit for the purpose, or that there is some mistake or oversight in Captain Abney's description. The description I read some time ago, but in what publication I cannot now say, but think it was a publication by Lerebours and Co., of Paris, during Daguerre's lifetime, and to the following effect: Daguerre had made a camera image upon a silver plate, prepared with vapour of iodine. This image was, of course, a negative one, the light having converted the yellow iodate into the blue sub-oxide. A process of fixation without, at the same time, destroying the image, was unknown to Daguerre at this time, and what he must have most earnestly longed for was a positive image, because his and Nièpce's surfaces were opaque. So, in order to preserve the image he had made, he put the Daguerreotype plate, with the impression upon it, into a small drawer, that it might be kept from the action of the light; that in this same drawer there was, or had been, a bottle of mercury which had been upset, and the particles of mercury had become diffused very generally over the whole inside of the drawer, by its having been continuously opened and shut; that on his again going to look at the image on the plate he saw a positive image where the molecules of mercury had attached themselves, and that was the very part upon which the light had acted, and which before had formed the dark lines of the image. It is not difficult to imagine what the feelings of an enthusiastic experimenter were at that instant, especially when it is remembered that the man was a French artist, and that the image formed by the light before the means of development was discovered was, although scientifically important, practically worthless, because so feeble and evanescent that it could scarcely be used even for copying from. I am pleased to see that although Captain Abney calls M. Daguerre's discovery a "fluke," he at the same times gives him the credit of being a systematic experimentalist, for of this there is plenty of contemporary evidence.

There are a great many similar flukes on record; but I believe that such things happen only to those who patiently labour and watch for them, and may therefore be accepted as the rewards that Nature sometimes gives to her faithful servants, rather than the result of either accident or luck.

Thos. Sims.

3, The Grove, Clapham Common, S.W.

MR. SCOTT RUSSELL AND THE VIENNA DOME.

[20316.]—"J. W. W.—s" seems (see page 451) to doubt my assertion, "that the principal expansion and contraction of a conical dome would be in an upward and downward direction." But it is easy of comprehension, that when under sunshine there would be vastly more surface of roof than of the retaining-ring under the direct action of the sun. It would be interesting to know what steps were taken in order to prove that the said, or any similar ring, "does not" (?) expand and contract; and I am certain that many of "ours," including myself, would like to see a diagram of what he terms "heading-joints," and which he states can be, and are, used in some forms of straight girders, as well as circular ones, so as to confine the expansion and contraction to each section of plate employed in its construction. I maintain "that the said, and 'all' other metallic rings and girders, however constructed, do expand and contract, in proportion to their length, every day and night in the year." And being aware that any ordinary chimney stalk of, say, 90ft. high, will sway with perfect safety, in an ordinary breeze of wind, say 1ft. out of the perpendicular, without starting a joint, I am quite satisfied "that this Vienna dome does expand and contract regularly, as the temperature varies, without displacing any of its fastenings."

Liverpool. **J. J. A.**

TRICYCLES.

[20317.]—It seems to me that there is something wrong in the position in which the handles on a tricycle are placed.

My idea is, that they should be much more forward. In their present position you cannot pull at the handles like you can on a bicycle, and, in my opinion, it is a decided improvement to have the handles (bicycle) bent forward at least a couple of inches.

If the tricycle handles were placed vertically over the centre of the crank-shaft (or even a little more to the front), I fancy a great deal more power would be obtained.

As I ride a tricycle only by way of a change—preferring the two-wheeler—perhaps it is fancy on my part; but, I think, if the backward position was advantageous, we should soon hear of bicycle-handles being bent back. I have seen such an arrangement, but I think it must be a mistake.

H. A. White.

[20318.]—As in most cases the right leg is stronger than the left; the force exerted on the crank must vary accordingly. In a "Sociable," as ordinarily constructed, this variation in driving power is doubled. Why not place the cranks so that the two riders are "out of step"—i.e., when one has his right leg raised his companion has his left foot up.

The work would then be equal during each semi-revolution, supposing riders to be equally strong. With such long cranks as are generally fitted the necessary action is anything but becoming to a lady. This objection might be reduced by shortening one crank, and having the other (the gentleman's) its full length. Of course, leverage is lost, but I doubt if the lady's help is worth considering. **Glatton.**

THE NEW WATER-GAS LOCOMOTIVE.

[20319.]—I send you the following account of a trip made by the Holland hydrogen engine, as it is called, and description of the locomotive, taken from the *New York Tribune*:—The arrival was ahead of time. The oil gauge showed a cost of 2·52dols. for the twenty miles run, which is not much, if any, cheaper than full rate on the long and closely managed trunk lines when coal is cheap. It is more than double the highest consumption of the "C. Holland" during a few weeks previous, when it had been doing heavy freight work. The principle of the apparatus is the decomposition of water at a high heat by mingling it with a small proportion of oil, without air, in iron retorts; the hydrogen set free being instantly burned, and all the heat of both unions—the carbon with the water-oxygen, and the hydrogen with the air-oxygen—being confined and utilised in the boiler, making steam. The retorts are four in number. They resemble half a peck-measure in size, and are set near the door of the furnace, a little above the level of the burners, which cover a floor about 3ft. by 8ft. in extent. The burners are as pin-holes along the lengths of a close series of 1in. iron pipes covering the floor of the fire-chamber and connected with a central gas main, which is supplied by pipes from the retorts. These pinholes being pitched towards each other in pairs, the gas-jets meet accordingly in pairs and mingle in combustion with jets of air coming up through 1¼in. holes just under each conjunction of gas. The number of gas-jets is 518.

The boiler, as originally designed and built, was intended to improve upon the ordinary conditions of gas-heating, but on being tried, was rejected, and the ordinary boiler pattern was restored, with a few modifications in the firebox and smoke-pipe. In April last the new boiler and heating apparatus were satisfactorily tested, and in the last of May the complete engine was delivered to the Erie Road. After a few standing trials it was set at work on the freight business, until yesterday, when it entered on its calling as a passenger engine. Very little time is now consumed in firing up; probably not more than half the average with ordinary locomotives. Rapid motion has been an aid to the fire, which formerly it tended to suppress. The dimensions of the engine are as follows: weight with all on board, 48 tons; length over all, 62ft.; diameter of driving-wheels, 5ft.; cylinders, 17 by 24in. **R. B.**

New York, July 12.

RAILWAY SIGNALS.

[20320.]—Railway signals, according to H. Stooke (letter 20267), sometimes show different angles for the danger position; this, I have no doubt, is because of the expansion and contraction of the rod or wire. Some years ago I wrote, in consequence of a sad accident, and on one occasion went to a station when I found a white light was reflected down the line, although I knew the signalman intended danger instead.

I think only two signals are used where lock systems are adopted, the "danger," and "clear."

If the horizontal position could be reliable, by means of a spring or stop, at or near the signal itself, it would prevent any miscalculation respecting 44° as danger, and 46° as clear.

My patent automatic apparatus for interlocking, and other signals (Model 21, Alexandra Palace Exhibition), when released by the passing train, would be actuated to "danger" by the weight at signal, because then independent of the rod or wire from the locking lever in the signal-box.

Well-street, Hackney. **J. Harrison.**

MORGAN'S PAPER FOR PHOTOGRAPHIC PURPOSES.

[20321.]—In your last volume, p. 379, mention was made of the many inquiries as to the nature of Morgan's sensitive paper, and of the effects produced with it. The following facts may therefore interest your readers.

A patent was applied for by Mr. W. T. Morgan, of Greenwich, in December last, but it received provisional protection only. In the provisional specification the invention is described as one relating to the manufacture of sensitive paper, and to blocks, pads, or tablets of the same, for photographic purposes. The following is the description given by the inventor:—

"In carrying the invention into practice I take superfine paper (preferably hand-made), as free as possible from grain or texture marks, and in order to eliminate all traces of lime or impurities of any kind, I pass it through a bath or solution of strong acid, preferably sulphuric acid and water, and thoroughly rinse. I then coat the paper with an emulsion of ground asbestos, talc, Chinese clay, or other substance of a similar nature in a solution of gelatine, starch, gum, and alum; when this is dry the paper is placed between highly polished steel or silvered plates and subjected to very heavy pressure by being passed between rollers. This paper is then again coated as before, but with a stronger emulsion of the same materials, and when dry is ready for glazing or enamelling; that is to say, for receiving a textureless glass-like surface so essential to the success of my process. This glazed or enamelled surface I obtain much in the same manner as lithographers obtain their transfer impressions from steel or copper engraved plates, that is to say, I damp the prepared paper on the back and carefully lay it with the prepared surface downwards on the polished metal or silvered plates previously made warm, and this paper is again submitted to very heavy pressure. The damp paper will adhere to the metal plate, but on again warming the latter, the paper may be easily stripped off. The paper is then stretched over a block by means of a frame similar to a linen stretcher, or by means of any other suitable apparatus; it is then carefully polished by being rubbed over the surface with paraffin-wax, bees-wax, or any material of a similar nature dissolved in highly rectified spirits; it is then coated by any of the well-known methods with a gelatine bromide of silver emulsion and when dry is ready for use. The paper may be used for a variety of photographic purposes: pictures can be produced upon it by means of photography, which pictures may be afterwards transferred to glass, canvas, opal, wood-blocks for engraving, or to any other substance to which it is possible to attach paper. It will be found most useful for decorative papers for windows, walls, panels, and the like, as any sized or shaped picture can be made. According to an important part of my invention, I arrange the paper in the following manner:—When the paper has been prepared in the manner above described, it is cut into suitable sizes, and any number of these pieces are superposed one upon another, the prepared side being upwards, and between each piece is placed a sheet of tin-foil or similar material. The papers so interleaved with metal sheets are then pressed into a shell or matrix of any suitable curvature by a die or pressing device of corresponding curvature which is subjected to heavy pressure, and forces the paper and tin-foil or other metal into a curve. The whole is then bound round the edges as is done with sketching or drawing-blocks or pads; the tin-foil assists the paper to retain its curve and also protects the rear sheet from light while the front one is being exposed in the camera. The paper and metal may also be made into flat blocks exactly similar to the ordinary drawing blocks. My object in bending or curving these tablets is that when they are placed in the camera in position for exposure they have the same centre as the curved surface of the lens, and by this means perfect equality of illumination is obtained over the whole surface. The lines are absolutely straight, the definition is more clearly defined, and many more technical advantages are secured, well known to the profession. The use of stops or diaphragms (if these are not entirely dispensed with) is considerably modified. The tablets are placed in the dark slide and exposed in the same manner as an ordinary sensitive plate. After exposure, the exposed sheet is detached from the block and developed in the usual manner. The surface to which the picture is to be transferred should be previously prepared by brushing over the same a solution of gelatine and alum, and allowed to dry. The picture while still wet is pressed in contact with the surface to which it firmly adheres, and when dry the paper may be stripped off, leaving the picture. The principle of curvature will also be found of great service in the process of enlarging where it is desirable to obtain absolutely straight lines. The picture having been produced on the paper can be transferred to a curved glass by the process above described, and the picture can be made to face either side by attaching it to the concave or convex surface. For magic-lantern slides or discs my invention is very advantageous, as pictures taken on the curved paper are transferred to curved glass, and when thrown on the screen will be found to cover the whole disc of light with perfect definition up to the edges."

T. H. G.

THE FOREGROUND IN SKETCHING—THE EXPANSION OF IRON — THE PERIODICITY OF STORMS—A CURIOUS WEATHER SUPERSTITION.

[20322.]—I FEAR that a "Country Sketcher," (letter 20291) will not arrive at pleasing results if he leaves out two of four fields between his eye and the distant object which he is drawing, under the belief that the eye will supply the omitted foreground. I suspect that the effect of that course will be merely to make the picture a representation of an object with two fields intervening, only drawn on a smaller scale.

Your correspondent, "J. W. W—s." is seemingly amused at my treatment of the Vienna Dome question; but he forgets that my remarks were made with immediate reference to the statements of Sir Edmund Beckett. I did not say that any part of the dome would undergo flexure, but only suggested that expansion might make itself evident in some other way than that mentioned in Sir Edmund Beckett's letter—a lateral movement of the pillars. Of course, when allowance is made in girders for local expansion, there can be no necessity for provision for expansion in their total dimensions. The whole point of Sir E. Beckett's letter, however, was that no such allowance had been made: and having no reason to doubt the statement, I was preparing to discuss the possible modes of expansion in structures so arranged. Your correspondent having called in question the truth of Sir Edmund Beckett's facts, I have no more to say.

I am sorry to see that Mr. Gardner (letter 20305) has left his 20 days' period theory of storms, and gone a hunting for celestial relations. As a matter of course, he has fixed upon the Moon, and will now probably spend the rest of his lifetime in the fruitless search for traces of lunar influence in our weather. Let him be warned in time, and give up the pursuit of the phantom. Many men have followed it before him, and all to no purpose.

It may be worth noting that on the 15th inst. (St. Swithin's Day) there was a new moon. That day being Saturday, we had the phenomenon of a "Saturday Moon," which ought to be followed by 20 days of wind and wet according to many proverbs. There are two curious circumstances connected with this superstition. The one is that it is unusually widely current. It is known among the farmers and peasantry in Scotland, Ireland, and the North of England. A correspondent of the *Athenæum* said he had heard it from American, French, and Spanish seamen, and even from a Chinese pilot. Whence this well-nigh universal belief? The other is that a gentleman actually deduced the rule from weather registers, without being aware of the existence of the popular superstition. He examined records covering a period of about 80 years, and as the result asserted that 19 times out of 20, a Saturday moon was followed by 20 days of wind and rain. He announced his discovery to the Royal Astronomical Society in 1848. Between the proverbs and the discovery, we are forced to conclude that there must have been some very striking coincidences to give rise to them.

J. A. Westwood Oliver.

Belle-vue Springburn, Glasgow, July 20.

STONEHENGE AND SUN-WORSHIP.

[20323.]—IT is the Clun stone circle I judge, from scant data possibly, but not altogether confined to flint implements, to have been constructed during the Neolithic Age. With respect to Stonehenge, I should be glad to know what evidence connecting it with either pre-historic era is forthcoming. That it is older than British times good authorities assert. Mr. Skertchley, speaking in these columns on ancient stone monuments has said: "We know that ages before the Druids worshipped here, these structures stood as hoary monuments of the zeal of long-forgotten races." He has also, anticipating the difficulty of supposing such massive blocks could be squared with only stone tools, said: "The Tahitians who, when first visited by Europeans, were quite ignorant of the use of metal, erected huge stone structures for the reception of the distinguished dead. One of these, described by Captain Cook, was no less than 267ft. long, 87ft. wide, and 44ft. high. The stones were 4ft. deep, and were neatly squared and polished. Similar instances might be cited from other places." Professor Ramsay says the standing masses of Avebury and Stonehenge have been set on end by a "vanished" race, and the same authority corrects Mr. Stooke with regard to the derivation of the material. He says the smaller stones only (believed to have been votive offerings) were brought from a distance. Most of the stones are simply the "grey wethers,"—fragments of denuded Eocene strata which orignally overlaid the chalk on that horizon. An eye-witness recently told me that similar blocks are seen sticking out of the soil all up and down in that neighbourhood. Any contribution of facts towards this discussion will be gladly accepted, I believe by others, besides Mr. Stooke and myself.

Neo.

COLOUR.

[20324.]—MR. SMITH (20307, p. 453) appears to misapprehend the bearing of Tyndall's experiment which he quotes. From a purely scientific point of view, the discussion about which colours are primary and which secondary or compound, is quite meaningless, because it is recognised that every tint and colour is both primary and secondary. Colour is, in fact, derived from two sources. First, it exists in the light itself, and every imaginable tint of pure colour exists as wave-length, or rate of vibration, in light. But it is also dependent upon sensation, and just as the sensation of white light is due to the combined effect either of the whole gamut of wave-lengths, or to the action of a variety of complementary colours or tones, so is each colour capable of being generated by several combined tones. The whole question has two aspects—the scientific and artistic, which have really no point of union, the one relating to cause and the other to effect; it is like the relation between the theories of acoustics and production of music from a violin. The effects of the spectrum, the decomposition, and recombination of the constituents of light, are entirely different from the relations of pigments and coloured materials, and science deals with one, and not with the other, for entirely different purposes.

Tyndall's experiment is perfectly simple and clear, when we understand that no agent adds to or produces colour at all: it only takes away a part of the light acted on. Once taken away, no subsequent combination can restore it. A blue glass simply absorbs all those rays of light which, when abstracted, leave blue; yellow and other glasses the same. The tone of each colour—that is, its purity, depends only on the residuary rays which pass. Now, taking the case illustrated, we have a so-called blue glass, which transmits blue and green, and a yellow glass, which transmits yellow and green. That is to say, we may consider the white light as consisting of blue, yellow, and green, because each of the two first glasses allows something to go through besides pure blue and yellow. But each of these glasses produces these colours, not by putting them into the light, but by taking out their complementaries. What happens when the glasses are superposed? The light first passes through the blue, which sifts out all the yellow, but permits green to pass with the blue; the yellow glass now sifts out all the blue, and, therefore, has nothing but green left to pass: that is to say, the green light is not produced by the union of blue and yellow lights; but is merely the residue. But blue and yellow pigments may produce a green effect with reflected light, notwithstanding, because these do send the two colours to produce a combined effect or harmony (which may be green) upon the eye.

In the second case, with two separate lights, the conditions are quite different. Here each glass sifts out only its own proper colour; but does send its residue on to produce its effect. Hence, the result is blue, green, and green-yellow, and the combined effect should be white, with an excess of green.

The explanation of the effect of white from a rotating compound disc, is that each colour producing in the eye its own rate of vibration, which is persistent, the whole of them combine to produce, in the eye, just the same result by their rapid succession as though they were acting synchronously, as in white light.

As I said at first, science recognises no three primary colours; for in fact we can produce the white light from various combinations.

Sigma.

[20325.]—IT is but a short time since Mr. Colton brought up this question before, and it is quite evident he has learned nothing in the interval, and that both he and Mr. Smith are only of the usual type of paradoxists, with whom argument is useless. When Mr. Smith quotes Tyndall, that by "judicious management one of these colours is rendered yellow and the other blue," he knows that he is only indulging in mere word quibbling. By judicious management, Tyndall means only judicious management of the stopping off screens so as to leave only the yellow and blue—*absolutely pure*—of the spectrum. It is only possible to misunderstand Prof. Tyndall's meaning intentionally. When Mr. S. goes on to say that, by Tyndall's own showing, what he here calls blue and yellow contain between them all the colours of the spectrum, I must ask him where Tyndall shows that? Tyndall tells him that he can obtain yellow and blue in the spectrum free from admixture of other colours, and that this pure blue and yellow light, when mixed produce white; but Prof. Tyndall nowhere says the white thus produced contains all the colours of the spectrum. On the contrary, it contains only the blue and yellow, as a prism would soon show. It is no use arguing, however, with paradoxists. I will, therefore, only propose a test experiment to Mr. Smith. Let him cut off from the solar spectrum all but the pure blue and yellow, and then recombine these. Let him test his blue and yellow before mixing by a prism, and after, and having done so, compare his resulting light with ordinary white light, and send you, Sir, the results of his experiment. If he is not satisfied of his error by that time, I am afraid he is past convincing. With regard to his assertion that an admixture of one-tenth white light to nine-tenths coloured would destroy all trace of colour to the eye, he says the thing that is not.

E. Holmes.

INDICATIVE SYMBOLS.

[20326.]—IF Mr. M. Jonson had been acquainted with the routine of a printing office, I believe he would not have recommended many of the indicative symbols contained in his letter (20248, p. 404). There can be no objection to Y, F, P, T, being used respectively to represent yards, feet, pounds, tons, though it looks remarkably like a change without an improvement; but there is an objection to Y^2, &c., and a very decided one to all signs with a line over them, or indeed to anything not usually to be found in the compositor's pair of cases. I believe if the mathematicians had consulted the printers when they adopted or developed the signs used in their formulæ, they would not have cause to complain of so many misprints. In writing, of course, there is no objection to any kind of symbols; but as written science nowadays is frequently printed, it is advisable to keep the symbols used within the ordinary type-range of a newspaper office. The saving in space by the use of these symbols is not a very large quantity; and seeing that mathematical formulæ, owing to the trouble and time occupied in setting, cost twice as much as ordinary matter, it requires considerable courage to introduce any new formulæ. In the ENGLISH MECHANIC I have noticed with satisfaction that the method of setting out sums suggested by Prof. Stokes has been adopted, instead of the antiquated and troublesome method of putting figures under one another with a line between, which line, being no multiple of the body-depth of the type, involves some trouble in justification, or making one column the same length as the other, besides keeping the lines square. It might be urged by Mr. M. Jonson that his suggested characters with the line over them might be cast in one, and so they might; but where are they to be kept? That is the gravamen of the whole business. The old-fashioned compositor is rapidly giving place to a race of mere type-setters, who take no pride in their work and no care of their employer's property. For this reason special characters, which have no appropriate boxes in the pair of cases, are frequently thrown on one side and lost—even Italic is not always restored to its proper place by these gentlemen, who are the loudest howlers when they cannot find the "sorts" they have themselves wasted. Apart from these considerations, it is not quite clear what is to be gained by representing "1 volt" as "Fu VIII.," but there is a decided gain in writing and also in printing "1 foot" as "1 F." The use of Greek letters to designate stars is, no doubt, convenient, and is well adapted to the purpose; but so far as the printer is concerned he is at this disadvantage—that the Greek letters are frequently mislaid, and often, thanks to the imperfect manner in which they are delineated by different writers, he has the credit of making a mistake—a printer, you know, being expected to be able to tell with "half an eye" whether the author meant Zeta or Xi Cancri, Nu or Upsilon Ceti. Those who wish to adopt symbo's have a fair supply in every pair of cases; they have, for instance, whole alphabets of capitals, small capitals, and lower-case; they have the three common accents on five vowels, and the diæresis ditto, parentheses, brackets, note marks (*, †, &c.), besides other signs which could readily be used, and, once understood, would be as effective as many of the troublesome signs now employed.

A Practical Printer.

THE PRESSURE OF WIND.

[20327.]—After reading Mr. Gardner's letter and the query of "Octurus" (47493) in your issue of the 21st inst., I am prompted to make a few remarks upon this subject.

In the first place, Mr. Gardner, in his letter on "Forecast and Periodicity of Storms," quotes the English Mechanic to the effect that in the gale of the 14th Oct., 1881, a wind pressure of 53lb. on the square inch—on the square foot, I think he means—was recorded at Greenwich. "Octurus," in his query asks, Which is correct? The "E.M." in stating the pressure of wind on the square foot at a velocity of 50 miles per hour, 49½lb., or "Molesworth's Pocket Book," which gives the pressure at that velocity as equal to 12·304lb. per square foot.

I would remark, with regard to the statement in Mr. Gardner's letter, that such a velocity as 53lb. on the square foot, not to mention on the square inch, is unknown in this country, except in anemometrical registers, and this I not long ago pointed out in *Nature*, curiously enough, citing this very instance. If your correspondent had wished for a still more astounding record of velocity, he might have stated the pressure registered, during the same storm, at the Bidstow Observatory, Birkenhead, which was 77lb. on the square foot, according to the newspapers.

The erroneousness in the registration of such high pressures as these, has been aptly pointed out by Mr. T. Hawksley, F.R S., in a paper read before the G. Section of the B.A. Meeting, York, 1881, in which he gives a formula, and a table compiled from it, by which the velocity and pressure of wind are connected, and which I will give here, if you can spare the room, as I think "Octurus," and others of your readers who take an interest in meteorological subjects will find it useful.

Let v = velocity of wind in feet per second; p = the pressure in pounds per square foot; ·0765 = weight in pounds of a cubic foot of the impinging air, 32 = coefficient of gravity. Then

$$p = \frac{\cdot 0765\, v^2}{32} = \left(\frac{v^2}{20}\right) \text{ very nearly.}$$

By means of this formula the following table of pressures is constructed.

Velocities in		Pressure in pounds per sq. foot.
Feet per second.	Miles per hour.	
10	6 8	0·25
20	13·6	1·00
30	20 4	2·25
40	27·2	4·00
50	34·0	6·25
60	40·8	9·00
70	47 6	12 25
80	54·4	16 00
90	61·2	20·25
100	68·0	25·00
110	74·8	30 25
120	81·6	36·00
130	88·4	42·25
140	95·2	49·00
150	102 0	56·25

When there is a diminished pressure, as in the case of the inclosed sail, roof of building, &c., we then have

$$p = \frac{v \text{ sin. } B^3}{20}$$

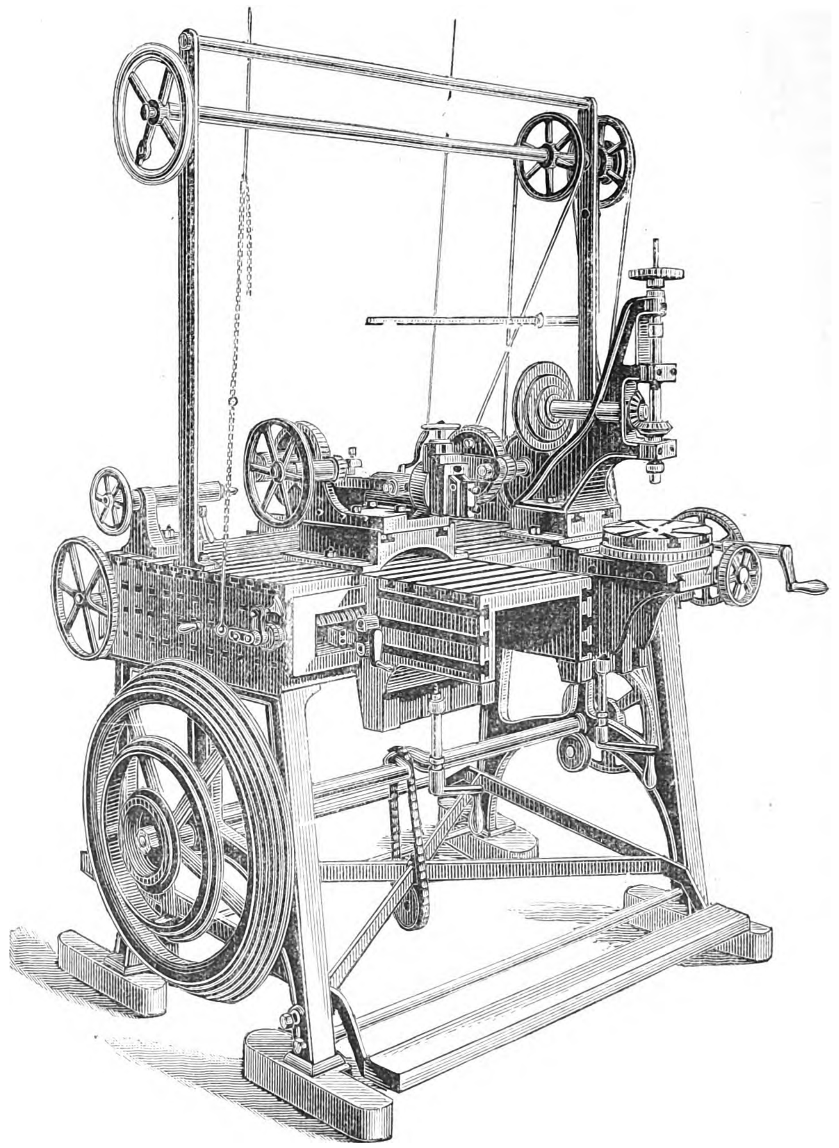
in which v = the absolute velocity with which the air strikes the receding plane, and s the internal angles between the obliquely-placed surface and the direction of the impinging wind.

By making use of the above table, "Octurus" will find that in the case he gives the pressure will be 14·81lb. per square foot. This, it will be seen, is greater than that given in Molesworth's Pocket-book, and considerably less than that stated in the "E.M." The formula and table given above, however, are more trustworthy, I think, than Molesworth, whose table of wind pressures, I find, on reference to an early edition, has remained unaltered for about 20 years. The figure in the "E.M." is evidently a mis-statement.

Worthing, July 24th. **C. H. Romanes.**

COMBINATION MACHINE.

[20328.]—I send two photographs of a new combination machine I have made. The bed is of cast iron, 4ft. long and 2ft. wide, with twelve T slots for bolting the different parts of the machine down, also thirty square holes on each end for same or fixing work. The standards are of cast iron, fitted with crank shaft running upon rollers, one end has balance flywheel, the other a driving-pulley. The treadle works on either side.



COMBINATION MACHINE.

The lathe side is fitted with Whitworth's 5½in. centre headstocks, traversing table is fitted with 1¼in. steel leading-screw, also rack and pinion. The leading-screw is fitted with quadrant for change-wheels for screw-cutting. The table is fitted with compound slide-rest, also with angle-plate to fix cylinders or other work. Work to be done on this side: Ordinary turning, screw-cutting, surfacing, cylinder boring—all self-acting.

The machine side is fitted with a drilling-machine and shaping-machine with two traversing tables. The one under drilling-machine is compound, having rotary, vertical, and parallel motions; it is fitted with eccentric to throw in and out gear of leading-screw for traversing the bed. The other under-shaping machine has T-slots on top, and each side it has vertical and parallel motions with eccentric, same as drilling-table. Work to be done on this side: Drilling, (shaping, either parallel or circular) wheel-cutting, tap fluting, nut shaping, milling, keyway cutting, boring, and many other things. The machine is driven from overhead shaft, fitted with clutch motion for starting and stopping.

The rotary table is fitted with mandril same as lathe-head for taking all chucks. A better explanation can be given upon seeing the machine.

Henry S. Frost.

(Engineer, Lathe and Tool Maker.)

45, Mortimer-street, Cavendish-square.

MEDICAL REPLIES.

[20329.]—Diabetes (47423).—The simplest test for sugar in the urine is its specific gravity, for estimating which a small hydrometer is sold. Healthy urine ranges from 1,010 to 1,030 at 60° Fahr. If the urine runs above 1,030, sugar is very probably present, and if so, the urine may range from 1,030 to 1,050. Put half an ounce of urine in a test tube, add a piece of sodic hydrate as large as a pea, and boil. If sugar be present, a dark brown colour is produced. Then there is the ordinary copper test, also that by fermentation, both of which will be found in textbooks. In diabetes a very large quantity of urine is passed of a high specific gravity, such as I have indicated. Great thirst and dryness of skin are induced by the elimination of so much water by the kidneys. As to diet in diabetes, the routine prescription is to exclude sugar and starch; but I believe that I have often seen life shortened by persistence in a rigidly non-saccharine diet.

Stammering.—In my note on this subject (47366) I see a printer's error. "Make the child read aloud, with extreme slowness and distinctness, for a quarter of an hour four *hours* a day" should be four *times* a day.

Billiousness (47239) is a hopelessly vague term which may mean anything. Querist must get personally examined.

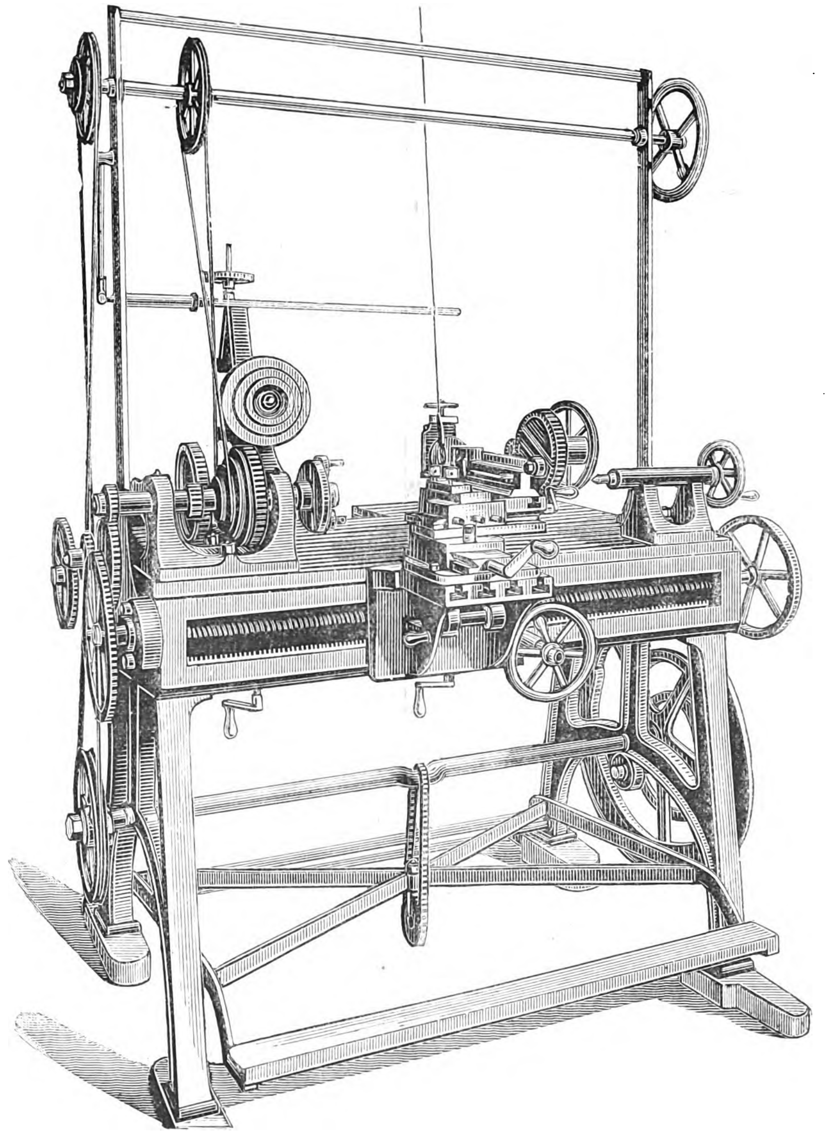
Pain in the Bowels (47436).—If "Printer" is suffering from lead colic, he will see a pale blue line round the edge of the gums on turning up the upper lip. For this refer back to a former full article by me upon "lead poisoning." If he has defective teeth, live on soft food, and do not swallow lumps of meat that have not been chewed. For this refer back to former articles on indigestion.

Dryness of Mouth (47488).—Not eligible for useful reply. **James Edmunds, M.D., &c.**

Grafton-street, Bond-street.

NOTES ON DYNAMO-MACHINES.—VI.

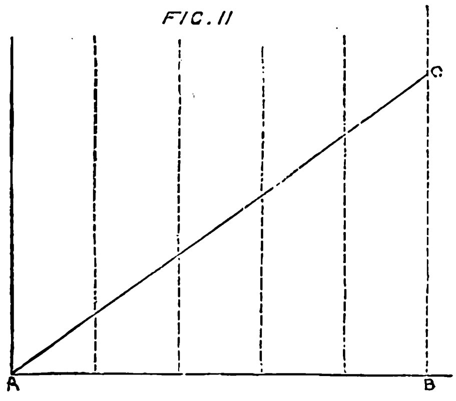
[20330.]—47. With reference to the characteristic curve for the ordinary dynamo-machine, we have said in a former note that for a short period at the beginning of the curve the strength of the magnetic field is proportional to the current. This, as has been explained, is due to the fact that the iron in the cores is as yet far from saturation, and it follows that this period, during which the strength of the field is proportional to the current, can be lengthened by increasing the amount of iron in the field magnets.



COMBINATION MACHINE.

48. For a machine having a comparatively large amount of iron in the field magnets, the rise of E.M.F. would be represented by a straight line A C, Fig. 11, taking, as in former notes, distances

FIG. 11



on the horizontal line A B to represent current in ampères, and vertical heights to represent E.M.F. in volts. This fact is important, as affording the basis of the solution to the problem indicated in Note 46.

49. We have a large number of incandescent lamps arranged in parallel circuit, and fed from a particular station. The problem is to arrange the generator so that fifty or a hundred, or, in fact, any number of lamps may be extinguished, while the current through the other lamps remains unaffected, the speed of the generator remaining constant. Let L represent the lamps (Fig. 12) and G the generator, then that every lamp may be perfectly independent of its neighbours, neglecting the resistance of the leading wires, it is only necessary that the difference of potentials between E and E′, the terminals of the generator, be kept constant.

50. The solution here given is due to M. Deprez

FIG. 12

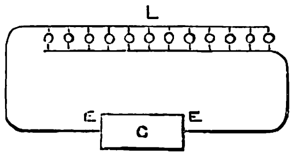
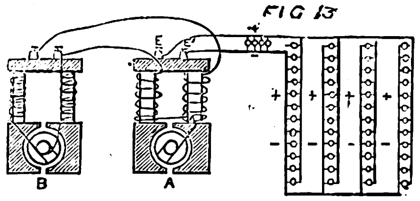
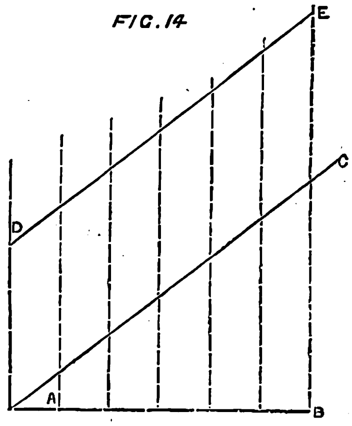


FIG. 13



Let a dynamo-machine (A), Fig. 13, be constructed, having a large mass of iron in the cores of the field magnets, and having two coils wound on these cores: *a* wound as in the ordinary dynamo and in circuit with the armature and lamps; *b* fed by an auxiliary dynamo B. In this machine a part of the E.M.F. is due to the magnetism derived from the current in the self-excited coil *a*, and another part is due to the magnetism derived from the current in the coil *b*, which is fed from the auxiliary dynamo. The sum of these two E.M.F.'s gives the total E.M.F. of the machine. The characteristic curve for this dynamo when self-excited and when no current is being supplied by the auxiliary machine, will be represented by the line A C, Fig. 14. Let the auxiliary dynamo be started and

FIG. 14

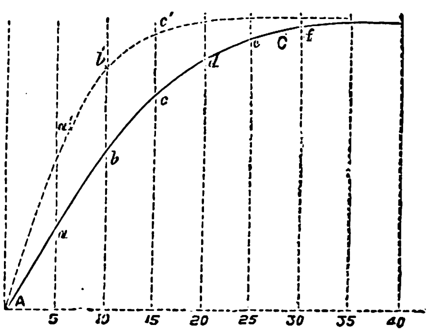


a current sent round *b*. A certain E.M.F., A D depending on the magnitude of this current, will be added to the first E.M.F., and D E will run parallel with A C (since the cores of field-magnets are very large), and will represent the total E.M.F. of the machine A. If the difference of potential between E and E′ is to remain constant, it is necessary to have the internal resistance of A such that if an angle be drawn with its tan. representing the resistance, that angle shall be equal to C A B; in other words, the tan. of C A B must equal the internal resistance of A—i.e., A must be driven at its critical speed. If this condition is fulfilled, it is obvious that whatever may be the total resistance in circuit or current flowing, the fraction of E.M.F. employed in sending the current through the external part of the circuit is constant, and is equal to A.D. This is only true for one speed of A, and if, during the process of lighting, the internal resistance of A increases, due to increased temperature, the speed must be increased a very little to make the characteristic curve coincide with the new internal resistance line. Increasing the speed of B does not alter the necessary condition of E.M.F. between E and E′ remaining constant, but merely increases the E.M.F.—that is to say, all the lamps are rendered brighter. The lamps can, consequently, be of any desired brilliancy.

51. The strength of field produced by an electro-magnet is proportional to $a\,N\,C\,\sqrt{L \times D}$, where a is a constant depending on material of which the core is made; N = No. of turns of wire; C = current; L = length of core, and D = diameter of core. This only holds good for very small currents, or so long as the strength of field produced is proportional to the current; but we can assume that the strength of field is constant for the same value of N C, and is independent within the limits with which we are concerned of the respective magnitudes which make up this product.

52. On this assumption, it is quite easy to say what effect will be produced by increasing the number of turns of wire on the field-magnets, since the E.M.F. is proportional to the strength of field. Let the line A C, Fig. 15, represent the

FIG. 15



characteristic curve for a particular dynamo having N turns of wire on the field-magnets. Let the turns on the field-magnets be increased to 2 N; then we know that with a current of 5 ampères 2 N turns will produce the same effect as N turns with 10 ampères. The first ordinate for the new curve is obtained by making $5\ a^1 = 10\ b$. Also with 10 ampères 2 N turns will give the same result as 20 ampères with N turns; consequently 10 b^1, the second ordinate of the new curve, must be made equal to 20 d; the third ordinate 15 $c^1 = 30 f$, and so on, the dotted line representing the new curve. It will be observed that the maximum E.M.F. is the same for few or many turns, since there is a point beyond which an additional current does not give an additional E.M.F. due to presence of iron. The effect of more turns is to saturate the magnets quicker.

53. Given the characteristic curve for any particular machine to find the new curve for increased No. of turns of wire on the armature, provided the space filled is about the same, we have simply to increase the vertical ordinates in the same proportion as we increase the number of turns of wire on the armature. It must be borne in mind that although we have taken considerable pains to explain the action of dynamo-machines geometrically, and have considered at some length how the characteristic curve is affected by modifying the construction of the machine, the results obtained are only to be taken as approximately true, for the complete theory of the dynamo has not yet been formulated. E.

FARADAY'S FIRST DYNAMO.

[20331.]—The following may interest some of ours:—"This instrument is of the horsehoe form, and is composed of twelve sheer (thin) steel plates, each 28in. in length from the poles to the centre edge. At the greatest width of the curve the horseshoe is 7in. across, and the extremities of the poles are 1½in. asunder. The keeper (armature), or lifter, which is made of the purest soft iron, is 5in. in length, 2½in. wide, and 1in. thick. Around the middle of the keeper, and occupying with its lower section the space between the poles, is a wooden winder, having about 100 yards of common threaded bonnet wire, from which the two ends, composed of four lengths of the wire twisted together, are carried out. One of the twisted ends passes beyond each end of the keeper, and rest upon the respective poles of the magnet. A short lever, placed in a frame, is so attached to the winder and keeper as to admit of their being forced up by the hand applied to the longer end of the lever. Every time this is effected a brilliant coruscation of light is produced at the end of the wire." Fiddler.

LEGAL REPLIES.

[20332.]—"Caveat Emptor" is a maxim of the English law, and it means "Let the buyer beware." Now it has been humorously translated, "Keep your eyes open." "F.W's." "impression" of what wonders the stove would do can clearly not avail him, and glowing statements in a circular or advertisement are, of course, mere puffery. There is thus no warranty, and without a warranty the buyer of an article of this kind can have no right of action, even though it fails to perform its promises. If the shopkeeper had, at the time of the sale, said that the stove would cook as advertised, and in a way that made his statement a warranty, then "F. W." would have been able to recover his money back again. But here there was nothing of the sort; and as there can be no legal obligation for the tradesman to change it for other goods, "F. W." must make the best of his bargain.

(47476.)—Without knowing exactly what were the terms of this agreement, I cannot answer for certain. But it is a clear rule of law that there can only be a distress for rent in arrear; and it is also decided that a distress after tender of the sum owing is illegal. In an ordinary way, therefore, the landlord could only distrain for the week actually in arrear, and if that were tendered him, a subsequent distress, even for that, would be illegal. But if, by the agreement, a power was given to distrain for the week's rent in advance, or to treat it as being in fact due, this would, of course, alter the whole question. The landlord, doubtless, refused the one week, in order that he might be able to distrain for the two, and, should he do so, the tenant can pay both under protest, and bring his action for damages in the county-court for illegal distress. Of course, the landlord could sue for the rent in advance; but, as far as I can see, he could not distrain, and, of course, the rent tendered must be paid.

(47479.)—As far as I can understand this confused question, what happened was this. The executors renounced probate; and, afterwards, when assets began to come in, the widow took out letters of administration with the will annexed—as she had a clear legal right, and, indeed, a duty so to do. The son's being under or over age has nothing to do with his position; and after the debts are paid, it is the widow's duty to divide the estate in manner directed by the will. The son will, therefore, get his appointed share, and, of course, the widow has no right whatever to will away the whole property, which she only holds as administratrix—though, to be sure, she can do as she likes with her own portion. The will remains perfectly valid. When there is a will there can be no such thing as a "sole heir," and, except as to land, a son has no more right than a daughter. "Adolescens" is very wrong in his law.

(47485.)—As I understand this question there was but one set of leaseholds, and but one sale by auction, and the share coming to the nieces from such single sale was over £200. Now, as the sale was the only source from which this property came, and as it took place upon one day, I am at a loss to see how the sum derived therefrom can be otherwise than succeeded to "at one and the same time and from the same source." To say that because the houses were sold in separate lots, therefore this one sale was divided into separate sources, is a refinement of casuistic argument that would find no support in any court of law nowadays. I therefore think that there is nothing in the point here put, and that it would not support an action, though it might lead its promoter into a very pretty bill of costs.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[46744.]—**Marble.**—The streets in the city of Armagh, after rain, show that a good deal of native marble is used there. Finer slabs are made into chimneypieces, and polish up well. It is brown, prettily mottled. Sometimes a vein of pale-pink stone is found of the nature of madrepore, and of this small fancy articles are formed for sale as keepsakes.—H. O'B.

[46762.]—**Sick Child's Arm.**—This case will very likely be benefitted by a plaister made of mustard and common treacle, spread on brown paper, renewed daily, wrapping a cloth round it. This seems a queer remedy; but it is a good one. Steaming the arm over a pan of boiling-water, enveloped in a flannel cover, is most useful also.—H. O'B.

[46780.]—**Water Power.**—With 35ft. of fall and 473 cubic feet of water per minute, a Hercules or other good turbine will give 25 horse power; wheel 9in. diam., outlet for water 14in. diam. It would cost about £30. It would be waste and useless to put up any other than a turbine.—Quod Dixi Dixi.

[16792]—**Aquarium.**—Permit me to insert a caution on this subject. Select only pond creatures; the inhabitants of running streams will live but a few days (or hours) in the still water.—H. O'B.

[46859.]—**Indigo-Blue Dyeing.**—I fear J. Ormiston handles our friend S. J. Simpson rather ungenerously, and he by no means gives additional valuable practical information. "Blackwater" is much obliged to Mr. Simpson for his concise and explanatory answer. Mr. Ormiston says that "the writer displays ignorance of the two methods of indigo dyeing, or he would have given a fuller and more correct description than he has done." "Blackwater" simply asked for information as to Read, Holliday, and Son's process, and in what manner it differs from woad vats? This question remained unanswered a long time, and I have to thank S. J. Simpson for giving me all the information I required or expected. He rightly assumed that I had a knowledge of woad vats. In the woad vat indigo is reduced to a state fit for dyeing by the fermenting power of the woad, aided of course by bran and madder. Now, the successful management of woad vats requires special knowledge not to be acquired every day. Beside practical experience, powers of judgment, and observation, the "trade secret" is necessary. A dyer who is thoroughly master of woad vats should be able to dye, with eleven or twelve pounds of indigo in a woad vat, seven hundred (700) yards navy blue serge, ¾ yard wide. I should like to know what quantity of similar goods can be turned out of a Read-Holliday vat at same cost, taking the average value of good indigo at 6s. the pound. As a rule, good woad-dyers are few and far between, so that any process that simplifies indigo-blue dyeing is the greatest boon to woollen manufacturers. The more goods dyed by a certain quantity of indigo in the woad vat the more brilliant and faster the colour.—Blackwater.

[47023.]—**Sea-Sickness.**—A person who only feels bad really suffers more than one who is really sick. In this case the great suffering arises from the contraction of the stomach on nothing. A deal of suffering is spared by always eating, so that the stomach has something to act upon. Don't drink brandy, or you will suffer for it. In most cases, not always, the sickness goes off in a few days. Fight against it, but keep the stomach full.—Edward Thos. Scott.

[47039.]—**Clock Query.**—Pinch the spring of the fly so as to make it turn a little harder. You may make it strike as you like.—Edward Thomas Scott.

[47056.]—**Bacteria.**—I am truly obliged to Mr. Thoms for his lengthy reply to my query, and will endeavour to profit by his information. I forgot to mention that in mashing with water at 188° Fahr. a few gallons of cold water is invariably mixed with the mashing liquor to reduce the temp. to about 150, before the rye is added and mashing begun. I would gladly avail of brewery yeast for fermentations (as at home) were it obtainable at a reasonable price; but at two francs per kilog. this is out of the question, and in summer it is seldom fresh, having to come at least 800 miles by rail. I usually change the mother once a month, sometimes even less frequently. It may interest Mr. Thoms to know that, by means of the barm I before described, I have (during winter weather) fermented mash from sp. gr. 1050 to 1002 in forty-eight hours regularly; last winter, from month of December till middle of March, this was the invariable attenuation. The returns of spirit from maize mash (the maize being digested whole by means of light-pressure steam and saccharified with 9 per cent. to 10 per cent. green malt), being very little inferior to English work fermented with brewery barm.—Cygnet.

[47101.]—**Polypus.**—The tonic powder, Bayberry, used as snuff several times in the day, has cured one of long standing, and restored smell.—H. O'B.

[47140.]—**Ampere.**—The ampère, as I suspect Mr. Stooke knows, is the unit of current, and is the current-quantity passing through a circuit with E.M.F. of 1 volt, and resistance 1 ohm in one second. It is also that quantity of current which liberates ·000158 grain of hydrogen per second. It is the new name for weber, which properly means one weber per second. Coulomb is the new name for the unit of quantity, formerly known as "one weber."—S. P. T.

[47143.]—**Aluminium.**—I thank "Spaniard" for his reply on p. 431. I am sadly disappointed to find none who have written are wiser than myself on the subject. Had I guessed how very difficult my query was, I should have set to work, and not allowed beginners to lead me into such a mistake. In a desultory way I had tried all published processes; but all are expensive and unsatisfactory, considering the very low price at which I can obtain the alloy. I have no doubt ghanite would easily form an impure alloy. I do not use it. I can make my alloy with any metal. My first experiment was with lead, and I am not sure that does not answer best. My ardour is not damped. Having discovered a "new process" for obtaining crude aluminium, I may find a new process for purifying it; things hidden from the wise are sometimes revealed to a tyro in science.—Zelia Naien.

[47156.]—**Varnish.**—It is black japan, made quick-drying by the use of driers, gold-size, and turpentine.—T. P.

[47168.]—**Tinning Copper Sheets.**—From "Coppery's" original query, I understood that he only wanted to tin one side of the sheet, for which the method I gave is applicable. If he wishes to tin both sides, he must do them both at once, and if possible use a bath of tin. However, by spreading whiting, made into a paste with water, over one side, he may preserve it to a certain extent while tinning the other.—Mide.

[47170.]—**Blast Furnace.**—The usual arrangement is fuel, ore, and flux. What is meant by their "chemical order"?—S. M.

[47181.]—**Boiler.**—What sort of work is the engine to do, and how much room have you for boiler? It would be better to have a vertical, perhaps, and of those you will find many illustrated in back volumes.—Essar.

[47186.]—**Gum-Paste.**—Ordinary gum-paste is made of picked gum-arabic and white sugar, equal parts, and to each pound of gum one pint of water. Dissolve the gum, add the sugar, and evaporate until it is thick syrup. Then add the whites of eggs (about three to each pound of gum), previously beaten up with orange-flower water or other flavouring; strain through muslin, and continue the evaporation until it will set readily when cooled. I don't understand "treatment when made," or "preparation of moulds." Treat it how you like, and pour into any clean surface, such as a plate or saucer, and cut into what shapes you please.—C. D. P.

[47191.]—**Loco. Building Shops.**—I do not think there are any loco. shops at Liverpool; but there are numbers of traction, and pumping, and other engine works.—D. G.

[47194.]—**Organ Tremulant.**—There is an illustrated description of a very good organ tremulant in No. 528, p. 204; and several others in previous Nos. No doubt, all will be described in Mr.

Warman's papers; but, possibly, you will not care to wait for that time.—S. Mayer.

[47196.]—**Electricity v. Gas.**—Mr. Williams has not read the correspondence, or he would have seen who put the original query. Electricity may be a substance, or an element to be analysed, and as it can be stored, we may agree with Col. Shakespeare, and ask, Where is its source? Again, I did not mean Lewis's incandescent, but the hydrogen incandescent gas-lamp, with a light bright enough for spectrum analysis. This is a gas-lamp with one jar, while many jars are used for the electric incandescent light. Now, while our friends have been finding fault with me for writing letters, asking and answering questions, I find on p. 439 that two French electricians have been experimenting with the arc light, and have actually burnt a vapour or gas (sulphide of carbon) with or together with electricity, and with incomparable results. This is a great advance on my first idea, seeing that the combustion takes place in vacuo—a seeming miracle; but the effect is not continuous or self-contained. What we want, is to utilise the waste products, of which hydrogen gas is one, and a most energetic, agent. Could hydrogen gas be burnt in vacuo? Answer: As there are no elements of light, but only energy or heat, it would be useless. But as the electric light depends on a great expenditure of energy in the battery, and this large motive power escapes, how can it be utilised? Can it be suppressed in the battery by atmospheric compression? Would the electrical action go on, cease, or be increased? My reason for asking these questions is, that I know of no experiments tending in this direction—that of expressing or collecting the motive force by compression or leverage. I hope Mr. Patrick will explain his dynamo.—Fiddler.

[47197.]—**Stamping Brass Discs.**—A die-sinker would make the proper dies. The blanks will, I expect, have to be prepared a trifle thicker and smaller, and then the stamp will spread the metal, which will take up the letters on the edge. —T. P.

[47202.]—**Extraordinary v. Otto.**—This is much a matter of taste; but I should prefer the 'Xtraordinary, and the Facile to either.—T. P.

[47205.]—**Anemometer Indications.**—I believe you are correct; but I should like to know what the fact is supposed to indicate—a cyclone? —Ignoro.

[47216.]—**The Berliner Violin.**—With the new metallic resonator, the thin wooden strips may be left out. The triangular rib merely serves to prevent the strain of the screw bending in the back; and hence, in order to avoid opening the violin, a corresponding rib might be glued to the outside of the back with the same result; but this would not look well. Otherwise there is no reason why it is necessary to open the violin.—E. Berliner.

[47226.]—**Picture-Frame Making.**—Thanks to those who have kindly sent hints. Do I understand "J. A. A.," Liverpool, that it is necessary or desirable to shoot one of a pair of mitres with the face downwards, as I can hardly see how it is to be held true in this way. I have always understood that in shooting a set of mitres, keeping the set of the plane the same, an error in one direction was compensated by corresponding error in opposite mitre without turning the face of the moulding. —Beta.

[47239.]—**Deafness.**—It seems to me Mr. John Alex. Ollard is pottering away too much at his ears, and starving his body of proper food. If he is deaf and bilious to the extent that life is misery, why cannot he 'bout ship for a month or two, and infuse a little common-sense into his philosophy and the selection of his daily food? His stomach, I take it, is not built on the plan of the herbivoræ. Let him take one-half of his vegetables after their physiological conversion into beef or mutton, cooked properly, of course. He can please himself about a little wine for his stomach's sake, but I do think he should not neglect a regular and instant course of mineral waters. The vegetable food that he is groaning under is, without doubt, deficient in bile elements. The loss of eyesight is a greater loss than that of hearing. The writer has been totally deaf for twenty years, and has got so accustomed to the loss as hardly to feel it. If there is any hope of Mr. Ollard recovering his hearing, or retaining what he has, it really seems to me he must do two things: bring his body into a healthy state, by a complete change of food, and not to doctor his ears himself, but get skilled advice.—Another F.R.M.S.

[47239.]—**Biliousness.**—From what Mr. Ollard says, it is clear that to advise him to try rashers of toasted bacon, or rum and milk, would be out of the question; but he might try the effects of dandelion leaves eaten as a salad, or as he would water-cress between bread-and-butter (I presume he eats butter, though it is an animal food). The ordinary wild dandelion leaves are, I believe, the most active, but the large-leaved Taraxacum, sold by all the best seedsmen, is most palatable, and when grown quickly and bleached like endive is an excellent and tasty salad. A great deal, however, depends on what is meant by "biliousness," and it would certainly be wise for Mr. Ollard to consult a physician as to the cause of the effects he calls biliousness.—Nun. Dor.

[47279.]—**Spoiled Plate Glass.**—Do not be surprised if all your attempts at clearing this should fail. Ask a manufacturer, who can explain to you that damp affects the very ingredients of plate-glass, so that the clouding exists through the sheet, and not merely upon the surface.—H. O'B.

[47279.]—**Spoilt Glass Shelves.**—The sole cause of the spoiling is damp air. Had the shelves been perfectly dry no spoiling would have occurred; but plate-glass stood together, always has its surface spoilt by the ordinary moisture of the atmosphere. There is no cure except repolishing with rouge or putty-powder.—E. Holmes.

[47309.]—**Clarionet.**—I have one of Rudall and Carte's best B flat clarionets, and have great pleasure in giving the length of the several parts, the bore, and also the distance between the centres of the principal holes. I cannot give the size of the holes with sufficient accuracy in writing. Mouthpiece, 2·8in. long; reed, 2·5 × 0 5 full; tuning socket, 2·1in.; top joint, 7·4in., each measured outside when put together, so that the lengths of the portions which fit one into the other are extra. Lower joint, 8·85 to commencement of the portion which fits into the bell, thence to extreme end, 0·8, or 9·65 over all. Bell, 4in. long. The bore is 0·6 (6-10in.), from the top to 6·2in. from the upper end of the lower joint measured outside. From this point it enlarges in a curve to 0 9 at the extreme end of the lower joint. The bell enlarges in a curve from 0·9in. to 2·2in. The outside diameter of the instrument is 1·1in. at the centre of its length. The distances of the principal holes from the upper end of the socket into which the mouthpiece fits are:—Pipe-key, 3in. full; long side-key, 3·6in.; A key, 4·75in.: G sharp, 5·2in.; thumb-hole, 5·8in.; 1st finger-hole, 6·4in.; 2nd finger-hole, 7·5in.; 3rd finger-hole, 8·7in. In the lower joint the distances are measured from the top of the joint:—1st finger-hole, 0·8in.; 2nd finger-hole, 2·1in.; 3rd finger-hole, 3·3in.; G sharp key, 4·5in.; F natural key—for this there are two holes (patented) at 5·5in. and 6·6in.; F sharp, 6·8in.; E 8·1in.—Emeritus.

[47325.]—**Street Medical Coil.**—To Mr. Lancaster.—I want to make a street, medical coil the same as is seen in the streets, with bells and battery —a complete machine.—F. Rowe.

[47340.]—**Silvering Mirrors.**—"Prism" (page 412) is wrong in quoting 50oz.; it should be 50 grains to 2oz. of water. A 6in. mirror requires 8 fluid ounces to give about a half-inch depth of bath under the inverted face, and 12oz. will give about 1in. under. I have not tried a weaker bath than this proportion, and would not advise it. We are greatly indebted to Mr. Brashear for his process; it is economical, gives little trouble, and the result is certain and satisfactory.—J. C. L.

[47341.]—**Electric Locomotive Engine.**—You had best make a four-wheel locomotive, for which procure a piece of hard wood 12in. long, 4½in. wide, and 1in. thick. The leading wheels may be about 2in. diameter, and the driving-wheels 3¼in. Set the line of axles close together for a circle of 5ft. to 6ft. diameter, if you wish to make a circular railway. The best gauge is 3in. to 3½in., and you must use your own discretion in conveying the electricity from the rails, through the wheels, to the electro-motor engine. The Simplest form of motor engine would be a Siemens armature, 2in. diameter and 1½in.. wide, with field magnet of 1in. × ½in. wrought-iron, 2in. long in each leg, and 2in. space between the poles. You can use No. 20 cotton-covered wire, about 5oz. or 6oz. each for field magnet and armature; gear on to the driving-wheel by a small pinion.—J. Sutcliffe.

[47349.]—**Dry-plate Queries.**—The facts are as you state; but why they are so I really do not know, and do not think anyone can tell you. In order to explain the matter, one must understand what changes take place in gelatine emulsion during the process of cooking; but so far as I am aware no satisfactory explanation has ever been given.—W. Robinson, Jun.

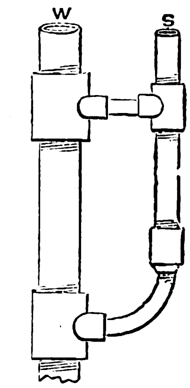
[47354.]—**Green Stains for Deal and Other White Woods.**—Acetic acid and copper filings. Turpentine and copper filings is another.—Jack of All Trades.

[47351.]—**Mathematical.**—I wish to contend that the assumption I made in my reply to query 47351 was not only legitimate, but true. As a case, take $(1 + x\ x^2)^3$. This equals $(1 - x^3)^3 (1 - x)^{-3}$, which equals $(1 - 3x^3 + 3x^6 - x^9)(1 + 3x + 6x^2 +$, &c). By multiplying each term of the first factor into each of the infinite number in the second, it will be found that all the terms involving powers of x higher than the sixth, destroy one another, leaving $(1 + 3x + 6x^2 + 7x^3 + 6x^4 + 3x^5 + x^6)$. This is the value of $(1 + x + x^2)^3$. "Hemisus'" reply shows that he has not considered the point very fully, or else I am sure he would have omitted the last five lines of his remarks.—An Engineer's Son, Sheffield, July 21st.

[47382.]—**Engine Query.**—For a condensing engine running at a speed of 264ft. per minute, with the boiler pressure at 75lb., I should give 1-16in. lead. To work with economy, the steam should be cut off at 1-10th of the stroke, or 4·8in. from the commencement of the stroke. Theoretically the terminal pressure should be 9lb.; in practice we should not have more than 4lb., the other 5lb. I should expect to lose from radiation and condensation. I am no advocate for expanding steam to 10 volumes, in particular when there is great variation in the load. Under such circumstances I should not expect to find steady running, however sensitive the governor might be. Calculations for the above given in full, if required.—J. Broadley, Bradford.

[47393.]—**Cocoanut Oil.**—If "Singapore" will send us an address, we can either suggest a very profitable manufacture, or introduce him to some City firm with whom he can open up communication with the same end in view.—Wynn and Co., 75, St. Peter-street, Islington, N., London.

[47399.]—**Condensing Exhaust Steam.**—For perfect condensation you would require 12 gallons per minute, which would be impracticable if water is so expensive as you say. There is a simple form of condenser that I have found useful, made of ordinary steam-pipe connections. S represents the exhaust steam-pipe in the figure, and W the water-pipe from tank. I don't think, however, that the return pipe to tank will reduce the back-pressure much, though it would heat the water for feed purposes. With a good supply of water the condenser will give a slight vacuum, sometimes 6in., and you may regulate your water supply in W to the extent of saving fuel by reducing back-pressure and heating feed-water, and not miss the expense of the water. Any water used for condensation will get too hot for second use, by reason of its obstructing the heat from the exhaust steam.—Fred. Walker.



[47400.]—**Electric Light for Workshop.**—If "P." would state how many gas-burners he has in his workshop, I should then be able to tell him exactly how many incandescent lamps he would require. If he has 15 ordinary gas-burners, he would require 15 incandescent lights. Those of the "Lane-Fox" type cost 7s. 6d. each, and if of 20-candle power, would require a "Brush" machine costing about £40. Of course, the capital outlay (about £300), would be rather great; but then, the many advantages which would accrue from the use of the electric light would soon reduce this to a minimum. I shall be glad to hear further from "P."—John Bull.

[47405.]—**Locomotive.**—As a practical boiler-maker, with eight years' experience as boiler inspector, I trust I shall be allowed space to give my opinion on the cause of wasting of plate at stay-holes as stated by "Hombre," who asks if there is a galvanic action formed between iron plates and copper stays. It is my opinion that the wasting of material is due to a mechanical action of the plates or the movements of the plates (bellows fashion) caused by expansion due to temperature and internal pressure tending to bulge out the plates which are rigidly held by screwed stays; this constant movement with every variation of temperature or pressure having a tendency to separate the atoms of the material in numerous very small fractures near all rigid bearings; these small fractures are filled with water or sediment, and on contraction of material so many very minute particles are wedged off, as it were, and thus an appearance of general wasting. This wasting, as described, is found more or less in all fireboxes, whether of iron with copper stays, iron and iron stays, copper and copper stays, or steel with iron or copper stays, sometimes on the outer casing of firebox or on the firebox itself, but always on the water side of the plate. When stays are of a large area and widely pitched, it is generally more severe than when light stays are used closely pitched; but this does not follow in all cases, as a strong firebox will sometimes cause wasting in the shell plate or casing, or a strong casing will set up wasting on the firebox whether of copper or iron. This wasting is best known among inspectors as "grooving" or "channelling," as it is generally local, and can clearly be traced to a mechanical action of the parts. It is found in all boilers more or less; in the locomotive it is found near the stays, as stated by "Hombre," and generally in the root of all the flanges forming the vertical corners of the firebox outer casing, particularly at the shoulders near where the firebox outer casing is secured to the barrel; here it is sometimes seen in a long groove ⅛in. wide, and from 1-32in. to ¼in. deep, and sometimes actually through, while in other cases (apparently under the same working conditions) it is found in the form of a fracture as fine as a line, scarcely visible when at rest, cold, as the fracture then closes. Perhaps "Hombre" had better look carefully for any traces of this grooving, for an outer casing with grooving in roots of flanges would not be worth even a new tube plate, as a new tube plate would have a tendency to excite such grooving, and cause it to set in more active than before. As a case in point, I may say a new fire-box was put in (against my advice) an old casing, and before it had been at work six months, the grooving came through at left shoulder, and in three months later, at the right shoulder. I did not see the casing with fire-box out; but surely the boiler-maker would not overlook it. Grooving is also often found on the plate along the edge or corner formed by the foundation ring when of the solid square section, particularly when the fire-bar level is low, or near the ring, which shows the advisability of keeping fire-bar level well up, clear of rigid joints or seams. In stationary boilers the grooving is very often found on end plates over furnace angle-iron rings, particularly when gusset stays are not properly applied; but in all cases "grooving" or "channelling" can clearly be traced to a mechanical action. Corrosion on boiler-plates is always understood to mean the defect due to impurities in the water, such as acids in different forms. It is therefore a chemical action. "Hombre" says the wasting is at taper holes, where stays pass through. Stay-holes should all be parallel, and the best means of putting in new stays will be to rimer out all the holes until a good thread can be had, and a larger stay applied. Has "Hombre" never seen a new tube plate put in without taking out the fire-box?—as I have; and I think it would come cheaper, if a good set of "loco." men were at it. Shall be glad to give further advice if necessary.—Boswell.

[47410.]—**Dry-Plate Intensifier.**—No change takes place in mercuric chloride on the addition of ammonia or other chloride, such salts being merely added to increase the solubility of the mercuric chloride. The addition of a soluble bromide or iodide changes the mercuric-chloride into bromide or iodide, as the case may be; but I am not aware of any special advantage in so doing. Whenever, in working with the wet collodion process, I had to resort to mercury, I always found a solution of chloride, followed by ammonia, hypo., or cyanide, to answer every purpose. With regard to the gelatine process, however, all attempts to intensify in that way have, in my hands, proved so unsatisfactory that should any negative be deficient in density I always prefer to take a fresh one, though I do not remember trying the particular process referred to.—W. Robinson, Jun.

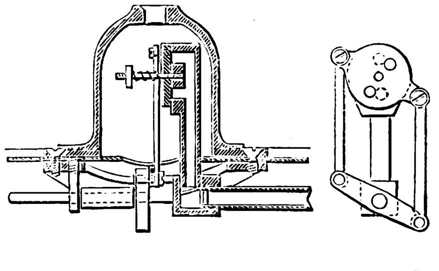
[47414.]—**Substitute for Leather Disc.**—Nothing like leather if managed properly. The fault lay in the shape of wheel and application of leather. Have no idea how applied, shape, for what purpose, &c., &c., and, therefore cannot advise. Are they both coned as bevel-wheels, or one. the driver, iron grooved, and driver leather or V?—Jack of All Trades.

[47415.]—**Organ Stop.**—If "L. G." will follow these few instructions carefully, I think he will have a fair quality of tone—no chiffing or quivering from his Clarabella stop:—1st. Lay all the pipes in their order—largest at left hand; then cut all the mouths open ¼in., nice and equal straight across, and the lips not too thin. 2nd. Cut the ears nearly level with the block (say, for mid C 1-16th of an inch, and top G 1-32in.); have them also equal from largest to smallest, and see that the caps fit square up to the ears, so as not to cause a hissing. 3rd. Nick them nice with a nicking-tool not too deep, and equal distances—say, mid. C 12 or 14 teeth to the inch, and gradually smaller to the top; then smooth the face of block with a smooth file, or a piece of fine sand-paper glued on a piece of wood, so as to leave no pieces of the grain for the wind to cut against; it is quite immaterial straight or cross-nicked. 4th. File away the cap at the thin edge for the wind to cut the lip—about 1-12th of an inch at C; also graduate to the top, but do not nick the cap at all, as that leaves the tone more crisp and pleasant (the caps want to be hollowed out and smooth). Now, one great fault with amateurs is that they want to do too much at once, and they spoil all by trying first one pipe, then another, with the mouth. Let me tell any one voicing wood-pipes: Don't blow them, as your breath swells up the wood, lessens the openings in the caps, and stops them speaking; but if they would only be patient, and try them on their own wind, they would find their labours rewarded with better success. P.S.—If "L. G." does not succeed, and he will advertise his address in the "Address Column," we will voice him one or two pipes, and send them back to him.—H. and S. B.

[47419.]—**Riveting China, &c.**—Should you not receive a satisfactory reply to your query, I will shortly give you such information, with sketches of tools, &c., as I can impart. I have never done such work; but have had frequent opportunities of seeing it done. For the reason given in my reply to 47470, I cannot do so just yet. —Alfojoe.

[47430.]—**Instantaneous Photography.**—The first defect referred to may be owing to your trying to cover too large a plate; to the lens not being well adapted for the purpose; or to a bad arrangement of shutter, which may possibly cut off some of the rays which should enter the camera. The second defect may probably be remedied by a little more care in development. Use a full dose of pyro. and bromide, but add the ammonia cautiously one or two drops at a time, and allow more time for it to act. At the same time, and if, as I presume, you want the cloud-negatives for printing in the skies of other negatives, you do not require any very great density, as the clouds should only be printed in very lightly. Choose a fine day with floating clouds, rather than one in which the sky is completely overcast.—W. Robinson, Jun.

[47432.]—**Locomotive Boiler.**—I don't know whether coppersmiths as a class understand model locomotive boiler-making, but before giving such a job to one I should make inquiries as to his ability. The starting-valve or regulator is sometimes put in the smoke-box, so that it can be easily got at, and generally consists of an ordinary plug-tap; but in a model I am making I have used a butterfly-valve, which is more easily made and less likely to get out of order. It is placed at the top of the supply-pipe in the dome, which latter I shall screw to the boiler so as to have access to the regulator. Cylinder 1¼in. long (but I suppose you mean 1¼in. stroke), if not more than 1in. bore, would hardly be large enough for a boiler 19in. long and 5in. diam.; they ought to be 1¼in. bore and 2in. stroke. If the engine is to be a coupled one, the driving and coupled-wheels should be about 6in. diam.; and if a single engine, then about 7in. diam. The inside firebox should be about 6in. long, 4in. broad, and 6in. deep; the boiler should have 22 tubes, ⅝in. diam. and 12½in. long, which, with the length of firebox and water space at back, would make up the 19in. I inclose sketch of the valve and method of fixing dome to boiler. If you should require any more information, I shall be glad to do what I can to help you.



Explanation of the Sketches.—The dome should have cast or soldered on an extra wide flange to hold the screws for fixing down; the lagging plates should be made to fit over this flange, close up to the curved flange of dome; a brass ring is riveted to the inside of boiler, to strengthen it and take the screws which hold down the dome. The valve and valve-face of the regulator should be ground perfectly flat. A small spring will keep it close until the steam is up; the dotted holes lead into steam-pipe, and the holes in valve are brought opposite by a slight turn of the handle at the other end of the spindle.—E. L. P.

[47433.]—**Portland Cement Floors.**—I must strongly advise "Melting Mechanic" not to adopt the plan suggested by "M.I.C.E."—viz., to put on the coarse bottom a ⅜ finish of one part cement and two parts sand, and then rubbing on the surface of this dry cement. It certainly makes a good finish when done, but is sure to scale off in time. I had two garden walks done last summer, one according to "M.I.C.E.'s" method, and the other as described by me. The former has now large patches of bare places where the cement has broken off; the latter is as good as the day it was finished. "M.I.C.E." suggests gravel, which might do, but must be well washed to remove all clayey matter; but is then not so good as broken stones or brick-bats, as the irregular surfaces of the latter bind together more firmly. The cost will vary according to price of labour, and whether the hard material is on the ground, or has to be bought. I think mine, buying everything, cost about 3s. a square yard 3in. thick.—E. H. Roe.

[47437.]—**Threads for Steam-Pipes.**—The Whitworth standard for gas threads, which is generally used for this purpose, is 11 threads per inch for sizes between 1in. and 3in.—T. W. Fillmore, Wimbledon.

[47441.]—**Minute Photography.**—I of course do not know for certain, but should suppose that ordinary photo. lenses of short focus and good defining power, would be used both for the reduction and subsequent enlargement of the despatches referred to; and for collodion, that which gave the most structureless film would naturally be selected by preference. Ordinary micro lenses, not being photographically achromatic, will not define properly unless allowance be made for the difference between the visual and actinic foci.—W. Robinson, Jun.

[47443.]—**Medical Coil.**—The dimensions given are quite correct, but 3in. means total height of bobbin, not between flanges. I have nine helices or layers, consequently three powers with the given quantity of wire; but you can make each separate helix a power, if you choose, by connecting the top and bottom of each one alternately to a corresponding pin in your power circle. I find three powers vary the strength sufficient for ordinary medical purposes, and the coil itself a useful and compact instrument. I have a couple of Daniell's cells connected to it, the cells standing in a cupboard, the wire coming to the coil through the skirting. Thus, standing upon the sideboard, it is always ready for use by screwing the contact breaker down, and forms an ornamental and useful adjunct to the sitting-room. I charge the cells once a week.—Fred. Walker.

[47444.]—**Boiler Corrosion.**—Does "E. M." mean to ask for a means of preventing "incrustation" or "corrosion"?—as from his query he speaks of corrosion, and appears to mean incrustation, which seems to be lime, which is very probable if well-water is used. By incrustation is meant the deposit on the boiler-plates, which, if lime as carbonate, is removable to some extent by the "Clark" process, so recently described in "ours," or by passing the water along a finely-perforated trough, and allowing it to fall in a great number of very fine streams, allowing the excess of carbonic acid gas to escape, and so precipitate the carbonate of lime; but even this will not thoroughly purify it. A little common soda used in solution daily (say, 1lb. a day) with the feed-water, will have a tendency to soften the incrust already formed, and keep new deposit from forming so hard; but constant careful cleaning is the best remedy. If "E. M." means "corrosion," wasting of plates (generally in fittings), due to the chemical impurities of the water, such as acids, the best plan is to get the water analysed, and so find out the best agent to neutralise the acids or other impurities which cause the corrosion. If corrosion is meant, a filter will be of little use. As a rule (with its exceptions, of course), where there is much deposit, there is little corrosion; and where there is much corrosion, there is little deposit, except what is loose and quite easy to remove, as incrust cannot firmly adhere to a plate which is constantly wasting at its surface, and the corrosive agents will not, as a rule, eat their way through a coating of hard deposit, particularly if of lime, from which it will be seen that a thin coating of incrust (say, 1-16in. of lime deposit) is a protection rather than otherwise.—Boswell.

[47446.]—**Photographic Enlarging.**—Formerly, enlargements were generally made on iodised paper, and developed with either gallic acid or pyro; but latterly, gelatino-bromide paper, developed with ferrous oxalate, has been largely used.—W. Robinson, Jun.

[47447.]—**Redipping Brasswork.**—Rub the articles with muriatic acid on a piece of soft rag.—T. W. Fillmore, Wimbledon.

[47447.]—**Repolishing or Re-dipping Sheet Brass for Labels on Tinwork.**—Dip them in aquafortis and into clean water, into which put a little soda; wash in clean water and dry in clean sawdust. This is best done when cut up into the sizes required.—Jack of All Trades.

[47449.]—**Induction Coils.**—What I meant by short-circuiting the cell is, that the two layers of 16 do not offer sufficient resistance to the cell; a bichromate would polarise in less than ten minutes. I have never read in any work what resistance a coil should be to obtain the full effects of a cell without polarising. I always make the primary just four times what you state the resistance yours is. If there is not sufficient resistance, the addition of more cells will not increase the effects; it is like adding cells to the quantity coil on a galvanometer. Stronger the coil is magnetised, the greater the spark. Why don't you wind two layers on large electromagnets? I made a coil the other day five layers primary, resistance 1 ohm; shock from this alone I could not bear, and with ten layers of secondary, not one-fourth the strength could I endure; this coil would go in the waistcoat-pocket. Further information if required.—George Tolman.

[47452.]—**Pleurisy.**—The safest remedy that can be applied to relieve and cure pleurisy is olive oil and turpentine. Put the oil and turpentine in a bottle, and pour the mixture on a piece of flannel large enough to cover the place that feels sore. A bandage or tape can be used to fasten it in its place. The proportion is six of oil to one of turpentine, by measure. It will relieve the pain immediately on application. It may take as long as four days before the inflammation is brought to the surface.—F. Norman Campbell.

[47454.]—**Bleaching Old Willow Baskets.**—These may be readily bleached by washing them and immersing in a solution of chloride of lime, rinsing afterwards through water, made acid to the taste by the addition of a little oil of vitriol. Or, if the querist has an air-tight chamber he can readily bleach his baskets by subjecting them to the influence of vapour from burning sulphur.—Nun. Dor.

[47459.]—**Silvering Looking-Glasses**—I can assure "C. H." (p. 460) that Brashear's silvering process is quite suitable, if not too expensive. A 6in. mirror costs for silvering from 6d. to 1s., according to price you pay for chemicals; but these must be pure and best quality. For method of application see Nos. 794 and 863, and Vol. XXXIV. generally; but "C. H." should have stated sizes of plates. If "C. H." requires it, I could put him in the way of buying the chemicals in fair quantities at wholesale prices, if he advertises his address.—J. C. L.

[47460.]—**Weight of Dynamite**.—The explosive effect of nitro-glycerine is given as equal to ten times its weight of powder. How far this holds for dynamite, of which 75 per cent. is nitro-glycerine, I am not prepared to say.—Ll.B.A.

[47461.]—**Black Transfer Paper.**—Get some unglazed paper, and rub it well with a paste made of gas black or black from a paraffin lamp and olive oil with a piece of sponge.—Jack of All Trades.

[47461.]—**Black Transfer-Paper.**—"J. C.," Pera, does not state for what purpose he requires the transfer-paper; if it be for the purpose of transferring plans on tracing-paper to drawing-paper, let him take a clean smooth sheet of tissue-paper, perfectly free from cracks or wrinkles, and sprinkle it with black-lead out of a packet of the "Servant's Friend," then rub in the lead with a pad made up of clean dry flannel until he gets a uniform surface, both as regards colour and quantity of lead. Lines made with this paper on drawing-paper can be easily removed with indiarubber after the drawing has been inked in.—Epura.

[47463.]—**Change-Wheels for Screw-Cutting.**—"Try Again" should get a book called "The Engineer's, Millwright's, and Machinist's Practical Assistant," by William Templeton, published by Crosby Lockwood and Co., in which he will find, among many other things, what he desires. Engineers generally have a table for the same.—T. W. Fillmore, Wimbledon.

[47464.]—**Wood Shrinking.**—Wood will shrink $\frac{1}{4}$in. in diameter,—i.e., soft woods have a cast-iron die, bell-mouthed; turn them $\frac{1}{4}$in. larger than required, and force them through, the one pushing the other out.—Jack of All Trades.

[47465.]—**Faded Daguerreotype.**—Cyanide of potassium (which can be obtained at any photographic establishment) will restore faded dagurreotypes. Make up a solution of about 6gr. to the oz. of water. Hold the plate, in the left hand, by one corner, and pour the solution over it. Keep it on till it has done its work; then drain off, and wash well under the tap. I was told this some years ago by a professional acquaintance, but have not tried it myself. If you prefer, you can get it done by any respectable photographer. I should advise the latter.—Camera.

[47465.]—**Faded Daguerreotype.**—According to Mr. England, a "faded" daguerreotype is a thing unknown; but the tarnish which causes the faded appearance can be removed as follows:—Pour on its surface a sufficient quantity of good alcohol (not methylated) to well cover the plate, and allow it to remain a couple of minutes to remove any grease; rinse well with plenty of water, and then immerse in a solution of cyanide of potassium 1oz., water 1 pint. It must now be closely watched, and the moment the tarnished film disappears, and the surface becomes bright, remove the picture, and place it in clean water, to stop the action of the cyanide. It can now be held at one corner by a pair of pliers, and copiously washed with distilled water, and a gentle heat applied by a spirit-lamp at the back, blowing gently with the breath on the face, without ceasing, till the last drop of water has reached the bottom corner. Any check in the drying will cause a line, and in such case the plate must be re-wetted, and another attempt made.—W. Robinson, Jun.

[47467.]—**Observatory on House.**—Americans travel a good deal, and if "American" could travel here before August 1 or after November 1 I should be happy to show him my observatory. Nothing can be structurally more convenient or successful. It is 50ft. above the ground and substantially free from injurious tremors. The pier is built on two iron girders, bolted together and bedded on felt and lead in recesses in opposite walls, the girders being clear of the brickwork in all respects, except where they lie by their own weight on their beds.—G. F. Chambers, Northfield Grange, Eastbourne, Sussex.

[47469.]—**Galvanising.**—You can use either lead-lined cisterns or stoneware. Pickle the articles in sulphuric acid 2 parts, hydrochloric acid 1 part, to 5 or 6 parts of water, and well scratch-brush with wire and sand. There is a good deal of difference in the quality of iron; some clean very readily in a weaker solution, as 10 parts of water. A piece of Malacca cane, hammered at the end, for a brush is very handy for cleaning with sand where you cannot get the outer shell of cocoanuts. When well-cleansed and dry, dip them into some killed acid and dredge with powdered sal-ammoniac, and put into a bath of molten zinc. Stoneware will stand fire to a certain extent, because it has stood fire before; but from the moisture it has absorbed from the atmosphere, which it will not very readily part with, the heat wants applying very cautiously.—Jack of All Trades.

[47470-1.]—**Watch Repairing.**—I regret that I am unable to give more than a very brief reply to "X. Y. Z.," owing to heavy demands upon my time just now. The desired information may possibly be given more fully by other correspondents. To hold or place the cylinder in position for inserting the plug, take an old watch-barrel, of good depth and size, a verge preferably, and (if it has a *bushing* in remove it) bring up the bottom part of the cylinder through the hole, letting the barrel rest upon the bench, and the cylinder-notch rest upon the barrel-bottom. This will form a convenient stake to drive the plug home upon. A small hollow punch is required to do the job. Certainly you could get a plug to fit if you purchase a gross of them in assorted sizes. You must be very careful in driving-in that the plug is not too large, or you will split the cylinder; it should be accommodated with very little force. The body of the cylinder must be made rigid with beeswax or shellac while turning the pivot up. You will not succeed in fitting jewels unless you have special tools. Such appliances are generally used in conjunction with the mandrel, which is rather an expensive tool. In any case jewel-holes require very accurate fitting, as, unlike brass holes, the depths, when once struck and drilled, cannot be altered. A countersink is formed in the plates or bars, by appropriately-formed cutters, into which the jewels, closely fitted, are placed. The edge of the metal is then turned over by a special-shaped burnisher, and the job is complete. Minute and hour-wheels may be bought finished, or in the rough, as may be desired. In some cases the socket and the wheel are formed from one piece; but by no means is it the rule.—Alfojoe.

[47475.]—**Sidereal Indicator.**—If "D. Mc." (page 461) means "sidereal *time* indicator," he will find engraving and description on page 116 of Vol. XVI. It is too long to quote here, but I will lend him my copy for a week if he advertises his address.—J. C. L.

[47477.]—**Waves.**—Chap. IV. of Rankine's "Civil Engineering" will give you some information on this subject in a condensed form. For further information you are referred to Airy's treatise on "Tides and Tidal Waves" in the "Encyclopædia Metropolitana." Haughton's little manual on tides might help you.—C. H. Romanes.

[47479.]—**Legal.**—The executors having renounced their right to prove the will and given up their legacies, and the widow having taken upon herself the administration of the estate, she is bound to divide the net assets, after the payment of debts and duties, in the proportions indicated in the will; or, if the bequests to the widow and the children are of specific sums, and the assets are insufficient to pay them in full, each legacy must be proportionally abated. The executors, of course, take nothing. The widow is only absolutely entitled to her own legacy or proportion, and the son can claim his legacy, subject to abatement, having attained 21; he could only be sole heir if there were an intestacy, and the property were real estate.—G. J. M.

[47481.]—**Colouring Gold Jewellery.**—Jewellery to be coloured should be at least 15 carats fine, and the solder should be only a shade under that. There must be no pewter or silver solder on it. It should just be annealed, and pickled in water to which sufficient sulphuric acid has been added to render it sharply acid to the taste. The best vessel to use for colouring is an ordinary clay crucible, and the colouring mixture I use is composed of 2 parts best saltpetre, 1 part of alum, and 1 of common salt. These are placed in the crucible with sufficient water to moisten them, and when they are melted, place the gold articles in the mixture. The jewellery must be strung on a piece of wire; it is better to keep a piece of platinum wire for this purpose, which should be annealed each time before use; failing that, a piece of gold wire (15 carat). You may use silver wire, but nothing baser. The colouring composition dissolves the silver, so you will require a fresh piece occasionally. You must move them about occasionally in the crucible, and as the composition gets thick, add a very little hot water from time to time. It must not be made too thin, but just sufficiently liquid to boil. The goods require to be in almost continual motion, or they will stick to the bottom of the crucible. Should this untoward (and, in the hands of a novice, far from unlikely) event happen, don't attempt to pull them out by force, but boil them out with hot water. After they have been in the crucible for a few minutes, take them out and examine them; but whenever they are taken out they must be plunged at once into boiling water, or the composition will dry on them, and you will have some difficulty in removing it. They should now be scratch-brushed and returned to the crucible From 10 to 20 minutes will be sufficient. When they are coloured, take them out, scratch-brush, wash in clean hot water, and dry in boxwood sawdust. For method of scratch-brushing see my papers on electro-plating in, I think, last volume. This process acts by dissolving away the alloy, and leaving only the pure gold on the surface. If the goods are anything less than 15-carat gold, they must be electro-gilt. I must take this opportunity of saying that I cannot answer any more questions through the post, as on the last occasion of my doing so I became involved in correspondence extending over many months. This included matter which would have been instructive and interesting to "E. M." readers, and it occupies time which I can ill afford for the benefit of one correspondent only.—Os.

[47485.]—**Legal.**—The nephews and nieces all "succeed at one and the same time, and from the same source," namely, on the death of the testator, the court deciding apparently that the leaseholds did not pass under his will. The fact that the property is not sold at the same time does not affect the case, each nephew and niece is entitled to an equal share of the whole, and in the case of the married nieces, if that share is of greater value than £200, it must go to their trustees under the covenant in the settlements.—G. J. M.

[47493.]—**Velocity of the Wind.**—The note in question states that on April 29 a pressure of $49\frac{1}{2}$lb. was recorded at a time when the hourly velocity was 50 miles. That is very different to saying that the pressure of the wind at 50 miles an hour is $49\frac{1}{2}$lb. The fact is mentioned as an exception, and was probably due to one of those sudden gusts, the cause of which is unknown.—F. M. S.

[47495.]—**Gun-Barrels.**—When brown enough to please, wash off well with carbonate of soda and hot water and then with clean; afterwards polish with a piece of black cloth and equal parts of raw linseed oil and turps, in which a piece of camphor is dissolved, or lacquer with plate laquer. I prefer the oil.—Jack of All Trades.

Whitworth Scholarships, 1882.—The following are the successful competitors in the order of merit:—£200: Charles Webster, Crewe. £150: J. H. Tomlinson, Newcastle-on-Tyne; J. H. Beaman, Woolwich; Thomas Turner, Sheffield; S. D. Codrington, Bristol; C. B. Outon, Stratford; G. H. Bannister, Woolwich; Frederick Lane, Woolwich; W. D. Laird, Woolwich. £100: Joseph Parry, Manchester; A. F. Ravenshear, London; C. W. Carter, Liverpool; A. Barrow, London; H. C. King, Swindon; M. Douglas, Crewe; Thomas H. Gardner, Manchester; E. E. Haine, London; George Halliday, Glasgow; G. W. Buckwell, Brighton; L. H. Cochrane, Liverpool; W. Duncanson, Stratford; H. Brown, Dudley; W. T. Hatch, Liverpool; T. Carlyle, Woolwich; A. J. Hill, Stratford.

The FitzGerald incandescent lamp has been exhibited as a street lamp in Westminster Bridge-road by the Phœnix Electric Light Company.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

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47172.	G.W.R. (B.G.) Engines, 339.
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47192.	Locomotive Engines. 340.
47207.	To "Ll.B.A., 340.

QUERIES.

[47497.]—**Perspiring and Tender Feet.**—To Dr. Edmunds.—From childhood to middle-age, I have been a constant sufferer from perspiring feet, with attendant soreness and annoyance. In addition to this, for a year or two I have had soreness and tenderness of the soles of the feet of a different kind, mostly felt when awaking in the morning, and which, I am told, proceeds from the liver. Will Dr. Edmunds kindly favour with his advice, and oblige?—Rural.

[47498.]—**Indigestion.**—To Dr. Edmunds.—I watch with keen interest the answers to medical inquiries, hoping to meet with some that would prove valuable to myself. I suffer from what the doctors say is indigestion and sluggish liver. My attack commenced five years since, and after much suffering I tried homœopathy without success, and also allopathy with some relief, but not permanent. I led such a wretched life, that I would willingly have given up food altogether, were it possible. I gave up butchers' meat, which I have not touched for 3½ years, and I have lived during this period in such a way that many of your readers would think life under such circumstances not worth having. Here is my daily diet (each week being a repetition of the last): breakfast—dry bread and tea; dinner—crushed groats (cooked in water and salt) only; tea—same as breakfast; supper—lentils only (cooked same as the groats); this, with a fish dinner on Sunday (eaten with fear), is how I live, which I would not mind were it a perfect cure. My symptoms are: after food, a kind of heat in the spine, more especially that part opposite the stomach, and with it shortness of breath and great weakness, and altogether poorly. When I first commenced, I had an oppressive weight on my shoulders, which, at the present, I experience but slightly. About two hours or so after meals, I begin to feel a little better, until the pain is brought on again by the next meal. I do not feel any pain at the stomach. My work is neither laborious nor sedentary. With my present knowledge, I find a cold sponge bath my best friend, which I take in the morning. Were it not for its benefit, I do not know what I should do. My life has been remarkably temperate: so I have nothing to reproach myself with. I would indulge in half a pint of beer or porter with my supper, but cannot, because of the above consequences, and I dread anything with alcohol in it.—Indigestion.

[47499.]—**Model Electric Railway.**—Will some reader of "ours" kindly give me information and diagrams for making the above, and oblige?—A Subscriber.

[47500.]—**Bichromate Battery.**—To "Beetle-Crushers."—With reference to your bichromate battery (letter 20240), would you kindly say how often the battery would have to be taken to pieces and cleaned? Also, how many plates of zinc and carbon are necessary? And please explain how the wires would be attached to the wires of a small electric lamp?—Semper Fidelis.

[47501.]—**Clock - Wheel Cutting Engine.**—Would any of your kind contributors skilled in watch and clockwork favour us with a drawing and description of a clock-wheel cutting engine with straight cutter—not a circular one, as I want to finish one tooth at one cut, without having to file up afterwards? A circular cutter will not do that properly.—Ten Years' Subscriber.

[47502.]—**Transparent Photographs.**—I have been trying, with but indifferent success, to make those beautiful transparent photos resembling coloured ivories which have recently been introduced. They are rendered transparent, coloured from the back, and mounted on concave glasses. A professional wants 5gs. for the "secret," which I cannot afford. Can any one with practical knowledge tell me of what ingredients to make the transparent varnish, and how to attach the picture to the glass, so as to exclude air-bells, and avoid injuring the transparency? I manage the colouring nicely.—Beenhorn.

[47503.]—**Intestate.** — To Mr. Wetherfield.—I should be very much obliged if you would give me your advice as to the following:—My father and mother both died without leaving any will—leaving only household furniture, &c. I have four brothers and two sisters: my eldest brother was married before their death, and living away from them. My two other brothers, who are unmarried, my sisters, and I, live in the house in which our parents lived, and which we have carried on since. Can the one who is married claim any of the furniture, &c., or can my elder brother claim it all, seeing that the house is in his name, and has been since July 1876—or how? Also, what proportion each is entitled to?—S. Swindells, Manchester.

[47504.]—**Bottling-Wax.**—Could any reader oblige with a recipe for making above? Also, the proper proportions of ingredients and their treatment—how melted, and in what sort of vessel? I have tried sulphate of baryta, rosin and oil, but they have not the desired effect, as the wax remains sticky and liable to bend. This is, of course, for a cheap quality, which sells at about £1 per cwt. or less.—J. B. H.

[47505.]—**Hot-Air Engine.**—Would any reader give working drawings of a model engine to be worked by hot-air? I want one to work a blowpipe?—Albert Smith.

[47506.]—**Cement for Knives in Handles.**—Wanted a good recipe for a cement for fastening table-knives which have come out of their handles?—Mater.

[47507.]—**Sulphate of Potash.**—To Mr. Allen.—I wish to know the quickest way of determining the per cent. of sulphate of potash, and the per cent. of soda salts in some commercial sulphate of potash, and shall be glad of your advice. I have tried a sample by adding HCl and BaCl$_2$; boil and filter, neutralise filtrate, add lime-water, boil, filter, add AmHO, Am$_2$CO$_3$, AmOx; boil and filter, evap. to a small bulk, add excess HNO$_3$; evap. to dryness; dissolve and filter, evap. twice to dryness with HCl. Dissolve in water, transfer to a pt. dish, evap. to dryness, then weigh the mixed chlorides; then separate the potassium as K$_2$PtCl$_6$ by Teschemacher and Smith's plan (see Crooke's "Sel. Methods," pp. 1 and 2). This mode of procedure, it seems to me, is liable to error on account of the large amount of filtering and manipulation. Could not many of the above reagents be added in succession, and so make one filtration serve for a number of precipitates?—thus saving time and probable errors. Any information as to the best mode of proceedure for sulphate of potash will be gratefully esteemed by—A Young Works Chemist.

[47508.]—**Weight of Girder.**—I have to thank "Ditton" for the answer to above, and can see I have put my query wrongly. What I want is, to experiment with a box girder of the ordinary shape, and one of another shape. In view of the expense, it must be a model. I therefore wanted some idea of the proportion of one to carry a given weight, so as to have some data to compare the one of a different shape with. Could I make one of stout tin-plate soldered? If so, could you give me dimensions for one? Should feel obliged for any information.—E. P.

[47509.]—**The Modern Harp.**—Will any one of the numerous contributors to the "E.M." on musical instrument construction kindly give some information as to the above, or refer me to the back Vol. or Vols. in which I can find full particulars if ever before published in the "E. M."? I have not got earlier Vols. than XVIII., and in looking through the indexes cannot see what I want—viz., a full detailed description of the modern double-action instrument (with measurements), and is it an instrument that an amateur (who has built an organ) is likely to be able to manufacture?—R. Cecil Clifton, Perth West, Australia.

[47510.]—**Cistern.**—I want to save all the rain falling on the roof of a house in South Devon, the walls of which measure horizontally 70ft. × 23ft. What should be the capacity of a cistern in cubic feet to receive the same, supposing the quantity of water drawn off from it daily was 1/365th part of the total quantity of rain falling throughout the whole year?—J. W. B.

[47511.]—**Coffer-Dam.**—I wish to make a coffer-dam about 30ft. long, to keep out 4ft. deep of running water. Will some practical man kindly advise me the best way? I only want it to remain about a month.—Quod Dixi Dixi.

[47512.]—**To Mr. Lancaster.**—Thanks for your information concerning the Grenet cells the other week. Will you tell me the difference between Grenet and Leclanché batteries? I was under the impression that mine were Leclanché, although the word Grenet was on the outer glass cell. Will you also tell me why the canvas bags are used instead of porous pots, and if the Grenet are equally suitable for bells as the Leclanché?—J. W. B.

[47513.]—**Water-Filter.**—Will some reader kindly instruct me how to make a charcoal filter capable of filtering one thousand gallons of water an hour?—the matter to be removed being chiefly precipitated lime and iron. The filter ought to be made so that it can be easily cleaned and the charcoal renewed when necessary. Full instructions will be much valued.—Engineer.

[47514.]—**Tennis-Balls.**—Can any of your correspondents tell me any means whereby tennis-balls which have been slightly broken can be mended?—O.

[47515.]—**Dry Collodion.**—Will Mr. Lancaster, or some other correspondent, kindly give me directions for making dry collodion plates (not emulsion)?—Camera.

[47516.]—**Splitting Stone.**—Can any of "ours" give me any information about a mode of splitting stone by laying a line of some explosive on the unbed for line of division, and firing it? I have read or heard of some such process being successfully used, and am anxious for information, as it seems to me it would be a great advance on our present method with wedges, which, though effective, is tedious, and costs a deal in labour to "pick" out the crannies for the row of wedges. What explosive should be used, and what thickness will it split? Also, can it be relied on to produce a straight break vertically?—Treadle.

[47517.]—**Pumping Engine.**—I have a force-pump ½in. bore, 1½in. stroke, and I wish it to work by a steam-engine at about 1 stroke per second. The supply-pipe is 2ft. in length, and the pipe up through which water is forced is 6ft. in length. The inside measurement of both pipes is ½in. Would a double-action oscillating cylinder 1in. bore and 2in. stroke, having a vertical boiler 3½in. in dia., and 1ft. long, of ordinary thickness, with 4 inside tubes, drive the pump? Also, would an iron flywheel 8in. in dia., and weighing 2½lb., or thereabouts, be too heavy? Will the boiler keep up steam at a pressure of 15lb. to the sq. in.? The pump is not to be connected direct with the engine-shaft, but as it is—separate by a band. I can shorten the stroke of the pump.—Edmund Ashcroft.

[47518.]—**Balance-Wheel Cutting.**—Will "A Fellow-Workman" or "Alfojoe" be kind enough to give me an illustrated description of the balance-wheel cutting tool? Also, a few hints how to cut an escape-wheel?—T. F. A.

[47519.]—**Legal.**—To Mr. Wetherfield.—A husband some years ago made a will in favour of his wife as follows:—"I give devise and bequeath all my real and personal estate, whatsoever and wheresoever, and whether in possession, reversion, remainder, or expectancy, unto my wife (A. B.), for her sole and absolute use and benefit; and I appoint my said wife (A. B.) sole executrix, &c." The wife is doubtful if this secures to her freeholds acquired by the husband, subsequently to the making of the will, and a policy of assurance recently effected on his life. Will Mr. W. kindly say if the wife's fears are goundless, and whether the will is sufficiently comprehensive to secure to her property of every description to be left by the husband at death? They have no children.—Audior.

[47520.]—**Inspecting Weights and Measures.**—Can any reader give me any wrinkles useful to an inspector of weights and measures?—the tools required, manner of testing, &c.—X. Y. Z.

[47521.]—**Monochord.**—I am about making a first-class monochord, and will feel thankful for replies to the following:—Best kind of wood, length, width, and height of body, length between bridges, thickness of top, bottom, sides and ends, number and size of holes, and whether better in top or sides? Is it more convenient to have scale for length of strings marked on top, or to have a movable scale? Should it have legs of wood or metal, and if so, what height, and should they be fixed to body or not? Must the top have bearers fastened to underside for the purpose of strengthening it, and if so, how many? For how many wires should provision be made, and what distance should they be apart? Should the wires be stretched by a weight or screw? I think an article on the above, illustrated with a detailed drawing, would be acceptable to many other readers of ours besides—Phosphorus.

[47522.]—**Koenig's Adjustable Resonators.**—Will some reader of "ours" kindly give instructions for making these, and also reply to the following?—What are the tubes made of, thickness of the tubes, lengths and diameters of tubes, must the sliding tubes be a very good fit, what are the sizes of the holes in tubes?—Phosphorus.

[47523.]—**Cubical Revolving Mirror.**—What are the dimensions of each side—will common looking-glass do?—Phosphorus.

[47524.]—**Acetic Acid.**—Will some reader kindly give a table of strength of acetic acid with corresponding sp. grs., and also say what is the best method for estimating the amount of real acid in solutions of different strengths?—Phosphorous.

[47525.]—**Hay Barn.**—Would any kind contributor who knows give dimensions and instructions for the building of a hay barn, with a roof that can be lowered when the barn is empty—one of sufficient capacity to hold about 20 tons of hay, to be supported on wooden posts, and with either corrugated galvanised iron or wooden roof, and the probable cost?—Old Hay.

[47526.]—**Quickest Railway Run.**—Can any reader give further particulars of the train mentioned in the "E.M." of July 14, which ran from Leeds to London in three hours? Also, the number of the engine?—Experimenter.

[47527.]—**Microphone.**—Will some reader tell me if the following performance of my microphone is out of the common?—When it is placed on a small wooden loud-ticking clock, and connected with a Bell telephone, the sound can be heard anywhere in the room in which the telephone is placed.—Experimenter.

[47528.]—**Sowing "Con-Acre."**—What is the meaning of "sowing con-acre"? I see the expression in debates on Irish agricultural questions, &c. Will some Irish fellow-reader oblige?—Kappa.

[47529.]—**Electric Lamp.**—How is the carbon thread in an incandescent lamp guarded against accident by too much current? I have made a dynamo, but am afraid of volatilising or ruining the filament by too strong a current. Will some reader help me to guard against this?—H. W.

[47530.]—**Softening Hard Water.**—I have some water springing from limestone, having a total hardness of 82·15, or about four times as hard as New River water. What is the best means of softening it?—Dandie Dinmont.

[47531.]—**Ventilation.**—I wish to ventilate a chapel by means of a tube with burners inside in the roof, and air admitted by vertical tubes at the floor. How shall I proceed? What area should the tubes be, and where should they be placed? Size of building 80ft. × 40ft.—Dandie Dinmont.

[47532.]—**Coil.**—To Mr. F. Walker.—In the "E.M." of June 9th, p. 313, you gave instructions to make a medical coil. I want to make one with an 8in. magnet, ½in. thick, composed of fine iron wire. Should the bundle of iron wires be insulated from the copper wire, or should the wire be wound direct on the core? Also, would No. 16 gauge c.c. copper wire do for the same in the place of the No. 22 which you used? What quantity of wire should I require? Also, how thick should coil be when finished?—W. Wright.

[47533.]—**Secondary Batteries.**—To Mr. Lancaster.—Would it be advisable to use as a positive element a lead or copper box closed at the top, with small holes round sides, and filled with small pieces of lead, such as coarse raspings? Would hydrogen be absorbed, or would it adhere to such a box better than it would to a simple lead plate?—H. L. Donkin.

[47534.]—**Dutch-Rhenish Ry. Locomotives.**—Can Mr. Gobert, Mr. Clements, or other correspondent, give me sketches, with details, of the engines and tenders on this and other Dutch railways? There was a query in the "E. M." some weeks ago about S. American and other locomotives: does Mr. Gobert know anything of them?—E. E. R. Tratman.

[47535.]—**L.B. & S.C.Ry.**—Can "Carstairs," or other reader of the "E. M.," give me sketches of the two engines, Stephenson (single driver) and Belgravia (coupled), of the above line? I should be glad of details and sketches of the tenders? Who are the builders of the small engines which work the East London Ry.? They are the smallest I have ever seen on ordinary railways. What is their power?—E. E. R. TRATMAN.

[47536.]—**Legal.**—To MR. WETHERFIELD.—Is the accompanied form a legal acknowledgment of a debt due for rent? Does it require stamping, and if so, how much, and how soon after date?—

I, A. B., of No. ——————, promise to pay to Mr. C.D. £10 in ten monthly instalments of £1 each, the first instalment to be due and payable at No. ————, on the —— day of ————, 1882.—

(Signed) A. B.
—M. I. S.

[47537.]—**Musical Box.**—Can you tell me a good plan for repinning the barrel of a French musical box? Several pins in mine are bent down, and when I try to straighten them they break off, or else break off the next time they meet a tooth.—BROCKLEY.

[47538.]—**Lunar Measurements.**—Would "F.R.A.S." tell me the modus operandi of measuring the height of mountains in the moon?—A TEN YEARS' SUBSCRIBER.

[47539.]—**Wear of Brake-blocks.**—Could "North Star," or any other reader, tell me how long the blocks used by the Westinghouse Co. last when used on local trains; how long it takes to wear off the first 8th when used?—CONTINUOUS BRAKE.

[47540.]—**Measuring Flow of Water.**—I wish to know a simple arithmetical rule to find the number of gallons of water that will flow over a tumbling bay, say, 6in. wide, at various heights?—PITCH LINE.

[47541.]—**Coil.**—To MR. LANCASTER.—I have a medical coil which lately has given very indifferent results. I thought the fault was a short-circuiting of the secondary coil, so I unwound it and insulated each layer, but still very little, if any, improvement. The contact-breaker also seems to act all-right. By inserting a small condenser in the primary coil, would it give me a stronger induced current? If so, what would be the best way to make the condenser?—TELEGRAPHS.

[47542.]—**Insects.**—I inhabit quite a new house in a country village, which, since the warm weather has set in, has been infested with a small white insect which does not fly, but runs quickly. It is not a parasite, but is found in all the rooms, running about the furniture. Can anyone tell me what it is, where it comes from, and what is the best means of getting rid of it?—LOUISA GEORGE.

[47543.]—**Hardening Hammer Faces.**—Will "Jack of All Trades" tell me the best way to harden hammer faces?—salt will not do. The hammers are faced with steel, and to drive steel wedges into rocks.—W. H. G.

[47544.]—**Electrical Measurement.**—To "LL.B.A."—In your kind reply you say that if E be different, then R will be different; and if we know E to be the same, then R will be the same. Now, by this law, we know the resistance of a circuit in ohms, we know the current flowing through it in ampères, and we know the electromotive force in volts. Now if we insert our galvanometer in this circuit, we know that it alters the resistance of the circuit, and also the E.M.F. in proportion; but, however, it deflects our galvanometer, say, 10in. Now if we place our galvanometer in another circuit through which a current is flowing, and it deflects the needle 10in., as before, will not the current, the E.M.F., and the resistance, be the same in this circuit as the previous one?—STUDENT.

[47545.]—**Daniell Battery.**—Would some one describe an easy method (but accurate) of measuring the intensity and resistance of a Daniell battery, and greatly oblige?—EWANDALE.

[47546.]—**Crystallisation on Metals.**—In some of the tobacco shops I have noticed tin boxes, the surfaces being crystallised and lacquered over. Will any brother-reader kindly inform me how to produce the same result on sheet brass, and oblige?—SCIENCE.

[47547.]—**Legal.**—Mr. Wetherfield will greatly oblige by giving an opinion upon the following?—Is an agreement worded as hereunder sufficiently technical and binding as between employer and employé to prevent the latter at any time from entering upon the same class of business carried on by the former in the districts specified?—

"Agreement between A. and B., dated ————
B. agrees not to encroach upon the districts of the said A. as seller of ————, the said districts being C. D. E. F. The engagement of B. can be terminated on either side by one month's notice being given."

—DOUBTFUL.

[47548.]—**Industrial Company's Accounts.**—I should feel much obliged for the following information:—Are there any books on industrial organisation, &c., which explain how the accounts of factories and workshops are kept, how the cost of production and consequent selling price of articles is arrived at, how supervision and designing is charged for in the cost of production, &c., &c., and also how the work done by each workman is checked—e.g., a workshop producing machinery, tools, &c., and also doing repairs to same;—how, in this case, is the price of each article and job arrived at so as to find the lowest prices remunerative—the work being done by hand and steam? The problem is evidently a complicated one. Will any well-informed reader explain the general principles and practice in England and America, if there is no good work on the subject.—BOSS.

[47549.]—**Bloater-Paste.**—Will any of your numerous readers kindly inform me the best way to prepare or make bloater paste (as genuine as possible) from the Yarmouth bloaters,—how to extract the bones, &c., and what time of year is the most suitable?—BLOATER.

[47550.]—**Dynamo.**—To MR. LANCASTER.—Being about to make a small dynamo of the Bürgin pattern, I would feel obliged if you could give me any information upon the following points:—Sizes and quantity of wire upon field-magnets and upon armature for best results, winding of wire upon field-magnets for self-exciting machine. I wish to use the machine in conjunction with accumulators to feed incandescent lamps, and should like one arc lamp at times for a short time occasionally. The size of machine is 19½in. long, 8in. high, and 9in. through cylinder for armature; size of opening of cylinder is 5¼in.; size of space for wire on field-magnets is 9in. × 5in., cores 7 × 5 × 1½. Does it matter what size iron wire is used for the rings of the armature?—I intended to use eight rings. I would be very glad to have any hints from you regarding the making and charging accumulators, as you say you have been trying them for time. I have abundance of steam-power, and could keep some on the machine all day if desired. How many lamps might I expect to light with it from a day's supply?—T. F. H.

[47551.]—**Coil.**—To MR. LANCASTER.—I am going to make an induction coil with 8 or 10lb. of secondary, No. 32. Would you kindly say length and diam. of core, number of layers and size of primary, and size of condenser, with any other information you may consider of advantage?—ONTARIO, Canada.

[46552.]—**Japan.**—Could any correspondent give us a recipe for a good Japan that will dry hard by steam-heat and not shell off, and present a good appearance with one coat?—would prefer it without asphaltum.—ONTARIO, Canada.

[47553.]—**Problem in Dynamics.**—A weightless rope passes over a smooth pulley, having a monkey at one end, and a ball equal in weight to the monkey at the other. The monkey suddenly begins to climb up the rope with uniform velocity v. How does this affect the ball? Does it remain at rest, or does it also acquire an initial velocity $= \frac{1}{2} v$?—A. J. SMITH.

[47554.]—**Legal.**—To MR. WETHERFIELD.—Some months since, in consequence of my wife's misconduct, I refused to live with or maintain her; she then applied to the parish, and the magistrate made an order for me to pay 6/- per week. This has been paid till last week, when I stopped it, having obtained further proof of her miconduct. How can I protect myself against her again appealing to the parish or magistrate, perhaps months to come, and when my witnesses may be scattered I know not where? I applied to the Court, and was told by an official the magistrates had nothing to do with it. She has written me that she has left London, and requests me to forward her money to the address given in North Wales. I am a working man, and have but little money to spare.—J. WELG.

[47555.]—**Incubator.**—Will any one give directions for making an incubator to be heated by kerosene lamp?—AN AMERICAN.

[47556.]—**Calulating Sizes and Powers of Boilers.**—To "J. H."—Referring to letter 20117, by "J. H.," on calculating the power and size of boilers, in No. 897, and on p. 287, will he, or any reader who understands his formula, kindly explain a little more fully how the number 474 is obtained, which is used as a divisor to get at the amount of water that is evaporated per hour?—A LEARNER.

[47557.]—**Statute of Limitations for Property Law.**—A neighbour of mine some 14 years ago inclosed some of my ground by mistake, but refuses to give it up or pay anything for it. By the new Statute is it already his, or when will it be his, if I don't get some acknowledgment from him? From what date does that Statute intend the 12 years to be counted from, or does his 14 years' possession make my chance bad in a lawsuit?—LOSER.

[47558.]—**Water-closet Seats.**—Will any of your correspondents give me a correct or standard method for striking out the holes in closet seats (both for adults and children), the sizes they should be, and also the proper distance to round them back from under edge of hole? I should like the method and sizes used in first-class work, also the usual height from floor to top of seat.—UN FALAGNAME.

[47559.]—**Legal.**—To MR. WETHERFIELD.—Would you kindly advise me on the following matter?—My mother bought a business, which was paid for, carried on, and the rent paid in her name. She had two sons only, my brother, younger than me, assisting her for some years, during which three leasehold houses were bought in my brother's name, but proof can be had that money was borrowed in my mother's name to help pay for the houses. About four years ago, just before having two of the houses made over to her name, my mother died, leaving no will, and from then until now my brother has held possession of everything, and as misfortune assails and he don't assist me, I should be pleased to know if I can claim any and what portion of the property, and how to enforce the claim if required.—J. KING.

[47560.]—**Self-Acting Vertical and Angular Feed to Planing machine.**—I have a planing machine by Messrs. Buck and Watkin, of Halifax, who are now out of business. The self-acting vertical and angular feed motion has been removed before it came into my possession, and I am anxious to replace the same. Can any of your numerous subscribers help me with a sketch and description of the above motions?—CADMUS.

[47561.]—**Pot-Pourri.**—Will any reader kindly tell me the ingredients and quantities for making the above? I am drying a quantity of rose-leaves.—J. CHAMBERLAIN.

[47562.]—**Meat-Safe.**—Will any of your readers kindly give particulars for making a small meat-safe—say, 3ft. 6in. to 4ft. in length, about same height (including, say, 1ft. for height from ground), stating materials to be used, &c.? A small sketch would be of great assistance.—FRITZ.

[47563.]—**'Xtraordinary Challenge.**—Can any rider of this machine oblige me with an opinion of its merits? Is it inferior in speed to an ordinary bicycle?—UNDERGRADUATE.

[47564.]—**Photographic Lens.**—Can "Orderic Vital," "Prismatique," or any other obliging reader supply me with the elements necessary for working a photo lens of the rapid rectilinear or wide angle symmetrical class, and oblige?—JIM.

[47565.]—**Valve motion.**—Would some one kindly describe how the valve in the Hathorn rock drill is actuated? It appears to be a very ingenious arrangement.—E. S.

[47566.]—**Spectacles.**—For engineers finding it necessary to use spectacles at their work, what kind would be the most serviceable (there are the usual and several patent kinds) and be least injurious in the end for constant use? Several makers claim that theirs improves the sight.—ENGINEER.

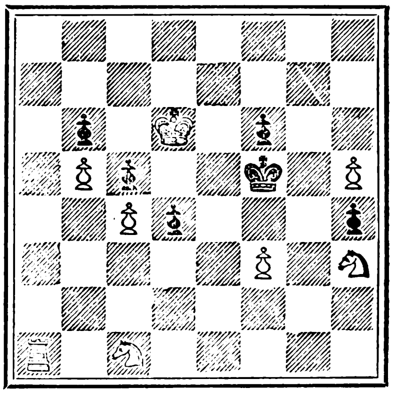
[47567.]—**Slide-Rule.**—Will any experienced reader please give an opinion as to the best forms of slide-rule or similar instrument of English make? I wish rather accuracy than variety of applications; a good, cheap, logarithmic rule without trigonometrical functions, say 18in. long, would be about what I require; but I believe there are improved forms in which the tables are arranged on discs or cylinders, and I remember having heard of one equal to an ordinary rule 7ft. long. I should like particulars of some of the improved forms. Are they easier to read, and do they (e g.) read to four figures?—MECHANICUS.

CHESS.

ALL Communications for this department must be addressed to the Chess Editor, at the office of the ENGLISH MECHANIC, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCLXVII.—By H. F. L. MEYER.

Black.

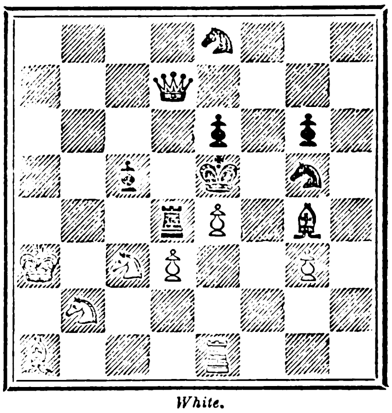


White.

White to play and mate in four moves.

PROBLEM DCCLXVIII.—By T. B. ROWLAND.

Black.



White.

White to play and mate in two moves.

SOLUTION TO 763.

White.	*Black.*
1. Q to R sq	1. R takes Q (a)
2. R to Q 7 (ch)	2. Kt covers
3. R takes Kt mate	
	(a) 1. B moves (b)
2. Q to Q 4 (ch)	2. K takes Q
3. R mates	
	(b) 1. R takes R
2. Q takes 4 (ch), &c.	

SOLUTION TO 764.

White.	*Black.*
1. B to R sq	1. Kt to K B 4 (a)
2. Q to K 4 (ch)	2. Kt to Q 5
3. Q to Q B 6 (ch)	3. Kt takes Q mates
	(a) 1. Kt to Kt 5 (b)
2. Kt takes P (ch)	2. Kt takes Kt
3. Q to B 6 (ch)	3. Kt takes Q mate
	(b) 1. R to R 6 (c)
2. R to Q 4 (ch)	2. P takes R
3. Kt to Q R 3 (ch)	3. R takes Kt mates
	(c) 1. B to B 3 (d)
2. Kt takes P (ch)	2. B takes Kt
3. R to B 7 (ch)	3. B takes R mate
	(d) 1. Any other
2. Kt to K 3 (ch)	2. B takes Kt
3. Kt to Kt 6 (ch)	3. Mates

If 1. $\frac{\quad}{\text{B-K 6}}$. 2. $\frac{\text{Kt to Kt 6 (ch)}}{\text{Mates.}}$.

NOTICES TO CORRESPONDENTS.

CORRECT solutions to 763 and 764 by Celsus; to 764 by G. Hume and Schmucke.

SCHMUCKE.—You will have seen the notice respecting 762 in our last.

WITH reference to Mr. W. T. Pierce's article on the A 1 Notation in the Chess Club Directory this year, Mr. Meyer calls our attention to the fact that the term "International Notation" was first used by Prof. O. A. Brownson, in 1874.

PROBLEMS received with thanks from F. F. Beechy and G. Hume.

THE *Jamaica Family Journal* has just started its second problem tourney. The prizes are: 1st, £2; 2nd, £1; 3rd, 10s.; 4th, 5s. There are also special prizes (1) for the best problem giving the black king most liberty, 10s.; (2) for the best, by a West Indian composer, 10s.; (3) for the best and most appropriate motto, a copy of Bland's Chess Annual: (1) and (3) are offered by Miss F. F. Beechey. The problems are to be two-movers; not less than two, and not more than four, must be sent by each composer. No competitor can take more than one of the regular prizes. Two problems at least must be posted on or before September 10th by other than Jamaica composers, and one month more will be allowed for making up the complement of four if so desired. The usual rules respecting motto and envelopes. Address: Mephisto, 96, Harbour-street, Kingston, Jamaica.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* EDITOR *of the* ENGLISH MECHANIC, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, July 26, and unacknowledged elsewhere:—

REV. E. S.—W. H. Smith and Son, Dublin.—Royal Cornwall Polytechnic Society.—C. Birchall.—T. Schobbeus.—J. Shanks.—W. H. Barwell.—Crossley Bros.—J. R. Cheshire.—Young Photo.—B. M.—J. P.—London River.—W. Bradshaw.—A Casual Sketcher.—Met l.—Orderic Vital.—Fellow Workman.—Jack of All Trades.—N. S. Heincken.

J. EDMONDSON. (A cubic yard of rubble masonry will, as a rule, require 1-5 cubic yard of mortar and 1 1-5 cubic yard of stone. The difference you speak of is due to the adoption of different local standards of measurements. The Irish "square perch" is 21ft. super., while the "square perch" used in the West of England is only 18ft. super.)—JOINER. (You can render ordinary glue insoluble in water by adding to the water with which it is mixed about a fiftieth part of the amount of glue used of bichromate of potash.)—EMIGRANT FARMER. (In this country, the following quantities of seed are sown per acre—viz.: Wheat, from 1½ to 2½ bush.; barley, 1½ to 3½ bush.; oats, 2 to 5 bush.; turnips, 2 to 6lb.; potatoes, 10cwt.; peas, 3 bush. in drills; beans, 4 bush.; carrots or parsnips, 6lb.; rape or cole, 2 to 4 quarts; rye, 4 bush.; 1 bush. of rye or oats and three bush. of vetches; 1 bush. of peas and three of beans; sainfoin, 4 bush. of rough seed with 8lb. of trefoil; white clover, 14lb.; red clover and cow grass, 15lb.; mixture of ½ bush. of rye grass, 6lb. trefoil, and 6lb. of white clover. Seeds, 2 pecks of mixed perennial and Italian rye grass, 3lb. white clover, 7lb. red clover, 1½lb. alsike, and 1½lb. trefoil; or 3 pecks Italian rye grass, 6lb. each of red and white Dutch clover and alsike, 3lb. trefoil, and 2lb. each of plantain and parsley. For crop of hay alone, 1 bush. each of perennial and Italian rye grass with 9lb. of red clover; for one year's hay crop and one or two years' pasture, 1 bush. of perennial rye grass, and ½ bush each of Italian rye grass and rough cocksfoot, 5lb. of red clover, with ¼ stone each of white clover and Timothy. Average yield per acre: Wheat, 4qrs.; barley, 5qrs.; oats, 6qrs.; turnips, 20 tons; mangold, 25 tons; beans or peas, 30 bush.; clover, 2 or 3 tons; hay, 2 tons.)—INCANDESCENT. (The question was answered by the contributor named on p. 457, last week.)—ELECTRICIAN. (It is usually taken at 1,000 hours, but some have been in use for much longer periods than that. Others fail after a few hours. After a time the glass becomes clouded by a deposit of carbon, so that if you get one to last 1,000 hours you may be satisfied.)—S. CROSSE. (See recent back numbers and articles on the Pacinotti ring and dynamo machines.)—ENGINEER. (The book you require is Nicholl's "Theoretical and Practical Boiler-Maker," which is published by the author at Yorkshire-street, Blackpool. The second edition has just been issued.)—R. L. JONES. (Full directions for making secondary batteries have been given many times. See p. 273, 293, Vol. XXXIV., and the index of that volume; also pp. 180, 200, 244, 247, 281, 291 this volume.)—GAMMA. (It is done by fitting the winding apparatus with ratchet work, but the maintaining power lasts only a limited time. See No. 852, p. 469, for full description.)—YOUNG POLISHER (Use Stephens' stains, or consult the indices. Copal, oak, spirit, or French polish.)—R. BARRACLOUGH. (For what purpose is it required? Generally speaking, a mercurial barometer verified at Kew is the best. To be obtained of any philosophical instrument seller.)—T. HENDERSON. (Have you tried your flying machine? We see nothing very new or likely to be successful in it.)—VITAL JACK. (Gamboge is a resin which oozes from the broken branches, or incisions made in the trunks of various trees which grow in Siam, Ceylon, and Cambodia. The substance is dried and exported in cylindrical cakes.)—T. GRAHAM. (We hardly know where you are likely to meet with a copy. We have one in an old volume of poetical extracts published many years ago without imprint. The subject was a favourite one with our old English ballad makers, and there are extant, besides the "King and the Miller," "King Henry and the Soldier," "King James and the Tinker," "King Alfred and the Shepherd," "King Edward and the Tanner," and probably others. "The King and the Miller" is, at least, as old as the reign of Edward IV.)—CHAIN SHOT. (We cannot undertake to value engravings. If you had mentioned the subject we might have told you something about it. Albert Dürer was born at Nürnberg in 1471. You will find a review of a good and recently-published "life" of him, and a reproduction of one of his latest plates—"Samson and the Lion"—in to-day's *Building News*.)—BROSCENICUS. (See No. 865, p. 167. Moulds of proper moulders' sand, thoroughly dry. Plumbago crucible. Have you a furnace? If not, see p. 76, Vol. XXX.)—F. S. (Cannot you see what you want in almost any optician's window? There is no necessity for a bulb. The tube need only dip into a little cistern of mercury, which may be of any material not attacked by that element.)—L. NEWTON. (You must not apply electricity for the cure of headache except on the advice of a competent physician.)—H. W. (If you refer to pp. 87, 111 of this volume, you will find illustrations of the method of applying electric bells in telephone circuits. If you want to make a bell, see back volumes.)—LUNETTES. (It is a question to be answered only by skilled examination of the eyes. You should wear your spectacles always, that is, when using the eyes, as their object is to relieve the strain on certain muscles. As a rule, in short sight, if suitable spectacles are used when the patient is young, they can be laid aside when maturity or middle life is reached.)—YOUNG MICROSCOPIST. (You mean the "eels in paste," we suppose. Make a moderately thick paste of flour and water, and keep in a warm place, stirring every day to prevent the growth of fungus. At the end of a few days examine the paste by putting a little bit diluted with a drop of water on the slide. You should procure one of the cheap manuals on the subject, or look through a series of articles in Vol. XXI.)—AN AMERICAN. (You will find description of such a machine in Nos. 773, 793.)

Watches and Jewellery.—Messrs. Woodward and Co., of Liverpool, have sent us a copy of their illustrated catalogue of watches and jewellery, which comprises goods likely to suit all tastes and pockets. The catalogue seems free from the ridiculous guarantees, offered in similar publications we have seen, of value and efficiency at impossible prices, and there is, therefore, the more probability that purchasers will put themselves into Messrs. Woodward's hands with satisfaction—especially as they undertake to take back all goods not approved of if returned within a week after sale.

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Messrs. JAMES W. QUEEN and Co., of 924, Chestnut-street, Philadelphia, are authorised to receive subscriptions for the United States for the ENGLISH MECHANIC, at the rate of 3 dols. 25c. gold, or Thirteen Shillings per annum, post-free. The copies will be forwarded direct by mail from the publishing office in London. All subscriptions will commence with the number first issued after the receipt of the subscription. If back numbers are required to complete volumes they must be paid for at the rate of 4d. each copy, to cover extra postage.

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Indexes for each half-yearly volume up to Vol. X. (except Vols. II., III., IV., V., and X.) inclusive, 2d. each. Post free 2½d. each. Indexes to subsequent vols., 3d. each, or post-free, 3½d. Cases for binding, 1s. 6d. each.

⁂ Subscribers are requested to order Cases and Vols. through their booksellers, and not to send direct. The regulations of the post-office prevent their transmission through the Post.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

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⁂ It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions; and in cases where the amount sent exceeds One Shilling the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement and charged for.

Advertisements *must* reach the office by 3 p.m on Wednesday to insure insertion in the following Friday's number.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Wanted, portable **Dry-plate Camera**, background, and Camera suitable for copying, &c. Many useful offers, or part cash.—BETA, Belbroughton, Stourbridge.

Hickory **Fishing Rod**, Winch and Lines, Acme Skates, Wood Skates, Daniell Battery, Porous Cells, Zincs, Leather Leggings, small Taps, Standard Screw Plate, Screw Chasers, Wire Netting for Poultry, Sulphate of Copper for Battery, brass Bottle Jack, quantity of Maps (suit school), botanical specimens, about 250 mounted on paper. Sell cheap or exchange. Want Fruit, Drapery, Dentist's Tools and materials, Plants. Would make artificial teeth for exchange.—DENTIST, 27, High-street, Rochester, Kent.

Binocular Popular **Microscope** (Smith and Beck), bought within last six months; ⅛, ¼, ½, 1, 2in. glasses, compound achromatic condenser with stops, polariscope, paraboloid, dark well, &c., first-class instrument, good as new; leaving country; every examination allowed; catalogue price over £30. Offers.—Y. R. S., Britannia Brewery, Allan-street, Kensington.

Wanted, set of **Tricycle Wheels**, or parts of same. Good exchange or cash.—WM. POATE, Havant, Hants.

Clarionet, 13 keys, E flat. Good exchange for large size Accordion, Magic Lantern, or offers.—WM. POATE, Havant, Hants.

32ft. **Reeds**, one bottom octave (CCCC to CCC), for harmonium. Offers wanted.—HAVARD and STEVENSON, 103, Bordsley Park-road, Birmingham.

What offers for 7½in. back-geared **Lathe and Tools**? Also Vertical Drilling Machine.—For full particulars apply to F. UNDERWOOD, Beverley.

Wanted, all the back numbers of the "**Electro-**METALLURGIST AND ELECTRIC LIGHT JOURNAL." Exchange.—G. C. T. CARTER, 3, Castle-street, Reading.

Type, chiefly new, several founts, press, &c. Offers requested in exchange.—L., 16, Addington-street, Ramsgate.

Telescope, 3in. O.G., well mounted, defines well, shows Jupiter's moons. Offers.—MILLER, P. O., Ramsgate.

I would like to exchange my collection of **Foreign** STAMPS, about 1,400, in Stanley Gibbon's 11s. album, for Coins or Britannia Company's Lathe.—J. C., 11, Calverley Park-gardens, Tunbridge Wells.

Boiler (slow-combustion), Hot Water Pipes, &c., wanted, for Heating Coil and cash.—Mr. S. HEWETT, South Norwood, London.

Bicycle, 52in., Bown's Æolus Ball Bearings both wheels, saddle, brake, bag, light splendid machine, nearly new, condition perfect, value £8. Exchange good Telescope or Microscope.—DAVIES, GILES, and Co., Sedgley, Dudley.

128 odd numbers from the 10 first volumes of the "**Eng-**LISH MECHANIC," in exchange for any useful book or numbers of the *Builder*, or send offers.—JAS. LEVESQUE, St. Helier's, Jersey.

Watch Mandrel, with compound slide-rest, £4 10s. Wheel-stretching and hole-closing Tool, £1 10s. Watch Depth Tool, 5s. Uprighting Tool, 10s. Box of Watch Punches, 6s. Watch Turns, with centres, 6s. Offers requested. Rare chance for amateur watchmakers.—J. WILLIAMS, 36, Mount Ash-road, Sydenham.

I have six, each ½in. and ¾in., **Bib Cocks**, low pressure; 6 each ½in. and ¾in. Ball, ditto; 1 dozen ¾in. Stop Cocks, ditto. What offers?—E. M., 4, Oxford-terrace, Windsor.

Organ Bellows and Windchests (new and second-hand), in good condition, ready for wind and pipes.—Address, WILLIAM JOHNSON, No. 12, Moxley near Wednesbury.

A good **Lathe** wanted. Exchange a splendid 50in. Bicycle, S.H.F. and double ball bearings.—Offers to HODGKINSON, High-street, Shanklin, I.W.

Electric Boat, fitted with paddle wheels, electric engine, paddle boxes, imitation boiler, funnel, rudder, battery; runs for two or three hours. What offers?—GEORGE TOLMAN, Wolverhampton.

Fine collection of **Minerals and Fossils**. Wanted, letter copying press, aneroid barometer, or violin case.—WORTH, Sheldmont House, Brondesbury, Kilburn.

Concertina wanted, Anglo, 30 or more keys, metal tops preferred. Exchange violin, bow, and case, value £5, cash.—HEWSON, 12, Great Crown-court, Haymarket, W.C.

My excellent solo **Violoncello**, worth £7 10s., in part exchange for really good Tricycle or Screw-cutting Lathe.—Address, T. REDMAN, Crossflatts, Bingley.

"**Cassell's Popular Educator,**" in 16 2s. parts, quite new and uncut. Offers in Quart Bunsen Cells.—C. W. BERDOE, 16, Broadway, London Fields.

Two **Lathe Heads**, 6½in. centre, 4 chucks, socket and rests. Wanted, Bed and Fly-wheel.—C. BLANCHARD, 4a, Little Church-street, Edgware-road, London.

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The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, AUGUST 4, 1882.

SPECIMEN OF ORNAMENTAL TURNING.

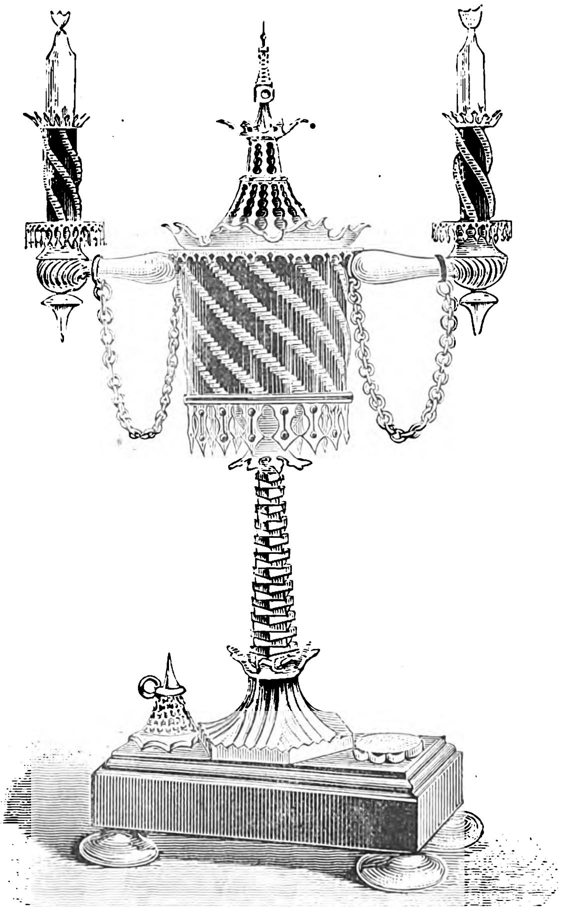
By J. H. Evans.

IN fulfilment of promise, and at the desire of a number of those interested in ornamental turning, I illustrate and describe in this number an ornament which contains a great variety of patterns, and although nothing out of the way in the form of apparatus will be required to do it, it will require a certain amount of experience in the use of those tools, cutters, &c., required to be used, and also a very considerable amount of patience.

It would be seen at once, could the original be viewed by all, that it is composed of African black-wood and ivory, the contrast being extremely effective. As in all cases I should advise beginning at the base, therefore the four feet will be the first thing to do. These are simply plain, without the slightest ornament or cutting about them. Having made them all exactly alike, which will require a deal of care, the stand, which is oblong, will be the next part to proceed with. This is four inches and a quarter long, by two and a quarter wide, and one inch deep. Although such a piece of wood does not seem much to look at, or appear difficult to produce, it is not at all an easy matter to do it. It will be seen that on the top edge a moulding is cut, all the mitres of which are brought up perfectly sharp, and I may mention that, unless all the edges of such a piece of work are made so, the beauty of the work is entirely gone.

Having now explained what it is, I will set about explaining the best way of doing it. In the first place it is better to rough out the piece of wood somewhat near the shape required, leaving, of course, enough material to finish it up. This done, hold it in a universal chuck, and, in the under side, screw it to fit the nose of the mandrel, and then place it upon the dome chuck. If necessary to be raised further from the wheel, a nose chuck may intervene between the work and chuck. With regard to the dome-chuck, I am now making them somewhat differently, inasmuch as the arm which carries the wheel is lengthened, to allow of larger work being cut in it. There is no reason why it should not be so made, and it is quite clear that the extra length does not in any way interfere with the working of it, except that it adds to its capabilities, which must be an advantage. The work being chucked, the slide-rest must be set quite true to the surface, and with the eccentric cutter, having the tool extended to cut a circle of about 1$\frac{1}{4}$in., the first side may be cut. This is a case in which the segment apparatus previously described will be found of very great advantage, as it holds the work perfectly rigid, which is a very important matter. Having cut one side, it is better to take one half-turn of the tangent-wheel of the dome-chuck, and cut the opposite side. This done, the slide-rest must be moved back, and, by moving the wheel one quarter, the position for the next face will be obtained; and, when cut, the half-turn again taken to bring the corresponding side to its place. The wheel having now been moved, and a face cut at each fourth, with care and a sharp tool in the eccentric cutter, about No. 20 wide, these faces may be cut perfectly smooth. We now come to the moulding round the top edge. To cut this, place in the tool-box of the slide-rest a universal cutter with a moulding-tool fixed. The precise radius is of no moment, as it cuts clean through. It will now be obvious that the cutter would cut the moulding exactly in the centre of the face of the wood, and, in order to bring the edge of the wood to its proper place, where the moulding is required, the screw of the dome-chuck must be moved, to lower the arm which carries the work. The dome-chuck should be fixed in a vertical position, which can be very easily done, especially by aid of the segment apparatus. When the work is set in position, and the tool to the centre, the two sides and ends may be cut, great care being taken when passing over the corners to avoid chipping—in the event of which happening the whole thing, so far, is at an end, and must, of necessity, be gone over again. We will assume, however, that, so far, all has been successful, and will proceed with the lower piece of the ivory pillar. This, it will be seen, is also cut in the form of a hexagon at the base, and to such a size that across the flat it is exactly the same as the top of the black wood upon which it rests. In cutting the semicircular flutes seen on each of the curves, there are two or three different ways to accomplish the same. First of all, the bare form must be cut, and this may be done with a long circular cutter about $\frac{5}{8}$in. in diameter, running in a universal or horizontal cutting-frame in the spherical slide-rest. Or another way to get over it, if the spherical slide-rest is not at hand, will be to have a horizontal cutter with a vertical movement. With this little difficulty will arise; in fact, it was with such a tool that the present specimen was done. Having set the tool to the centre, also to the radius of the curve, the six plain facets should be cut, the cutter being driven at a high speed, the vertical movement being taken each side of the centre till the corners are all cut up sharp. This done, set the vertical slide, for such it really is, to the centre with a round-nose tool, and cut the first flute. Take this round to each side by shifting the under peg, and then raise the tool by means of the slide, and cut three cuts each side. The tool should be kept with a very keen cutting edge, and then each cut will have a high polish when finished: this is one of the most important things in ornamental turning. The six sides to form the hexagon can be cut by simply setting the radius of the eccentric to cut sufficiently large to bring up the corners, and move the slide-rest the length desired to complete the form.

On the top of the curve will be seen another thin piece turned to a curve. This being turned, is fitted on to a box-wood chuck, and then cut into the shape seen by the aid of the eccentric cutter and drill, the eight points being brought up by cutting a corresponding number of circles, and adjusting the radius of eccentric cutter to bring the points up sharp. This done, the smaller hole is pierced through with a drill. Following this is the pillar, which is turned taper and cut with a basket pattern. The present was cut of a coarse pattern to give effect, and has in it 104 consecutive cuts. The tool being No. 10 ten-hundredth wide, it was, of course, equal to one turn of the slide-rest screw; and if the rest is set at zero when starting, particular attention being paid that there is no loss of time in the slide-rest, or, at all events, that it is taken up, which is easily done by moving the rest either always in the same direction, or, if not, move it either way sufficiently to be sure that the tool-box is moved, and not the screw only. To cut the pattern as seen, set the radius of cutter; see, as I say, that the reader on slide-rest screw is at zero, and cut, dividing the division-plate into four only, 96, 24, 48, 72. This is, of course, for the 96; any other may be used. The first cut will be according to these settings. This done, move the slide-rest one turn, and set the index-peg so that the next cut begins at 12, 36, 60, 84. These different divisions must be used alternately, which will bring each series of four cuts, with their points, in the centre of those previously cut; and when cut clear with a sharp tool it is one of the most effective patterns. There are a number of different ways of cutting what is termed the basket pattern. By altering the number of divisions between each series of cuts a spiral line of points will be the result, all equally effective in appearance. On the top of this pillar a corresponding piece to that on the top of the lower curve is cut and executed in exactly the same way.



CANDELABRA IN BLACK-WOOD AND IVORY.

We now come to the body, which is made of African black-wood, and, as will be seen, covered with ivory cut very thin. This entire part forms a box to hold stamps, &c. Having turned it to the form required, a thin coating of ivory must be accurately fitted to it, and the latter then transferred to a boxwood form of exactly the same shape, and well fitted, and then held to the boxwood chuck by some very thin glue, and, when dry, proceed to turn, keeping, of course, the slide-rest set to the same angle as when turning the black-wood; and here, in cutting the ivory we come to a basket pattern as before described, forming, as seen, a spiral line, only cut through in order to show the black-wood. This cutting through could not, as a matter of course, be done unless the boxwood fitted the ivory well all over, so as to support the latter, as it will be seen there is very little substance left. The ivory being turned, there will be no necessity to go to the trouble of highly polishing the outer surface, as it is cut up sharp all over; but it may be cut without. Place the vertical cutter, or the universal, whichever is to be used, in the slide-rest, and in it a cutter, No. 8. Set the division-plate at the 96 division, and cut round. Bring up the point sharp, taking eight divisions at each cut, leaving twelve points. Now take one division forward, and cut round at each succeeding eighth hole. Advance one hole again, and proceed as before, advancing one hole for each succeeding series of cuts, all being cut at every eighth. After the one hole has been taken for each adjustment, there are 35 consecutive series of 12, making 500 cuts in this one piece alone, every one of which must be very carefully done, simply because if one is hastily done and allowed to break away, the whole piece will be valueless, and this, I need scarcely say, is exceedingly annoying, more especially if it happens when the work is nearly finished. When cut, the boxwood must be placed in warm water, not boiling, in order to soften the glue and allow the ivory to come off. The chuck being taper, little difficulty will be found in removing it.

We now pass on to the pointed fringe, we may call it, that hangs down from the bottom of the body: this is made from a circular piece of ivory turned to fit the bottom of the black-wood; it is $\frac{5}{8}$ deep, and is cut out with the eccentric cutter and drill. First turn the ivory inside and then place it on boxwood, the same as in the previous case, and glue it on; then turn the outer surface, and if, when the part is turned that fits on to the chuck, the slide-rest is set to the stop, and the tool then set back to whatever thickness is required—for this a full 32nd—there will be no fear of turning it through, which is done in many cases in the endeavour to get it too thin. This piece, when turned, should be highly polished, as some parts of the surface are left uncut. To begin cutting out this pattern, it is always better to cut the largest hole first—that which forms the points. In this case there are 16, consequently 16 holes have to be made, and the eccentric cutter may be used in place of large drill, the radius being adjusted to the required size. Having cut the first row of holes, the slide-rest must be moved sufficiently to allow the next cut to pass into the hole previously made; the same number being cut, the drilling instrument must now take the place of the eccentric cutter, and a drill placed in it the size 24, and the rest again moved, so that nearly half the hole is cut into the second one, leaving only the full half. This completes the first part; it will now be observed that in the centre of each part left another hole, No. 12, is drilled, and then with a smaller drill a groove is cut through the ivory from one hole to the other, and so completes this part.

On the top of the body a ring of ivory is fitted, with a very thin projection, which is cut out in the first place with a drill, No. 20, which having been inserted 30 times leaves sufficient space for a small drill. No. 6 is used at the extremity of each part so left; at the top of this another hole is drilled, which finishes off the effect given to it. I may mention, as a matter of fact, that it is almost impossible to convey the exact appearance of the original by engraving, unless very great time and expense are devoted to it. We will proceed to the top or cover of the body, which is made of black-wood, the same as the bottom. Having fitted it, it should be chucked by the latter fitting, and turned to the curve desired; a piece of ivory must then be fitted accurately; the ivory then transferred to a counterpart of box-wood, and treated as all other such work—viz., glued. And here again I will call attention to the necessity of seeing that all parts of the ivory touch the boxwood-chuck, as it will be seen the ivory that is left after it has been cut is extremely delicate. In cutting such a piece as this, it would look like requiring a spherical slide-rest; but not so. The curve can be turned carefully by hand, and the surface highly polished; then the slide-rest can be set to an angle, and the centre of the drill brought as near that of the part to be drilled. The first cuts will be those that form the points, 15 in number; and follow on with a series of six drills, all gradually decreasing in size, which necessitates 90 cuts in this piece; following this is the ivory slip which goes above it, containing 32 holes in all, 8 in circumference and 4 in length; on the top of this is a very delicate kind of star, curved both sides, and cut out to 8 points. This is a very delicate piece of work, and will require more care in chucking really than in cutting. The extreme top is turned by hand, and then cut with a drill; and in the centre of the ball a small bead drill is inserted four times. On the bottom of the lid a somewhat deep piece of ivory is made to fit and curved over, being then cut into eight different points in the first instance, the centre of each remaining portion being again cut out, forming in reality 16 points in all. This lightens the appearance very much.

So far, then, the base, stem, and box are completed, and we must now go on to fit up the arm which carries the candle-sockets. In order to get them exactly opposite each other, place the black-wood on a chuck, and with the drilling instrument, drill a hole each side. If the drill is adjusted to the exact length of the lathe-centres, as it should be, the holes must be perfectly true, the arms extended are, as will be at once seen, quite plain. On the end of each a socket is fitted, being first turned in plain form precisely alike, the points turning downwards being separate pieces. When bored out to receive the candles, they should be chucked by that hole, each one on a separate boxwood chuck, identical in length, and to cut the pattern seen on the bottom, the eccentric cutter is the instrument with a left side cutter single angle of 45°, thirty cuts, the slide-rest being set about 3-16ths below the centre of the lathe; having cut one, place the other on the nose of the mandrel, and the chuck being the same length, and the same settings used, they must both be precisely alike. I may say that this is really the only way that I can recommend to facilitate making any number of things alike, as the same setting can be used without any readjustment of the slide-rest.

In cutting the fringes, so to speak, for the top of these sockets, extreme care must be used, as they are the most delicate parts about it: two pieces of ivory must be turned out, 1 1-16th diameter, to fit over the top of the socket, and, as will be seen, a very thin projection left to rest upon the top of the same, the two pieces being turned to the same size; place the same upon two separate boxwood chucks and glue them; when set, turn them each as thin as possible, and slightly taper off the extreme edge, so that the points left will be quite sharp. This done, set the slide-rest quite true to the cylinder, and with a No. 12 bead tool the first series of 24 holes may be drilled. The reason why I say use a bead tool is that it has less to cut out, and renders less chance of breaking away; when this row of holes is completed, shift the slide-rest, or rather the drill, so that when the next hole is drilled a kind of square is formed at the part left uncut; the division-plate must now be set to the centre of the part left, and another hole drilled at the top. When both these pieces are finished and are exactly alike, which they must be, the slide-rest must be set round to the surface, and with a small drill, No. 8, 48 holes are again cut, leaving the same number of points. This will be found exceedingly delicate; but as it is only to keep it resting on the top of the socket it is quite strong enough for the purpose; these two pieces will be found perhaps the most difficult part of this specimen; when accomplished, however, it is a most elegant finish. We now come to the stems in which the candles actually go. It will be seen that they are made of black-wood, with ivory over them, 1½in. long and ½in. in diameter, and highly polished. The ivory is turned in the form of a cylinder, and then fitted to a counterpart of boxwood in a similar manner to the other parts turned to the thickness required, and then cut with the vertical cutter in the same way as the body, only a lesser number—viz., 4 strands (we may call them) cut with a tool not so wide as the larger pattern. To complete its length 25 cuts are taken; thus the division plate divided into four, cut round, move one hole forward, adjust slide-rest exact width of tool, cut round again at every quarter of the pulley; proceed in the same way till the length required is cut. When finished it will be found a somewhat difficult matter to get the ivory off the chuck, for two reasons: first, the ivory that is left is so extremely delicate, and secondly, the wood upon which it fits being a cylinder, the wood swells with the immersion in hot water, and so fixes. In doing this specimen I broke several before getting two perfect ones. At the top of this part it will be seen there are two more pieces turned to a curve fixed in the same way, and cut out with a drill, which, being used in the same way as before described, forms a kind of star pattern, 12 points in the first, and eight in that piece which fits on to the bottom of the candle.

The chains are composed of separate links, each alternate one being split. This done, those that are split may be either put in the mouth or warm water; they will then open freely without splitting. The quickest way to make a chain of this kind is to hold a piece of ivory in a die-chuck, and bore it up the size required; then turn it into a long cylinder and cut off the rings with a sharp narrow parting-tool.

THE TRANSIT INSTRUMENT.[*]

WHEN the immortal Cap'en Cuttle presented Walter Gay with the celebrated "silver watch, which was so big and so tight in his pocket, that it came out like a bung," he accompanied it by the injunction to "put it back half an hour every morning, and about another quarter towards the afternoon, and it's a watch that'll do you credit." In these days, however, when millions travel daily by railway trains, running in no small proportion of cases, almost with the punctuality of the Sun itself; and when Greenwich Mean Time is automatically flashed daily at 10 a.m. to every Chief Post Office in the Kingdom, the kind of time kept by the watch of the honest old master-mariner must of necessity fail to find acceptance even in the most out-of-the-way Village. Hence, anything which will enable the dweller in country places unerringly to obtain the exact hour, minute, and second at his station (therefore at Greenwich), must possess the greatest practical value, and must be welcomed by all who have a train to catch, a phenomenon to note, or an appointment to keep. To explain, then, the method of deriving the time originally from observations of the heavenly bodies is the object of Mr. Clark's excellent little book, which we should be glad to see in the hands of all country gentlemen—and for the matter of that, town gentlemen too—throughout the kingdom. Our author commences by a description of the (seeming) diurnal rotation of the heavens, and shows how the passage of a star over a wire stretched by a weight, may furnish a means of roughly obtaining the time. He then goes on to describe the Transit Instrument, the method of using it, and its adjustments; shows how it may be brought approximately into the Meridian, gives examples of Transits of the Sun and Stars, whence, the local (and, of course, from the local, the Greenwich) Mean Time is deduced; tells the beginner how to find the meridian altitudes of the Stars he has to observe, and furnishes instruction on counting time by ear, on an ordinary watch, erecting a meridian mark, &c., &c. So far the work is thoroughly apprehensible to, and may be used by, any one familiar with the first two rules of arithmetic. In the second part of his work, Mr. Clark goes into the theory of the subject, explains the difference between Mean and Sidereal Time; shows how to calculate the times of Transits from the Nautical Almanac, and gives in detail the various corrections to be applied to observed Transits to render the resulting observations as rigidly accurate as the size of the observer's instrument will permit. To follow the whole of this intelligently, some rudimentary trigonometry and familiarity with the use of tables of logarithms will be needed. The work concludes with a copious series of "Transit Tables," which may be described as a large extension of the lists of Greenwich Mean Times of Southing of the Principal Fixed Stars, which conclude our own monthly "Astronomical Notes." The language employed throughout is plain and perspicuous, but the Student will do well to note example 5 on p. 57, as it seems to us that elsewhere it is not always made quite so clear as it might be, that it is really always *local* time that is obtained by a Transit Instrument, from which Greenwich Time is derived by the application of a constant quantity dependent on the Longitude. We have said above how desirable we deem it that the work under review should be widely diffused. Very notably would we commend it to the attention of churchwardens, authorities of town halls, and others having public clocks under their control. As the same time shown by a parish-church clock has more than once been decided to be the legal time, it is imperatively necessary that the indications of such a clock shall be rigidly correct. Mr. Clark expresses an opinion (which we regard as perfectly well founded) that any gardener or coachman might easily be taught the use of such an instrument as he advocates. There is no possible excuse, then, for the horological vagaries to be not infrequently observed in the clocks of country churches. The cost of such a Transit instrument as our author describes would form an absolutely insensible addition to the rates in almost every village in the Kingdom. We are, however, tempted to think that many a squire would cheerfully set up a Transit *impensa sua* for the enduring benefit of his own neighbourhood, when he once learned how cheaply it might be bought and how easily used. And this brings us to say, in conclusion, that an advertisement at the end of Mr. Clark's little book has reference to a form of instrument which the author has induced some manufacturing opticians to make, for about one-fourth of the price that a small Transit now generally costs. It is, however, described as having "a 14″ telescope and 1⅛″ aperture." Turning back now to p. 30 of the work before us, we find it correctly stated in a foot-note that "minutes and seconds of arc are written thus 1′ 15″." What sort of an affair a telescope of 14 seconds of arc focus, and one second and an eighth of arc aperture can be, we rather fail to see. We should have imagined that such dimensions would have been dependent upon the linear ones of the telescope and its distance from the eye. If, though, the sign ″ is meant for inches, we must protest against a practical astronomer, such as Mr. Clark obviously is, so misusing a symbol, which has a perfectly definite and universally accepted signification. The best thing for the reader to do, however, is to buy the book forthwith, and correct this slip with his pen.

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[*] A Treatise on the Transit Instrument, as Applied to the Determination of Time, for the use of Country Gentlemen. By LATIMER CLARK, M.I.C.E. London, 1882.

THE ACHROMATIC OBJECT-GLASS.—VII.

By W. Bradbury.

(*Continued from page* 441.)

PROBABLY no one has since possessed so comprehensive a knowledge of the theory of the object-glass as Sir John Herschel. His results represent the accumulated study of the greatest theorists on the matter; and however unsuitable for practice some of the numbers may seem, undoubtedly they are as nearly correct as it is possible for such to be. I regret my inability to give a more systematic account of the analysis upon which they are founded. Herschel's work is subject to the same shortcomings as all purely mathematical research must be—viz., that theory is only of use in so far as it can furnish a guide for practical work. However exact a rule may be, mechanical conditions may not permit it to be worked upon.

Leaving the investigations of Herschel, I come to those of Barlow.

It will be remembered that in speaking of Martin's work with lens combinations, it was said that no rule existed by which the particular aberration of a lens could be computed. Also, one formula only was known for finding the general aberration of a lens of any kind of glass. Barlow set himself to work to remove these difficulties and deficiencies.

Taking the mathematical expression, which had then been deduced, showing the approximate error in refraction by a spherical surface, he formulated an equation giving the aberration of a lens for any condition of the incident rays. This was, essentially, all that was requisite for determining what kind of lenses would, when united, destroy each other's errors. For if the rays traversing the second lens were united in a point, the error introduced by passing through the first must be counterbalanced by the second. Or, in other words, the aberration of the second lens for diverging rays must be equal to that of the first for parallel rays.

Introducing the condition of parallelism, Barlow confirmed the accuracy of Huyghen's rule, and also found the true value of the equation for any description of glass. The coefficients depended on the refraction only, and when it was 1·5, they were the simple numbers previously given. I append several values for common indices in crown glass. Denoting the co-efficients by letters, the equation stands thus—let us call its value p, then:

$$p = \frac{A \, . \, q^2 + B \, . \, q + C}{(q+1)^2}$$

If this equation be solved, we find the value of q to be:—

$$q = \frac{P - \frac{B}{2} \pm \sqrt{\left(p - \frac{B}{2}\right)^2 + (p - C)(A - p)}}{A - p}$$

$$\text{or } q = \frac{p - \frac{B}{2} \pm \sqrt{p\,(A - B + C) - AC + \frac{B^2}{4}}}{(A - p)}$$

The value of the co-efficients are:—

Index.	A	B	C
1· 5	4· 5	1·	1·166
1·51	4·47	1·06	1·146
1·52	4·44	1·12	1·127
1·53	4·41	1·16	1·110
1·54	4· 4	1·23	1·093

The quantity p is the coefficient of parallel aberration, whose real value, as before found, is $p \times T$, or its equivalent $p \times y^2 / 2\,(\mu - 1)\,F$. A useful table may be formed, by taking various equidistant numbers for the value of p; and then by the second of the above equations, finding the corresponding values of q for the four or five crown indices.

Aberration Table for Parallel Rays.

Value of p.	Ratio of surfaces or values of q for different indices.			
	1·50	1·51	1·52	1·53
1·05	—	—	—	·150
1·10	·292	·291	·296	·303
1·15	·380	·374	·377	·380
1·20	·445	·445	·446	·447
1·25	·515	·510	·506	·509
1·30	·572	·570	·568	·567
1·35	·635	·627	·625	·626
1·40	·689	·686	·683	·683
1·45	·750	·743	·740	·740
1·50	·803	·800	·798	·798
1·55	·865	·858	·855	·855
1·60	·921	·917	·913	·913
1·65	·979	·975	·973	·972
1·70	1·042	1·037	1·034	1·034
1·75	1·103	1·098	1·096	1·095
1·80	1·166	1·161	1·159	1·159
1·85	1·230	1·226	1·223	1·223
1.90	1·296	1·292	1·289	1·290
1·95	1·360	1·356	1·357	1·359
2·00	1·434	1·431	1·429	1·430
2·05	1·506	1·503	1·503	1·504
2·10	1·581	1·578	1·579	1·590
2·15	1·658	1·657	1·658	1·659
2·20	1·738	1·738	1·738	1·742

This table may be continued to any desired length, but probably the numbers here given will be sufficient for all forms likely to occur in Barlow's combinations. The higher numbers are for convex lenses having a much flatter outer curve, such as is used in Herschel's plan. By this table we can select a suitable ratio for the crown radii, when the aberration of the flint is known; but it will serve also as a general aberration table; for by multiplying the number in the first column by the thickness of the lens, we get its actual aberration.

In computing the error of the second lens, Barlow was not able to obtain an equation so simple and convenient as the previous one. Even with the artifices for reduction, it is tedious and intricate, and does not appear capable of being expressed in a simple form. When multiplied by the factor 2 F (μ − 1) of the convex lens, the quantity p', or the spherical error of the flint lens for diverging rays, is given by the following equation:—

$$\left\{ \left(\frac{C + q'}{C\,(\mu' - 1) - q'}\right)^2 \times \frac{C + q'\,(\mu' + 1)}{C\,(c\,(\mu' - 1) + \mu')^2} + \left(\frac{c + 1}{b\,c + 1}\right)^2 \times \frac{q'\,(c + 2 - b)}{c} \right\} \left\{ \frac{\delta\,(\mu - 1)}{q' + 1} \right\} = p'$$

The quantities b, C and c are introduced to simplify the calculations. Their values are $\delta = (\mu' - 1) / \mu'$; ($\mu'$ being the refractive index of flint lens): $C = \delta \, . \, q' \, . \, / \, (1 - \delta)\,(\mu' - 1)\,(1 + q')$: $c = \delta \, . \, q' \, . \, / \, b\,(1 + q' - \delta\,q')$. q' is the ratio of the back surface of the flint to its inner one.

The value of p' so found, must be looked for in the first column of the preceding table; and the corresponding value of q in its proper column may be determined by simple proportion.

In calculating the curves of a combination by these rules, it is always necessary to assume a ratio for the curves of the flint lens, and thus find the value of p'. They are not adapted to the inverse process of assuming the curves of the crown lens. The general nature of the operations may be thus indicated:—

1. From the given dispersive ratio, ascertain the crown and flint foci required to satisfy the compound focus.
2. Assume a value for q' the ratio of the flint surfaces, and from the focus and refractive power, find the curves requisite.
3. Determine the values of C, c and b, and thus obtain p', the flint aberration.
4. By reference to the table, or by substitution of p in the proper equation, find the corresponding value of q for the crown lens.
5. From q and the crown focus and refractive power the radius of each surface may be determined.

It will be noticed that Barlow's equation for computing the vergent aberration consists of two parts—the first represents the effect due to the incident surface; the second that of the emergent surface. The first part is by far the most complicated, and its value is very small compared with that of the second. Hence, in most cases, it may be neglected, and the value of p', found from the second part alone, will give a slight over-corrective power to the convex lens.

But if this method be used to compute the curves of an Herschellian combination, the whole expression must be taken into account; as, owing to the change in the character of the curve, the omission of the first part would entail serious errors.

For ordinary cases we may draw up a table, which will enable approximately correct results to be found, without much intricate calculation. Using only the second equational part, it may be expressed in terms of curve ratio, dispersive ratio, and refractive index. The intermediate quantities, b and c, are then unnecessary. Also since the values of q in the aberration table do not greatly vary, the mean may be taken as applicable to all the crown indices.

Approximate Rules for Finding the Curves of an Achromatic Object Glass.

Refractive index—crown = μ: – flint = μ'.
Ratio of dispersive powers = δ. Compound focus = ϕ.
Focus of crown lens = $F = \phi\,(1 - \delta)$.
Focus of flint lens = $f = \phi\left(\frac{1-\delta}{\delta}\right) = \frac{F}{\delta}$.

Assumed ratio of flint surfaces:—

$$r_3 : r_1 : 1 : q'$$

Then, inner flint radius $r_3 = f\,(\mu' - 1)\left(\frac{1+q'}{q'}\right)$.

Then, outer flint radius $r_1 = f\,(\mu' - 1)\,(1 + q')$.

Value of flint aberration:—

$$p = \left(\frac{\delta \cdot q'}{(\mu' - 1)\,(q + 1)} + 1\right)^2 \times \left\{1 - \frac{1}{\mu^2}\left(1 - \frac{\delta\, q'}{q' + 1}\right)\right\} \mu - 1).$$

Corresponding value of q:—

p	q	p	q	p	q
1·15	·374	1·45	·739	1·80	1·160
1·20	·446	1·50	·798	1·85	1·220
1.25	·506	1·55	·855	1·90	1·290
1·30	·568	1·60	·913	1·95	1.360
1·35	·625	1·65	·972	2·00	1·430
1·40	·683	1·70	1·030	2·05	1·500
1·43	·716	1·75	1·090	2·10	1·580

Then, front surface crown lens $r_1 = F\,.\,(\mu - 1)\,(q + 1)$.

inner surface crown lens $r_2 = F\,.\,(\mu - 1)\left(\frac{q+1}{q}\right)$.

We will illustrate the use of this table by finding the radii of an objective, made of the same glasses as used in illustration of Herschel's rules.

There are:—

Hard crown .... Index 1·51
Dense flint .... „ 1·62
Dispersive ratio = 0·6

Then, taking the standard focal length of 1,000in. = ϕ, we have:—

Focus crown = 1,000 × 0·4 = 400.
Focus flint = 400 ÷ 0·6 = 666·66.

Next, assume that the ratio of the flint surfaces is 10 = q';

Then—r_3 = 666·6 × ·62 × 1·1 = 454·66.
r_1 = 454·66 × 10 = 4546.6.

Substituting the requisite values in the equation of aberration, we find p = 1·487 and corresponding value of q = ·787.

Then—r_1 = 400 × ·51 × 1·787 = 364·5.
r_2 = 364·5 ÷ ·787 = 463·1.

Therefore, the radii giving a focal length of 1000in. are:—

Crown } 364·5 Flint } 454·6
lens } 463·1 lens } 4546·

Dividing by 20, we obtain those for 50 inches focus:—

Crown } 18·23 Flint } 22·73
lens } 23·16 lens } 227·3

Barlow gives several examples of the use of his formula.

No. 1.—Crown index, 1·515. Flint index, 1·6·

FIG. 1

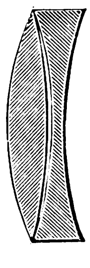


FIG. 2

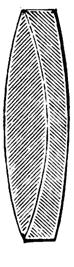


FIG. 3

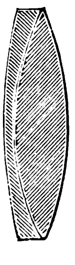


FIG. 4

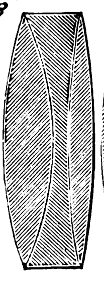
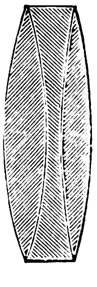


FIG. 5



Dispersive ratio, 0·66. Object-glass, 5½in. Aperture focus, 80in.

Computed curves:—

Crown } 28·9 Flint } 27·19
lens } 27·2 lens } 271·9

Actual curves used:—

Crown } 28·4 Flint } 26·4
lens } 26·4 lens } 264·
Comp. focus = 77·9.

Spherical error perfectly balanced, although crown aberration = 1·738 instead of 1·730. Achromatism perfect, although δ = ·664 instead of ·66. Crown reversed—achromatism not altered, but spherical error not so well balanced: being 1·62 instead of 1·73.

No. 2.—An under-correct combination.

Crown } 30 Flint } 26·4
lens } 26·4 lens } 264.

These answer to value of δ = ·681. Blue colour at the focus too strong to allow any judgment on the spherical error.

No. 3.—An over-correct combination.

Crown } 26·4 Flint } 28·4
lens } 30· lens } 264

These answer to value of δ = ·638. Yellow colour at the focus preponderates.

No. 4.—Crown index, 1·515. Guinand's flint lens index, 1·63. Dispersive ratio, ·545. O.G. aperture, 5½. Focus, 77.

Computed crown curves, 31·57; 41·93. Flint, plano-concave.

Actual curves:—

Crown } 32·5 Flint } 40·4
lens } 40·4 lens } —

Corrections satisfactory in every respect.

No. 5.—Crown index, 1·515. Flint, 1·613. Dispersive ratio, ·637.

Computed radii of crown, 12·32 and 27·3.

Actual curves:—

Crown } 12·3 Flint } 22·2
lens } 27·7 lens } 56·4

Colour and spherical aberration both perfectly corrected.

No. 6.—An object-glass made on Herschel's plan:—

Crown index, 1·515. Flint, 1·587. Dispersive ratio, ·6775. Compound focus, 29·5.

Radii computed from Herschel's formula:—

Convex 19·91 } Concave – 6·66
lens 6·50 } lens + 34·49

Using Barlow's method to match the flint curves, those of the crown come out, 19·913 and 6·499.

To alter these so as to remove the central contact curves, the actual radii used were:—

Convex 19·0 } Flint – 6·58
lens 6·61 } lens + 32·5

These gave a very satisfactory result.

(*To be continued.*)

THE VARIATIONS OF GRAVITY.

THE idea has long since been expressed that it might be possible to measure the variations of gravity at different points of the globe by the height of the column of mercury which balances the pressure of a given mass of gas at constant temperature. M. Mascart has recently tried to carry out this method, and experience shows that it is susceptible of the greatest precision.

The apparatus (described in a note to the Paris Academy) consists of a sort of siphon-barometer, the short branch of which is closed, and contains a certain quantity of gas. To avoid oxidation of the mercury, and consequent loss of pressure, the author used carbonic acid; this gas was introduced at a pressure sufficient to balance a column of mercury of 1 metre when the tube was held vertical.

The chief difficulties encountered in the experiment consist in the determination of the temperature and in measurement of the level of the mercury by means of a divided scale. The instrument was placed in a metallic cylinder full of water, which was kept in agitation by an air-current from a syringe-bulb of caoutchouc. With a thermometer divided into 1-50th of a degree, the temperature could be estimated, at least in relative values, to less than 1-100 of a degree. The divided scale was fastened on the barometric tube itself; it was seen by reflection on a gilt surface which sent the virtual image into the axis of the tube, and the mercury was observed through the layer of gold, as in the prisms of M. Govi. One may thus, with a single microscope, observe at the same time the level of the mercury, and the corresponding division of the scale—all error of parallax being so eliminated. The scale was divided into tenths of a millimetre. When the illumination is properly managed with reflectors it is very easy to estimate the hundredth of a millimetre.

To submit the method to a decisive test, M. Mascart determined, by a series of observations at the College of France, the empirical relation between the apparent heights of mercury and the temperature. Then he carried the instrument to Plessis Piquet, to a tent at an altitude of about 180m. (600ft.); it was then brought back to the laboratory of the College. The mean difference of the readings was 0·027mm. Calculation shows, indeed, that between these two stations, with a difference of altitude not reaching 150m., the change of height in the mercury should be about 2-100th to 3-100th of a mm., i.e., a gravity hardly superior to the limit of exactness the experiment admits. No doubt, the instrument is somewhat inconvenient to transport, for it is necessary to avoid entrance of gas into the barometric chamber, but it is believed this difficulty is not insurmountable.

As regards sensibility, the method appears to be not inferior to the most careful observation of oscillations of pendulum. If the height of the mercury column be determined to nearly 1-100th millimetre (which the author believes realisable), the corresponding variation of the length of the pendulum would be also 1-100th mm., which would produce a change less than half a second per day, or 1-50th second during one hour. This is a degree of precision rarely attained in pendulum observations.

On the occasion of this communication from M. Mascart, M. Boussingault stated that during a stay in Ecuador he had attempted, by a somewhat similar method, to find whether, in the same locality, gravity did not undergo variations analogous to those of magnetism, observed first by de Chauvalon and confirmed by Hansteen.

In a spherical vessel of thick glass, having a capacity of 8 litres, was placed a barometer inserted in a small cup full of mercury. The graduated tube carried a runner with vernier, enabling one to appreciate a length of 1-20th mm. The glass vessel, having been filled with dry air, was closed. The upper part of the tube projecting out of the vessel was about 0·40m.

(16in.) The dry air was submitted to a pressure of about 640mm. The observations were made near the mines of Marmato (altitude 1,000m.).

The capital point in this research was to place the apparatus where the temperature would remain invariable. In the equinoctial region, the zone of invariable temperature is at less than 40in. depth. For greater security, the instrument was placed in the gallery of an abandoned silver-mine (the *Sachafruto*). A few days after, when equlibrium of temperature was thought to be established between the apparatus and the soil, observations were commenced. The air of the gallery was constantly 20·5° C.

The height of the barometric column did not vary. It was concluded that there had not been any perceptible change in the intensity of gravity during these experiments.

GIRDWOOD'S IMPROVEMENTS IN ENGINE-GOVERNORS.

In the well-known Allen governor (which was illustrated and described on p. 373, Vol. XV.) the inventor, Mr. R. K. Huntoon, made use of the resistance offered to the passage of the blades of a fan by oil contained in a small drum to regulate the speed of the engine. A novel departure on this principle has been recently patented by Mr. W. W. Girdwood, of Lea Cottages, Poplar, E., which will be sufficiently explained by the following description, and the accompanying engravings. Theoretically, governors of the type in which the containing vessel or the fan are made to revolve are not perfect; but Mr. Girdwood claims that he has succeeded in extruding inertia, centrifugal force, and impact from his governor. His invention consists of a hollow wheel containing liquid, which is mounted upon suitable bearings and has one of its journals extending through one of its bearings, to which journal is attached a disc having a pin fitted at right angles and eccentrically to it. A driving pulley is mounted upon suitable bearings, and in the same axial line as the hollow wheel. One of the journals of the driving pulley extends through its bearing nearest the hollow wheel, and has a disc attached to it. A spindle passes through the centre of the driving pulley and is free to move in any circular direction, and upon its extremity nearest the hollow wheel a small pinion is fixed; this small pinion and spindle must be imagined to remain stationary until an acceleration in the speed of the engine to be controlled occurs, when it has a slight rotary motion given to it. Upon the disc of the pulley is fitted a pin at right angles, and eccentrically to it and to the pin is attached the central portion of a volute spring, which is wound to a certain tension and is then enveloped with a metallic drum, which is capable of rotation upon its own axis. The circumference of this drum assumes the form of a cog wheel, which gears into and rotates round the central small pinion and spindle passing through the driving pulley. The crank disc of the hollow wheel is next attached to the periphery of the drum, either by a flexible chain, steel tape, or solid connecting rod. The pin upon which the spring drum is fixed passes through the disc of the driving pulley, and is connected to a ratchet and pawl arrangement for increasing the tension of the spring when the apparatus is at rest. If the driving pulley, which is driven by the engine to be controlled, be now put in motion, so long as that motion is uniform and steady, the spring drum with its cog-wheel will describe its orbit round the central small pinion and spindle without affecting it in any degree whatever, but should the pulley receive increments of speed, they are not transmitted directly to the hollow wheel, but impart, first, an epicycloidal motion to the spring drum and its cog-wheel, which in its turn rotates the central small pinion and spindle. Upon the other extremity of this central spindle is fixed a lever, from the angular motion of which action is obtained for either opening or closing the steam valve of the engine to be controlled. The angular motion of this lever is opposed by a spiral spring, which is capable of delicate adjustment. When the speed of the driving pulley increases, the epicycloidal movement of the spring drum causes a further convolution of the contained spring; but when the speed decreases an evolution of the spring occurs, and hence a reverse movement in the lever of the central spindle results, which is further assisted by the spiral spring. The hollow wheel containing liquid must be very light, and weight must be annihilated as far as possible. If the wheel is composed of iron, brass, or wood, it should contain oil or water; but if of glass, mercury. The weight of liquid should exceed that of the wheel and shaft, the object being to entirely obliterate any momentum that might be stored up in the revolving wheel. The level of the liquid must always be below the centre of the wheel, and the summit of the wave-line formed by its motion must not pass the centre line. In some cases the patentee puts a float inside the wheel, covering as near as possible the surface of the liquid in order to preserve its quiescence; above all, the wheel must not be full of liquid, because in that case the liquid would assume a circular motion by the rotation of the wheel, and its presence there would become nugatory as a means of offering resistance to the motion of the wheel. By using a light wheel in which the weight of liquid predominates, motion is weighed, and at various speeds the wheel offers various resistances, and it is the refusal of the hollow wheel to receive increments of speed that causes the epicycloidal movement of the spring drum.

In the drawings, Fig. 1 is a sectional longitudinal elevation, showing A, the hollow wheel; B, the driving pulley; C, the central spindle; the lever L being in connection with the steam valve and spiral spring, which is enveloped with a graduated scale for registering the pressure; D is the pinion fixed upon the extremity of shaft C, near the wheel; E is the spring drum with its cog-wheel gearing into D, and capable of rotating round it; F is the ratchet and pawl arrangement on the one side of the driving pulley's disc, with the volute spring fixed upon the ratchet spindle on the other side of the disc. The spring drum E is shown connected by a steel tape G to the crank disc H on the one extremity of the journal K, which is the shaft of the hollow wheel; L is the liquid, with the float M shown in section. Fig. 2 is transverse view of driving pulley's disc, showing ratchet and pawl arrangement for increasing the tension of the spring when the apparatus is at rest; the central portion of the volute spring is attached to the ratchet spindle upon the other side of the disc. Fig. 3 shows transverse view of the other side of the disc; E is the spring drum gearing into the pinion D of the central spindle C; G is the steel tape connecting the spring drum and crank disc H of the hollow wheel; the volute spring is represented by a number of concentric circles, and is attached to the ratchet spindle F. Now, immediately there is any attempt of the driving pulley, and hence of the spring drum, to travel faster than the hollow wheel, the distance between H and E would increase, causing E to revolve slightly, thus giving to the pinion D a rotary motion, also an angular motion to the lever L, acting on the parts operating the steam valve.

FIG. 1

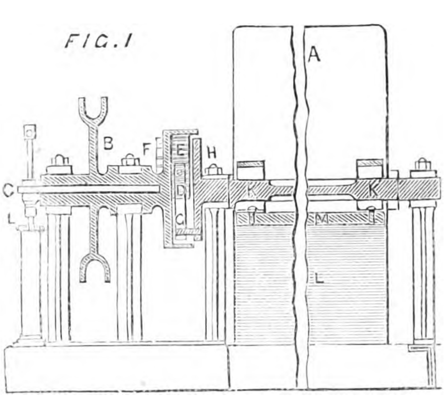


FIG 3

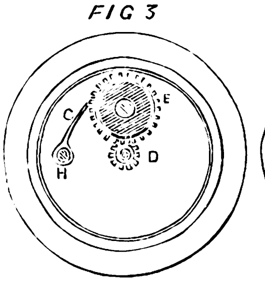
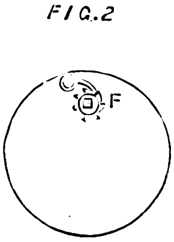


FIG. 2



THE ARCTIC METEOROLOGICAL OBSERVATIONS.

By the time these lines come before our readers, the observing parties sent out to the Arctic regions will have commenced operations, and have begun that long list of observations which is to cover a period of twelve months' sojourn in the icy North. We need not recapitulate the story of the inception and gradual progress of the scheme; it must suffice to say that it originated with the late Lieut. Weyprecht, and took form in the shape of his programme presented to the International Meteorological Congress, held in Rome in 1879. Since then the scheme has been gradually growing, until we have arrived at the time when the observers are actually at their appointed stations, or on the road to them. The idea is to have a number of stations around the pole within or near the Arctic circle, at which observations are to be made throughout the year, commencing as nearly as possible on August 1, and ending as near as possible with the close of the following August, thus giving a period of thirteen months to those who are ready in time, and happen to be located at situations where there will be no haste in breaking up the establishment. With some such map of the Arctic regions as that given in No. 533, it will be easy to plot down the respective stations, and it will be then seen that one side of the meridian of 90° is occupied by only three expeditions, the other nine being, comparatively speaking, close together on what may be called the Greenwich side of the meridian of 90°. On that side, however, exploration has advanced further, and the places selected are better known and more easily reached than a corresponding number on the other side of that meridian could possibly be. As it is, the United States occupy Cape Barrow on the north coast of Alaska; the Russians are at the mouth of the Lena; and the English observatory is at Fort Rae, the latitude of which is only about 63°. The Germans are located at Cumberland Sound, about 66°, and the Danes at Godthaab, about 64°—the three last being outside the Arctic circle. The most northerly position is taken by the United States, who occupy Lady Franklin Bay, 81° 20' lat., 64° 58' W. long., in addition to Cape Barrow, which is between 71° and 72°. The Russians occupy the Lena mouth, 73°, and Karmakulé Bay, Novaya Zemlya, 72° 30', in addition to the station in Finland, at Sodankylä, 67° 24'. The Swedes occupy a position in one of the bays of Spitzbergen, in lat. 79° 53', long. 16° E; the Austrians will occupy Jan Mayen Island, 70° 58'; while the Dutch are located at the mouth of the Jenisei, in Dickson Harbour, 73° 30'. In addition, the Norwegians have an observatory at Bossekop, in 69° 56'. It will be seen that the majority of these places are readily accessible in the season—some, in fact, all the year round; but, although the Lady Franklin Bay party will be furthest away, it will be remembered that they have a supply of coal in the seams found by the *Discovery*; indeed, it is not unlikely that far north as it is, the station will become a permanent one, especially as during the season there seems to be little difficulty in reaching it. Cape Barrow is the most desolate post, speaking comparatively, and that too, is occupied by the Americans, who have thus a station at the two northern corners of their "continent." For the purpose of comparison certain days are indicated as term-days, on which all stations must make their magnetical observations at fixed intervals regulated by Göttingen mean time. That is, the readings are to be made every five minutes, and always at the exact minute, taking them in the following order:—Horizontal intensity, declination, vertical intensity. During one whole hour on term-days, observations are to be made of the declination every 20 seconds. On other than term-days, the magnetical observations will be made at the pleasure of those appointed for the duty, and each expedition will make the hourly meteorological observations according to any standard of time chosen. These latter observations will consist of careful notes of the temperature of the air, and also of the sea, where possible. Pressure of atmosphere must be specially observed, the barometer used being compared every week with the standard instrument. For humidity the psychrometer and the hair hygrometer will be used, but at low temperatures they will be frequently compared with other instruments for direct observations. For wind, Robinson's anemometer will be used, the direction being given for every 16 points, and according to true bearings. Clouds, weather, rainfall, &c., will be noted in the usual manner. The observations on terrestrial magnetism depend for much of their value on being made synchronously; and special attention will be taken of this branch, as also of auroral phenomena, on term days. Three classes of observations are expected to be made by each expedition, and the summaries are to be sent to the International Polar Commission, who will publish them as speedily as possible. Besides the observations specified in the programme as essential, there are many "optional" observations, as they are termed, which will, no doubt, be made as often as possible by some members of the expeditions, during certain seasons, at least, so that when happily the observers return to the more habitable parts of the earth, we may expect to receive from them information as to the physics of the Arctic regions which will, if followed up in future years, be of considerable value. It should be mentioned that the French will have a station in the South at Cape Horn, while Germany will observe at South Georgia, both about 55° S. lat. The Italian Antarctic Expedition is also expected to return with valuable data connected with the physics of the icy South, and as similar observations will be carried on in connection with the Arctic expeditions at a number of observatories in different parts of the globe, it is possible that at least our knowledge of terrestrial magnetism will be much enlarged.

RECENT IMPROVEMENTS IN VOLTAIC AND STORAGE BATTERIES.

THE recent development of electric lighting has apparently given an impulse to the invention of improvements in, or modifications of, voltaic batteries, some of which are undoubtedly of value; but, for obvious reasons, the attention of inventors seems mainly directed to the construction of storage cells. If we may judge from the claims put forward by the patentee, Mr. Ross, of Camberwell, a battery recently devised by him is better suited to working the electric light than the Bunsen or Grove, for it occupies but little space, is very economical, and at the same time is of great power and permanency. It is a carbon-zinc battery, composed of broken coke, graphite, charcoal or other varieties of carbon, either platinised or not, in the carbon cell, and small lumps of amalgamated zinc in the zinc cell, by which means the patentee is able to expose a larger amount of the surface of the elements to the chemical action of the fluids in which they are immersed, and give a larger amount of conducting power to the negative element. The zinc is prepared in a comminuted form by pouring it, when in a molten condition, into water, and afterwards amalgamating it. As regards the liquids in which the zinc and carbon elements are immersed, the patentee has found that it is advisable to modify the ordinary practice, and has proved by numerous experiments that some of the best known galvanic batteries, such as the Bunsen, Grove, Daniell and others, would neither be economical nor convenient for the purpose of domestic lighting, because they occasion a large consumption of zinc, and also because there are objections to the use in the carbon cell of nitric acid, as it gives off offensive vapours. With the view of obviating these objections he has obtained very advantageous results by putting in the carbon cell hydrochloric acid, either pure or diluted, with about one-fifth of its volume of water; but its action must be strengthened by the addition of a small quantity, usually not more than from 5 to 10 per cent., of some powerful oxidising agent such as nitrous or nitric acid, aqua regia, chlorate or permanganate of potash or others containing two or more atoms of oxygen.

In the zinc cell he uses sulphuric or hydrochloric acid diluted in the ordinary way, according to their strength, with from eight to twenty parts, or thereabouts, of water to one of acid; but when using hydrochloric acid in the carbon cell, he finds it advantageous to dissolve in the acidulated water of the zinc cell chlorides or sulphates of iron, soda, potash, or magnesia, using by preference, but not necessarily, saturated solutions of these salts.

Amongst recent improvements in storage or secondary batteries we note as containing a novel feature the invention of Mr. D. G. Fitz-Gerald, of Brixton (No. 5481, 1881) in which carbon is employed in conjunction with lead or compounds of lead. The carbon is in the form of fragments, which should be in direct contact with each other at one or more points, whilst the insterstices between the fragments are filled with lead in a state of division, or with an oxide of lead, such as red-lead or plumbic peroxide, or with an insoluble salt of lead, such as the sulphate. The carbon fragments may with advantage be in the first place impregnated or coated with lead by immersing them in a solution of a salt of that metal such as the acetate, and subsequently reducing the metal either by heating the prepared fragments without access of air or by electrolysis, the prepared fragments being in the latter case made the cathode in a suitable electrolyte—preferably a solution of the acetate or nitrate of lead with which a plate of lead is used as anode. In the construction of a cell or couple with the carbon fragments the latter are divided into two portions, each of which is in contact with a plate of carbon, to which a suitable terminal is attached by the use of a binding-screw or by casting on to the carbon plate a lug or piece of lead in which a connecting or terminal wire is imbedded. The two portions of carbon fragments are prevented from coming into contact by the use of a diaphragm of felt, of porous earthenware, of Paris plaster, or other suitable material.

Mr. Fitz-Gerald prefers to employ boxes or vessels of wood rendered waterproof by immersion in melted paraffin, the interior portions being further coated with a waterproofing substance such as marine glue. These boxes, or containing vessels, have two of their dimensions very large in comparison with the other dimensions, so that when one side of the box is removed the remaining portion has the form of a square tray. A plate or strip of gas carbon of smaller dimensions than the bottom of this tray is laid flat upon the latter, and is made to project through the side of the tray sufficient to establish a contact. A layer of carbon fragments of such thickness as nearly to half fill the tray is then laid upon the bottom, and lead in a state of fine division, or an oxide or insoluble salt of the metal is sifted on to the carbon and shaken down into its interstices, the layer being subsequently subjected to a pressure sufficient to bring the carbon fragments into good conductive contact with each other and with the carbon contact piece. A plate of porous earthenware, a sheet of felt or other suitable material to constitute a diaphragm, is then laid upon the compressed layer, the edges of the diaphragm being preferably cemented to the tray. Or a layer of Paris plaster may be run on to the layer of carbon fragments, the plaster being used in conjunction with the felt, or otherwise. Upon the diaphragm is then placed a second layer of carbon fragments with the interstitial spaces filled with lead or a compound of that metal, exactly as in the previous case. The side of the box constituting a lid or cover to the tray is then applied with sufficient pressure to bring the carbon fragments into conductive contact. To secure a watertight-joint strips of caoutchouc may be employed, and for the purpose of introducing the electrolyte a glass tube may be cemented into the upper portion of the box or containing vessel. The electrolyte may be dilute sulphuric acid in the proportion of one of acid to ten or twelve of water.

Mr. J. W. Swan, of Newcastle, has also patented further improvements in secondary batteries, in which, after corrugating the plates, as described on p. 414, Vol. XXXIV., he exposes them to the combined action of acetic acid, carbonic acid, and atmospheric air, which results in the production of a coat of carbonate of lead. The plates thus treated are paired with other lead plates and subjected to the action of electrolytic hydrogen by making them the cathode in an electric generator. They are then made up as in a Planté cell. This invention is simply the use of white-lead instead of red-lead.

Still another invention which compares curiously with Mr. Fitz-Gerald's, above noticed, is that patented by Messrs. Grant and Jones (No. 5521, 1881). The patentees combine lead or other metal with carbon in the following manner. Flour, starch, or meal is mixed with an oxide of lead into a plastic condition by the aid of syrup. The mixture is moulded into suitable shapes and carbonised, the organic matter being oxidised, and the salt of lead reduced to the metallic state. For some purposes the patentees mix red-lead with flour and syrup, and spread it over sheets of paper, which are then folded into suitable shape and carbonised, a solid lead core being used to form an attachment. This utilisation of flour enables the patentees to prepare moulded blocks of a very porous nature, for they ferment the mixture of lead, salt, and flour with yeast, and carbonise it when it has risen, just as if it were bread. The invention includes the use of plates of carbon covered with dusty or granular lead, which is prepared by adding powdered charcoal to molten lead and stirring the mass until cool.

PROPER MOTIONS OF THE STARS.*

By Prof. R. Grant, M.A. LL.D. F.R.S.

THE spectacle presented by the stellar heavens as viewed by ordinary observers is characterised by two remarable features: the absence of uniformity in the brightness, and the absence of uniformity in the distribution of the stars. Certain of the stars soon came to be recognisable by their superior lustre, and certain groups of stars became familiarly known as so many landmarks in the stellar firmament. The way was thus prepared for an important discovery. It was ascertained respecting a limited number of the stars that their places in the heavens relatively to the general multitude of the stars were continually changing. They consequently received the appellation of planets, or wandering stars, while, on the other hand, the stars in general, in consequence of their always maintaining the same relative position, were denominated *fixed* stars. Ptolemy, in his great work upon the astronomy of the ancients, places the earth in the centre of the universe, and assumes the sun, moon, and planets to be revolving in orbits around it, while beyond all was the sphere of the fixed stars, which revolved with a uniform motion around the earth, effecting a complete revolution once in twenty-four hours. No opinion is expressed respecting the nature of the stars, nor is any allusion made to the possibility of the stars being endued with a proper motion.

When Copernicus propounded the true system of the universe, he made the earth a planet revolving like the other planets round the sun, and he explained the phenomenon of the diurnal revolution of the starry sphere by the revolution of the earth upon a fixed axis in the opposite direction. No opinion was expressed by him respecting the physical nature of the celestial bodies, or their having any probable community with the earth in this respect. Indeed, it could hardly be said that any new light was thrown upon the physics of astronomy by the theory of Corpernicus. As a mathematical exposition of the movements of the celestial bodies it was eminently successful. Indeed, it wanted only the discoveries of Kepler respecting the elliptical movements of the planets to make it perfect in this respect. But it must be acknowledged that in the system propounded by Copernicus the earth was regarded as the body of paramount importance in the universe.

It was the invention of the telescope and its application to the purposes of astronomical observation which first revealed to the human mind the marvellous extent of the physical universe, and suggested the idea that the earth might be a mere atom in comparison with the vastness of the material system beyond. When it was discovered that the planets are round dark bodies like the earth, shining only by the reflected light of the sun, and that they presented apparant diameters of sensible magnitude when viewed through the telescope, no doubt was henceforward entertained that the planets are bodies comparable with the earth in magnitude, and that the earth is merely one of a family of similar bodies, which revolve in orbits of different magnitudes around the sun. It is worthy of remark that Galileo, to whom is due the telescopic discoveries which first disclosed the vast extent of the material universe, has nowhere expressed any opinion respecting the nature of the stars. His mind was probably too much occupied with the more immediate consequences of his discoveries to indulge in speculations leading to more remote conclusions; and a similar remark is generally applicable to his successors in the field of telescopic exploration, who flourished during the seventeenth century. It was reserved for Huyghens to propound the doctrine that the stars are suns. This he did in a work on Cosmical Astronomy, which was published in 1699, shortly after his death. Henceforward the stars have been regarded by astronomers as self-luminous bodies, comparable in magnitude and splendour with the sun.

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* Abstract of lecture delivered at the Royal Institution.

While more correct ideas were being formed respecting the nature of the stars, the method for ascertaining the exact position of an object in the celestrial sphere underwent at the same time a complete revolution. The telescope in its original form was not suited for aiding the observer in fixing the precise position of a star in the heavens, but the subsequent form of the telescope, consisting of a combination of two convex lenses, suggested the admirable invention of telescopic sights, which may be said to constitute the foundation of all exact astronomy. The places of the stars were now determined with a vastly greater degree of precision, and the way was thus prepared for the consideration of the important question whether the epithet *fixed* is strictly applicable to those bodies, or whether they might be rather endued with a movement so extremely slow as to have hitherto eluded detection.

To Halley is due the discovery of the important fact that some of the stars have a proper motion. In 1717 he communicated a paper to the Royal Society, in which he showed that a comparison of the places of Sirius, Arcturus, and Aldebaran, as determined by Hipparchus about the year 130 B.C., with corresponding observations of the same stars made by himself, clearly indicated that during the intermediate interval the stars had sensibly moved southwards with respect to the ecliptic, and he obtained a further confirmation of this result by examining the account of an occultation of Aldebaran by the Moon, observed at Athens in the year 509 A.D.

A few years after Halley announced this important fact, Bradley made his famous discovery of the aberration of light, and its effect upon the apparent place of a star; and subsequently the same astronomer discovered the apparent sidereal movement depending on the nutation of the earth's axis. The astronomer could now ascertain the true place of a star in the heavens with a precision to which the results of previous efforts could offer no comparison, and it seemed probable that ere long the great problem of the proper motions of the stars might be attacked with some hope of success.

To ascertain the proper motion of a star it is necessary to have two well determined places of the star separated from each other by a sufficiently great interval of time. Down to the middle of the last century no such materials may be said to have existed, if we except a few isolated cases, such as those referred to by Halley, for the probable errors in the observed places of a star far exceed in magnitude the minute quantity which was the object of inquiry. To Bradley is due a great work of observational astronomy which has constituted the basis of the more extensive investigations of the present day relating to the proper motions of the stars. This consisted in a series of star observations executed by that astonomer at the Royal Observatory, Greenwich, from 1750 to 1762, but which it was reserved for Bessel, the great German astronomer, to reduce, and finally to publish in the year 1818. A comparison of those star places with the corresponding results obtained at Greenwich Observatory in the present century by Sir George Airy, the late Astronomer Royal, has conducted astronomers to important conclusions respecting the proper motions of the stars. Materials tending to elucidate the same great question have also been derived from the star observations of several other astronomers of the present century.

[The lecturer here exhibited a diagram containing the following illustrations of the proper motions of the stars:—

Star.	Magnitude.	Proper Motion in a Thousand Years. ″
Sirius	1	1360
Procyon	1	1210
Arcturus...	1	2230
α Centauri	1	3710
Capella	1	250
Rigel	1	20
Antares	1	30
Groombridge, 1830 ...	7	7106
61 Cygni	6	5200
O² Eridani	4	4100
Lalande, 27,744... ...	6	1681
Lalande, 30,044... ...	7	1607
Lalande, 30,694... ...	6	1789
Weisse's Bessel XVII.,322	7	1476]

The last four proper motions have been recently detected at the Glasgow Observatory, where a system of star-observing has been prosecuted since the year 1860.

It must strike every one who inspects the foregoing list that the proper motion of a star has no relation whatever to the apparent magnitude of the star. Thus Rigel, one of the most brilliant stars in the heavens, has a proper motion of only 20″ in a thousand years. On the other hand, the star 1830 Groombridge, which has a proper motion of 7106″ in a thousand years, is a star of only the seventh magnitude. The same remark obviously applies to the other stars in the list. And yet one would have thought that the brighter stars, being presumably nearer to us than the fainter stars, would for that reason have a larger proper motion. With respect to α Centauri and 61 Cygni, which we know, from the researches of astronomers on their parallax, to be the two nearest stars, it turns out comformubly to what one might expect, that they have also large proper motions; but what are we to think of 1830 Groombridge, which, although a star of only the seventh magnitude, and one which hardly indicates any sensible parallax, exhibits notwithstanding the largest proper motion of any star in the heavens? These anomalies are doubtless attributable to differences in the absolute magnitude and intrinsic splendour of the stars, and furthermore to the fact that the proper motions as revealed by the telescope are only the motions which are resolved at right angles to the line of sight.

Heretofore the proper motion of a star has been found to take place constantly in the same direction and as the angular amonnt of proper motion is in all cases exceedingly small, the same result will probably continue to manifest itself for ages to come. The mean apparent diameter of the sun amounts to 1944″, consequently Arcturus would require nearly a thousand years to describe, in virtue of his proper motion, an arc of a great circle of the celestrial sphere, equal to the mean apparent diameter of the sun.

HOW ANIMALS BECAME CARNIVOROUS.*

IN the scale of creation plants were developed first; they began as very low forms or may even all have sprung from one low form. As time went on they grew in number and variety. Some slight circumstance was sufficient to cause one to change its character, and it handed down its peculiar character to its offspring. In this way fresh varieties of plants were formed, and now we have an immense number of all sorts. Some are content to carpet the fields like the daisy, whilst others thrive best by shooting up into the air like buttercups, but each one has assumed its present shape by finding that it could so get on best. These changes were not made in a few years, but are the works of centuries, and if anyone could have watched them he could scarcely have been able to tell where a change began, so minute were the differences. After the plants had appeared—or almost at the same time—the lowest forms of animal life appeared and fed on the plants. These low forms of animal life had also to differentiate themselves by some stress of circumstance, and in time new kinds of animals were the result. Some insects were forced by stress of circumstances to feed on each other, they did this for some time; their organs changed in structure, and in time it became right for them to feed on carcases.

We see an everyday example of this in the midge; it sucks the blood of animals if it can get it, if not it feeds on the sweet juices of plants. The leech is also another example, it feeds on vegetable food in the pond in which it lives, but it will live on the blood of an animal if it can get it.

No doubt at one time animals were herbivorous, but some stress of circumstance made them feed on the bodies of one another until they developed certain peculiarities, and hereafter it was right for them to do so, and now they are called carnivorous animals. Let us instance many goats on an island, they increased in number until there were more goats than there was food for them—this is now a recognised law. Some died of starvation or in the fight for food; one was very hungry, and tearing off the skin it eat the flesh of its fallen kin. The flesh appeased its hunger, and when hungry it again returned to the carcase, and thus it went feeding on dead bodies. After a time it began to like flesh, and when it could not get dead bodies, then it killed its kind and fed on them. The offspring of this animal would tend to do the same, and since it has to fight for its living it has to grow new parts. Its teeth must change, its limbs must also change, and the character of its stomach must alter. After a few centuries we find a different animal from the original goat; in fact, we have now a carnivorous animal. From this instance you see how changes may occur. Some one may say that goats could not be taught to eat flesh, but experiment has shown that goats and sheep or any animal can be taught to eat flesh until it refuses its natural grass, hay, or corn.

A change of this nature has been lately seen in New Zealand. In the memory of man the kea or *Nestor notabilis* was a fruit-eating parrot. Sheep were introduced into New Zealand, some of them died, and the kea tearing off the skin eat some of the flesh. It liked it and began to feed on flesh only. Now, as dead sheep were not always to be had it attacked living sheep; killed them and fed on their bodies. The kea is now a carnivorous bird, and in consequence is killed wherever found. Man himself has tried to be carnivorous or partly so. His original dwelling-place was in a hot country where he had fruit all the year round. He increased rapidly, and to find food emigrated to places where fruit was only ripe once a year, so that he could only live on it for about six months. In winter he killed animals for food, and found that by eating their carcases he could live until the summer came round. He found hunting hard work, so he tamed the young of the cow and the sheep, and killed them when he wanted them. This has now gone on for ages, and man has begun to think that a mixed diet suits him best. But for all his carnivorous practices he has not changed his nature yet; his teeth, tongue, stomach, length of intestine, flat nails and perspiring skin all point to his frugivorous character. That such is his nature seems beyond dispute, and that men can live without flesh food is now an everyday experience. There are hundreds of men now living in England who never eat meat from year's end to year's end, and they are as strong as other men and remarkably free from disease. Let readers ponder over this, try and live without meat, and they will soon come to the conclusion that man has no carnivorous traits.

DRYING MOULDS.*

A WELL-DRIED loam or dry sand mould is a very essential point in making a casting that shall be free from scabs. Some irregularity may be admissible in the mixing of the loam or blacking; but it must be thoroughly dried. When the water in a damp mould is heated, it is converted into steam, and steam, when confined, creates pressure. Iron, when poured into a mould, heats up the surface and interior portions, and this heat generates steam if moisture is present, and the mould is very rarely strong enough or close enough to hold the pressure, which increases until it forces an opening through which it can escape. This may be towards the surface away from the iron; but it is more likely to be in a direction towards and through the iron. The outside of a mould is generally encased by an iron flask, or held by a curbing, between which and the brickwork sand is rammed hard and compact, and, with the exception of through a few vent-holes, it is almost impossible for steam to escape in this direction. Towards the face of mould the brickwork is open, or, if it is a dry sand mould, the surface is generally made porous by vent-holes, so that it may be seen why steam will escape through the surface of a mould before it will find its way through the outside. This is the reason why a damp mould will cause a casting to scab.

It may be asked, Why does not a green sand-mould scab, the sand being damp? True, the sand is damp; but there is a certain limit to this dampness, which, if overreached, will cause trouble. The surface of a loam or dry sand-mould is generally hard and close, while that of green sand mould is porous, thereby permitting the steam generated at the surface of the mould to escape through the sand until it is free; but should the green sand be rammed too hard then the steam cannot force its way through, and it will come up through the surface of the mould and pass up through the liquid iron, thereby making a scabby or bad casting. A green sand mould that is rammed too hard, and a loam or dry sand mould that is not dried, have very much the same effect on the casting. Whether a loam mould is dry or wet is very often guessed at. The moulder will say it looks dry, and that as it has been in the oven a long time it must be dry. It is not the length of time a mould has been in the oven nor the looks of its surface that can always be depended on to indicate its quality of dryness. A mould that should be dried in two or three nights is often only half-dried, as the oven may not work well, or there may have been some neglect on the part of the watchman. The fire may have been very hot for a short time, thereby scorching or burning the surface of the mould, while the interior is not half-dry.

There is a great deal to be done in the way of properly managing a fire so as to save fuel and dry a mould as it should be dried. The first fire should be a slow and easy one, so as not to blister or crack the surface of the mould, which is caused by the effects of the steam—quickly raised under the surface—to escape. This steam meeting the resistance of the half-dried blacking, which is very much like a sheet of rubber, stretches and blows it up into little hills, but has not sufficient pressure to burst through and escape. There are many who think that by keeping a slow fire all the time to dry a mould or cores they save fuel. In some cases this may be so, as when a mould has a little body, so that one night's firing will dry it; but when a mould has a large body, after the first easy firing, in my opinion, there will be more fuel saved by keeping a good steady fire than by keeping a slow one. A slow fire will drive the heat in for about 8in., after which the further drying will be very slow. With some moulds or cores this slow firing might be kept up for a week and yet the interior not be dry. Whereas if the fire had been hotter the heat would have been forced into the interior and the steam and dampness expelled with probably two-thirds less fuel. I have seen large cores put into an oven and orders given for a slow fire for fear of burning them, and after there had been fuel enough used to dry two sets of such cores, the boss would get disgusted because they were not dry, and give orders for a very hot fire, at the same time looking at the cores as if to say, "We will see who is to be boss." When the cores came out of the oven in a burnt condition, one could imagine them as saying, "Well, Mr. Boss, if you had used better judgment we would all have been well dried long ago." In the making of large body-moulds, or cores, there should, if possible, be openings made from the centre to the outside to assist the steam in escaping from the interior; and also, when possible, the centre portion should be filled up with coke or cinders as much as can be safely done. The more coke or cinders the less sand and firing will be needed. Plenty of venting in moulds or cores is also a great assistance in drying. It is generally easy to tell when a dry sand mould or core is dry; but with loam moulds it is not so easy. Very few loam moulds are made; but that the following plan could be adopted for determining if they are dry. Let the moulder, when building the bottom part of his mould, make an opening that will allow the inserting of a wet brick, or a lump of wet loam, and on the outside of this let the opening be closed with temporary brickwork and mud. When he thinks his mould is dry, he can pull out the temporary brickwork and see the condition of the inserted brick or lump of loam. If this part of the mould has been placed away from the fire, and this brick or loam, when broken, is dry, he can generally depend on the mould being dry.

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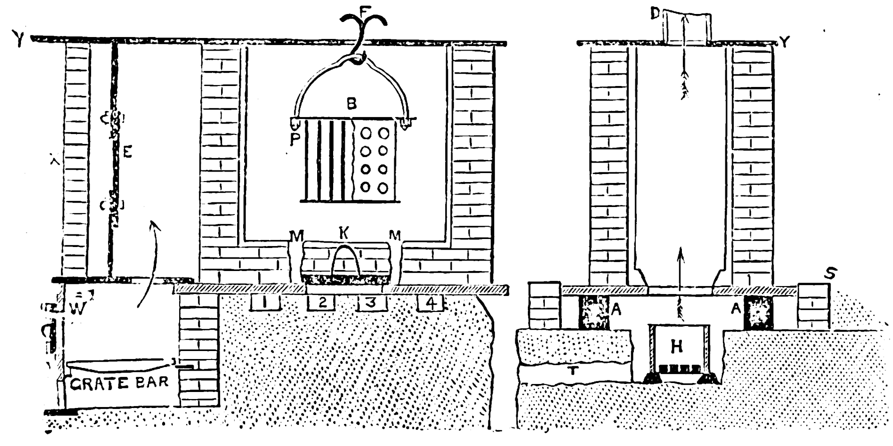
* By T. R. Allinson, L.R.C.P., &c., in the *Field Naturalist*.

* By Thos. D. West, in *American Machinist*.

The cuts shown are for illustrating some of the ways of drying loam moulds, that are too large to be dried in the ovens or too heavy for the crane to lift, making it necessary that they be dried in a pit or on the shop-floor. B is a fire basket, sometimes made in the form of an open grate-frame work all round the sides, as shown at P, and sometimes of boiler-iron, drilled full of holes, as shown. For bottom grate-bars in both styles, wrought-iron rods are generally used. The baskets are made round or square in form, according to the shape of moulds there are to be used in. The width and height will depend upon the dimensions of the mould. There should be at least 18in. of space between the surface of the mould and the fire-basket, to prevent burning the surface of the mould before it gets thoroughly dried. Sometimes, instead of using one large basket, three or four smaller one are used, in order to better distribute the heat.

When the mould has a bottom in it, like the one shown, the baskets are generally hung by having the hook F held up by a crane, or a strong bar. When a mould has no bottom in it, the basket can be let down so as to rest on bottom bearings. For moulds of this class, it is best, when possible, to have them hoisted up so as to have the bottom part of the mould about on a level with the top of the fire-basket, the better to dry the lower part. When the inside of a mould is too small to admit of a fire-basket being placed in it, a temporary fireplace is made adjacent to the bottom of the mould, and the heat made to pass up through the inside of the mould, by having the outer opening or space closed up with brickwork or sand, as shown at S. The fireplace shown at H can be made in the form of a basket, and placed directly under the mould or core. This basket can be pulled out to clean and renew the fire. Or there can be a temporary fireplace, as shown at W, built up outside of the core or mould, and the heat conducted through a channel to get to the inside of the mould. To confine the heat, the moulds are generally covered over with sheet or boiler-iron plates, as shown at Y Y. D is a stove-pipe, to carry off the smoke and create a draught. E is a sheet-iron curbing for retaining the heat. X is a brick wall for the same purpose. Either the wall or the curbing will answer the purpose. The combined fires are only needed when there is over an 8in. wall to be dried, in which case a fire in W, so as to heat up the outside of the mould, is combined with a fire on the inside of the mould, and also channels, as 1, 2, 3, and 4, connected with the fire W, to carry the heat underneath the bottom plate, which should have plenty of holes in it. The two fires thus combined will thoroughly dry a mould. These channels can be formed by using brick, or rough gutters can be made in the sand, either of which, if desired, can be filled up with sand after the mould is dried. The heat could be got under the bottom by having the plate raised on iron blocking, as shown at A A. It is always the bottom portions of such moulds that are the hardest to dry, especially so if the mould is built up in a pit. In such cases, it is a good plan to have, when possible, a large hole cast in the bottom plate, so that when the bottom is being bricked up there will be a part of the mould left open. Then below this opening in the mould let there be a small pit dug with channels T, to the outside of the mould, to admit air to the pit, creating a draft. Then, with a fire-basket lowered down through the mould into the pit, we would have a fire below the bottom of the mould the same as shown at H. After the mould is thoroughly dried by the combination of the fire-baskets H and B, the pit is filled up with sand, and a plate having built upon it bricks or core-sand and previously dried and still hot, is lowered down to fill up the opening, as shown at K. Between the two plates there should be a little soft loam to form a solid bearing. The open space M M, is then filled up with a dry mixture of loam, and should the top surface not be even with the original surface, it is made so by filing off or building on. A thin sheet-iron plate, having on it a charcoal fire, is laid over so as to assist in drying out dampness.



Sometimes when building the bottom of a loam-mould that is very thick, it is best to partially dry the bottom brickwork before the upright portions of the mould are made; which can be done by having the plate raised up and a wood fire underneath and a charcoal fire on top. After this the bottom can be permanently set where wanted. The best kind of fuel to use in the fire-baskets will depend on the draught. Charcoal requires the least air, gas-coke more, and soft and hard coal and coke the most. The moulder must use his own judgment as to the best plan to be adopted for drying any particular mould, as there are hardly two moulds that the same drying arrangements should be used for, but it is hoped that from some of the different plans given there can be found one that will answer his purpose.

ALLOY FOR SILVERING METALS.

A METHOD for silvering, or, more properly, whitening metals, has been recently devised by M. De Villiers. It is a modification of the tinning process, an alloy being used instead of the pure tin. This alloy consists of 80 parts tin, 18 parts lead, and 2 parts silver, or 90 parts tin, 9 parts lead, and 1 part silver. The tin is melted first, and when the bath is of a brilliant white the lead is added in grains, and the mixture stirred with a stick of pine-wood, the partially-melted silver is added, and the mixture stirred again. The fire is then increased for a little while, until the surface of the bath assumes a light yellow colour, when it is thoroughly stirred up and the alloy cast in bars. The operation is then carried out in the following manner:—The article, a knife blade for example, is dipped in a solution of hydrochloric or sulphuric acid, rinsed with clean water, dried and rubbed with a piece of soft leather or dry sponge, and finally exposed to a temperature of 70 deg. or 80 deg. Cent.—158 deg. to 176 deg. Fah.—for five minutes in a muffle, to prepare the iron or steel to receive the alloy, by making the surface porous. If the iron is not very good the holes are large, and frequently flaws and bad places are disclosed, which make the silvering more difficult. With steel the process goes on very regularly. The article, warmed to, say, 140 deg. Fah., is dipped in the bath, melted in a crucible over a gentle fire. The bath must be perfectly fluid, and is stirred with a stick of pine or poplar; the surface of the bath must have a fine white silver colour. For a knife-blade an immersion of one or two minutes is sufficient to cover it; larger articles require five minutes of immersion. After taking it out of the bath it is deeped in cold water, or treated so as to temper it, if necessary. If left too long in cold water it frequently becomes brittle. It is then only necessary to rub it off dry and polish without heating it. Articles treated in this manner look like silver, and ring like it too, and withstand the oxidising action of the air. To protect them from the effect of acid liquids like vinegar, they are dipped in a bath of amalgam, composed of 60 parts mercury, 39 parts of tin, and 1 part of silver: then dipped warm into melted silver, or electro-plated with silver to give them the silvery look. This kind of silvering is said to be very durable, and the cost comparatively small.

RECENT ADVANCES IN PHOTOGRAPHY.—III.*

By Capt. ABNEY, R.E., F.R.S.

THE next spectra are exceedingly interesting, to me at all events, and I should like them to interest you. They represent a new form of molecule. I believe very few people know anything about them. The peculiarities of the mixture were discovered by me, and a paper about them sent to the Royal Society a very short time ago. That molecule is this: it is not a combination between iodide and bromide in the ordinary acceptation of the word, that is to say, it is not $Ag_2 Br_2 + Ag_2 I_2$, or not simply one equivalent of each of bromide and iodide of silver added together, but an absolute combination, $Ag_2 Br I$, or a double molecule, which has been formed, and on which the spectrum has a totally different effect. You will see (No. 7) that, instead of having the maximum intensity at G, its maximum is far into the green, and it has a minimum about G. In the same way another molecule is formed by a combination of molecules of chloride of silver and iodide of silver, and that, too (No. 8), has no maximum about G, but has a minimum there, which is the place where the maximum sensitiveness is found in the ordinary iodide of silver.

I will try and explain how these last curves are produced. If you take iodide and bromide of silver together, and expose them to the spectrum, what happens is this: first of all, iodine and bromine are liberated. What becomes of the iodine and bromine? The bromine immediately attacks the sub-iodide of silver, and forms a new molecule, $Ag_2 Br I$; the bromine undoes the work of the iodide as fast as it is done, so that we have, in the place of maximum intensity of the iodide, the least work done. In the same way with the chloride. The chlorine liberated from the chloride undoes the word which is done by the iodine; the consequence is that, in the place of maximum intensity of the iodide, we have a diminution of intensity in the case of the double salt; in other words, the dry bromo-iodide of silver is less sensitive for the spectrum about the part G than any other part of the spectrum to which it is sensitive. In order to prove that, I tell will you a little experiment which was carried on by myself. Chloride of silver was absolutely blackened in the light, and sub-chloride was formed; then it was treated with iodine again, and it become a buff colour. When this new molecular form was placed in the spectrum, we got exactly the same result as we do here, showing that we have a new molecule of chloro-iodide of silver. I think this will very likely throw a great deal of light upon some of the phenomena which are met with in ordinary dry-plate work.

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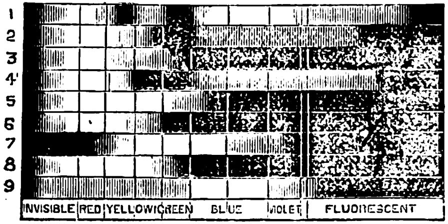
* Condensed from a series of Cantor Lectures delivered before the Society of Arts.

Now I crave your attention to one thing. You may ask if chlorine always undoes the work done on the iodide. The fact is, that it does not, if you have free nitrate of silver present: since this salt is able to take up the iodine and bromine, therefore the bromine cannot act on the sub-iodide of silver; it leaves it there, and you have the impressed spectrum totally different; in fact, the bromide and iodide spectrum are superposed one on the other. There are a great many facts I could show you to prove this. We come to the conclusion then, for sensitiveness, you must have a sensitiser present. In gelatine plates, you must say that gelatine is a sensitiser, but it certainly is a very feeble one; anyhow, if you want to get sensitiveness in a plate you must have a sensitiser present which will mop up, not only iodine, but bromine. When this is the case, bromine cannot go and destroy the work done on the iodide.

Before concluding this part of my lecture, I may also say that I have found that the printed image and the developed image have precisely the same characteristics. Thus, if you get pure iodide of silver, you get the termination of both the printed and developed spectrum close to G. A curious thing with regard to iodide is this: if you have the smallest trace of impurity in it, it is immediately shown in the spectrum by a prolongation below G, and you can go to the chemist and tax him with having given you iodide which is not pure.

Now there is one point that has exercised the minds of a great many photographers, and that is the illumination of their dark rooms; and I hope I may be excused if I go over what may be apparently well-trodden ground, but I believe that there are many here present who have no absolute certainty as to why they are using certain glasses to glaze their developing rooms. I want to show photographers the absolutely safest light they can use in developing their pictures. Here we have a spectrum, and beyond it you see the fluorescent rays. I will ask Mr. Woods to pass through the spectrum one or two glasses. First of all, we will take ruby glass (No. 2), and you will see that when it becomes very bright indeed, there is a certain amount of blue light comes through the glass; I can see a trace of yellow, and a trace of green. Now I will take the yellow glass: here is one which photographers are very fond of, but I dare say you will see that there is a great deal of blue light comes through that. That was the ordinary glass used for photographic dark rooms within the last half-dozen years, and people were perfectly content if they glazed their rooms with it. But there are yellows and yellows, and I will show you the difference between two. Now we will have a magenta (No. 4), which you see cuts off a great deal more light. The next (No. 6) is a stained red glass, which cuts off the green, too. Now, there is one combination which I wish to show you, because people often complain that their photographic studios are not safe as to light, and that they use ruby glass and get foggy plates. I have great doubt about fogging bromide plates with proper red glass, where ordinary precautions are taken, though not with the ruby glass which lets blue light through. If people would only use the spectroscope with a strong light, they would very soon see where their glazing is at fault. Now, I will throw on the screen the light through a piece of blue glass (No. 1), and I think you will see that there are bands in the red and yellow: there is plenty of blue coming through and some green. If photographers want to be absolutely safe, let them glaze their studios with cobalt glass and stained red, and they will get nothing but the light of that particular refrangibility which I will warrant is totally unable to affect any gelatine plate—of the ordinary type, at all events. You may glaze and glaze with ruby, but you will never get rid of blue light entirely. Of course it diminishes with every thickness you take. If you want to use ordinary plates, which are not so sensitive that you cannot look at them, my advice is to use a combination of stained red (No. 6) and ruby glass (No. 2), which will give you a comfortable light to work in, for it cuts off the blue, and leaves the red in a brilliant patch. Those that are using that combination ought to have nothing to fear; but if they still fear, let them use a combination of cobalt (No. 1) glass and stained red glass (No. 6), and then they will only get the colour of that narrow strip of light which you saw just now. I should like to show you the green glass in the spectrum (No. 7), that you may judge what kind of light gets into it. It was at one time seriously recommended as an admirable thing for not trying the eyes, and for being safe to use in the developing room. A combination of red and green is a fairly safe light for iodide plates or ordinary plates, but not for gelatine plates, which are extremely sensitive. Next we come to a series of pretty colours, which may be very useful to us. Here is the spectrum of magenta (No. 4); the yellow is cut out entirely, and the green, leaving the blue, violet, and orange. Now I will try aurine (No. 8) and chrysoidine (No. 3). Here you see the blue is gone entirely. Some have said that the ultra-violet rays go through aurine, but I will leave it to you to say whether they do or not. There is no trace here of the ultra-violet rays when I apply this card with the sulphate of quinine on it. They should appear if there were any. We have next a combination of magenta and aurine, which is a perfect red light, and is very good indeed for the photographic studio. I think I may say, without a breach of confidence, that I believe a certain "ruby medium" in the market is made according to the directions that I gave some time ago. You may ring the changes of combinations of these glasses; you may have scarlet and aurine, or mageta and aurine, and either one or the other will give you this red band only. If all other means fail, the photographer may use the ferrous oxalate developer. You will see that it cuts off the blue light at all events. I should not at all mind developing a plate in such a light as that. In fact, you may bring the most sensitive plate out into a white light, when developing in a dish, with a covering of ferrous oxalate over it.

FIG. 6

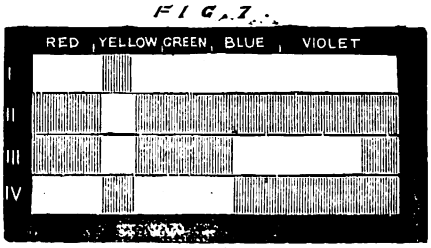


1. Cobalt glass.
2. Ruby glass.
3. Chrysoidine.
4. Magenta.
5. Flashed orange.
6. Stained red glass.
7. Bottle green.
8. Aurine.
9. Quinine.

In 1874 we had a most astonishing discovery made, and that was, that by dyeing a film of sensitive collodion you were able to get an increased action by the spectrum. In common with others I took up that subject and investigated it, and I wish to draw your attention very briefly to it to-night, because I think it is one of the advances made in photography which ought not to be passed over. If you take one of these aniline dyes, such as a blue dye, and expose it to light behind a piece of black paper, with an aperture in it, such as I have here, you get an image on the dye, such as you see. What is the meaning of that? The meaning is that the dye is oxidised, for if you apply an oxidising agent you get the same result. Dr. Vogel found that if you dyed plates with some of these fugitive dyes—they were all fugitive to a great extent which he used—he was able to obtain an extension of the impressed spectrum exactly in those parts in which the dyes were absorbed, and he introduced the term optical sensitiser to describe the fact. Now, I am going to quarrel with that expression, because he explains it in this way; he says, in effect, that the sensitive aniline dye is able to take up a vibration, and to direct it to something else; in other words, that when light has done all it can in endeavouring to bleach a dye, that its period is transformed, and it does something else on the silver salt which is in contact with it. Well, that is not a philosophical way of looking at things, because if you could only arrive at that principle, you might just as easily arrive at the principle of perpetual motion, which is a thing which I am not prepared to admit. Now, I honestly say, that for a long time these experiments staggered me, and the arguments Dr. Vogel brought forward seemed fully to justify his term of optical sensitiser, as applied to the dye-stuff; but eventually I was able to come to a different conclusion, and that conclusion I wish to put before you. If you have a substance which is oxidised in the presence of a haloid salt of silver, what do you expect? You expect that the haloid salt of silver would be reduced. If you place pyrogallic acid in contact with the haloid salt of silver, and help it to be oxidised by ammonia, you expect that the haloid salt of silver will be reduced, and I lay the action of the dye to precisely the same principle as the pyrogallic acid, which helps to develop the image; in other words, the oxidation of the dye causes a reduction of the bromide of silver, or iodide of silver, as the case may be, and simply provides a nucleus on which development can take place. I wish, however, to point out that Dr. Vogel has an objection to my explanation. He says, "Oh, but you require time to bleach things; you require time to alter them." So you do; you require time to blacken the chloride of silver; nevertheless, the slightest exposure to light begins the change in it, and so the slightest exposure to light begins the change in the dye, and on this principle, of course, the action of dyes upon sensitive films can readily be explained.

I have got behind the screen three pieces of sensitive bromide paper, one dyed with a blue dye, another with eosine, the third, pure bromide of silver, without anything. I propose to develop those on the screen. I must give this a rather longer exposure than last time, because blue dye takes away the sensitiveness to a material extent. You can see the colour—it is somewhat of a lavender grey, which no doubt will show that it absorbs exactly in the same position where the extra length of the spectrum is developed. In the eosine, I dare say you notice a peculiar dimming of light about the green; this is a very fluorescent dye, and it is in that position where we shall expect the action to take place. I will, however, show you where the absorption takes place of these two dyes we have used. This is a spectrum of the dye: it lets the ultra-violet rays through; in the green we have a great cutting-off. Here we have the cyanine, which is a different colour altogether. It cuts off the yellow, and also the green; therefore, on the principle of work, we should expect that where absorption takes place in the dye, there dye would be oxidised, and the silver reduced in consequence. I now expose the three slips of paper above alluded to, and I will develop them before you. [The papers were developed in yellow light, as before.] The impression of the spectrum on the eosine-dyed paper flashes out, the part in the green comes out very strongly indeed. The blue-dyed paper shows, besides the ordinary spectrum of the bromide, a band in the yellow. Finally, we have the undyed paper. The above diagram shows the effect obtained on cyanine blue. Here you see the marked difference in the three cases.

FIG. 7.



USEFUL AND SCIENTIFIC NOTES.

The Tractrix Screw Propeller.—This propeller has some points of novelty which deserve attention. Its surface is generated by the tractrix curve, which is claimed to be the only natural form of least resistance to rotation. The resistance at the root of the screw is abolished, and a direct thrust astern is obtained, the propeller being the only one which forms a complete column of water astern at all speeds. The tractrix screw is said to apply its power in the same direction as that in which the water is moving at the time of entering the propeller; and amongst its advantages may be noted the same efficiency at all speeds, greater length and strength of blade, with smaller diameter, and the minimum of noise in working. The tractrix propeller is decidedly worth a trial, especially in steam launches, to which its comparatively small diameter admirably adapts it.

Paris as a Seaport.—While Manchester merchants are seriously discussing the project for making a waterway between that city and the sea, the French Society of Civil Engineers have recently had under consideration a project of M. Bouquet de la Grye, hydrographer to the Navy, for rendering Paris accessible to ships with a draught of six or seven metres (20—23ft.). He proposes to deepen the Seine bed by dredging, and to lower the water level between Rouen and Poissy, so forming a maritime basin about 103 miles long and 150ft. in width. The excavation would progressively reach a depth of 53ft. below the present bottom at Poissy, and the water level would be lowered about 40ft. The quantity of matter to be removed is estimated at 75,000,000 cubic metres. Only the sharper curves of the river would be avoided; bridges would be raised or rendered movable. At Poissy vessels would rise by a "cascade" of locks, about 110ft. in the forest of St. Germain, to an upper canal, fed with water from the Seine, by means of turbines driven by the fall of Seine water at the locks of Poissy. This canal would extend to Aubervilliers, passing above the Seine and the railways; its level would be nearly that of the canal of La Villette. There would be two harbours, a lower and an upper, at the borders of the forest of St. Germain, and ships going to the higher canal would not interfere with those at the lower port, whence Transatlantic merchandise would be sent straight to the Rhine Valley. The expense of th lower canal between Rouen and Poissy is estimated at about 150,000,000 francs, that of the upper about 100,000,000. The scheme has been vigorously discussed, and some eminent engineers have taken grave objection to it.

SCIENTIFIC NEWS.

ON the 23rd of the present month the annual general meeting of the British Association will be held at Southampton, when Dr. Siemens, the President-elect, will be inducted to the chair and read his address. The presidents of sections are:—A, Mathematical and Physical Science, Lord Rayleigh; B, Chemical, Prof. Liveing; C, Geology, Mr. R. Etheridge; D, Biology, Prof. A. Gamgee; department of Zoology, Prof. M. A. Lawson; department of Anthropology, Prof. W. Boyd Dawkins; E, Geography, Sir R. Temple, Bart.; F, Economic Science, Right Hon. Sclater-Booth, M.P.; G, Mechanics, Mr. John Fowler. The American and the French associations meet about the same time and last as long as the British, which, so far as the American Association is concerned, is unfortunate, as the meeting in Montreal was intended to have an international character, at all events so far as regards English-speaking races.

The following ephemeris of comet Wells may be useful. The time is Greenwich midnight:—

	h. m. s.		° ′
Aug. 6	12 4 51	N. Dec.	4 22·7
10	12 13 43	,,	3 48·2
14	12 21 56	,,	3 15·7

The volume of Greenwich Observations for 1880 has been published.

Mr. Tebbutt, of Windsor, N.S.W., who discovered the great Comet of 1881, has undertaken to organise a society of amateur comet-seekers in Australasia. The Boston Scientific Society is the prime mover in this enterprise, which it will be remembered Mr. Denning has endeavoured to promote in this country. The additions made to the list of comets in recent years are ample encouragement to those who will undertake to systematically sweep an allotted portion of the sky.

It is stated that Mr. A. Marth will have charge of the Transit of Venus station, at Aberdeen Road, Cape Colony, Mr. Burton, the observer previously appointed, having died suddenly.

The statue of Darwin, to be placed in the Natural History Museum at South Kensington, will be executed by Mr. Boehm.

The report of the City and Guilds Institute for the 1882 Technological Examinations, shows a considerable increase in the number of candidates, and also in the number of subjects, the former probably depending to a certain extent on the latter. Although some of the examiners are able to report favourably, and others hopefully, there is abundant evidence of the need of these examinations, or rather of the education which they are supposed to test. Taking all the subjects (37) together, the percentage of failures amongst all the candidates is 38, but amongst those candidates coming from classes affiliated to the Institute, it is 42·3 which compares favourably with the 50·6 in 1881. The proportion of candidates who have fully qualified by passing the examinations of the Science and Art Department is small—only 400 of the 1,222 successful candidates having obtained the requisite certificates of the Science and Art Department. That is nothing more than might have been expected, and the sooner the regulation is abolished the better for the success of the City and Guilds Institute examinations. The reports of some of the examiners are severe, but no doubt just, and call for serious investigation. For instance, Prof. Graham, the examiner in so simple and yet important an industry as breadmaking, says, "In the pass examination forty candidates entered; not one has passed. Those numbered 1343 to 1390 seem to be children who have been crammed by a person grossly ignorant of the subject, and whose sole idea has been to get the children to learn by rote various parts of my 'Cantor Lectures.' Parrot-like, they repeat my words, not only without knowing their meaning, but mixing them up so as in many cases to produce the most absurd nonsense." Capt. Abney says "some of the candidates who sat knew absolutely nothing either of the practice or theory of Photography." Mr. Holtzapffel (Tools), and Mr. Thrupp (Carriage Building), complain that the candidates are unable to draw, while Prof. Perry (Mechanical Engineering) reports an improvement in the "character of the sketches," although he finds that "good teaching" is still wanted.

One would have thought that scientific instruments employed in works of public utility were safe from the mischievous fingers of the British Tourist; but Mr. Clement L. Wragge writes that on July 23 it was discovered that malicious or wanton damage had been done to the intermediate station at Red Burn, on Ben Nevis. The thermometer box had been broken into and the wet bulb broken, while the compass points had been removed. The station is about 2,700ft. above the sea.

An ingenious patentee proposes to supply towns with the electric light free of cost. His "idea" is to attach the lamps to advertising columns, and the rent paid for displaying the notices is supposed to cover the cost, and leave a surplus sufficient to pay a good interest on the outlay.

Herren Nies and Winkelman are reported to have made a series of experiments on the changes in volume of metals on cooling from fusion. They find that tin, zinc, bismuth, antimony, iron, and copper, all expand at the moment of solidification, and they have reason to believe that the same holds good for lead and cadmium. They believe, in fact, that all metals expand on solidification, which, it should be noted, means the moment of solidification, as the majority contract on cooling. It is only at the moment of change from the fluid to the solid or semi-solid state, that the expansion takes place.

Mr. F. W. North's report on the coal-field of Natal estimates that the field in Klip River county covers about 1,350 square miles, and contains over 2,000 million tons of workable coal. The quality is good.

As an indication of the interest taken by the United States in fish culture, it may be mentioned that the Government has voted a sum of £10,000 for the International Fish Exhibition, at which America will be fully represented by a splendid collection of appliances and models.

M. Cailletet recommends vaseline as a lubricant wherever mercury is likely to be present.

While the instantaneous photography of objects in rapid motion is now practicable, that of objects at rest, while the apparatus is in rapid motion (of translation), is of course also practicable—*e.g.*, photography of landscapes from a railway train or a balloon. M. Candeze has lately described in the Belgian Academy some successful attempts to photograph from trains. He supported the camera with both his hands to avoid shaking as much as possible, and directed the objective to the landscapes passed. The objective was of special form. Instead of a longitudinal tube with the lenses screwed into its two ends, he used a tube placed transversely, carrying its lenses opposite each other in the curve. Within the tube was a light drum, moving under the action of a spring on release of a catch. This drum had two quadrangular apertures, and was at once shutter and diaphragm, producing on the sensitised plate a sort of flash, the duration of which could be made as short as a hundredth of a second The views obtained have not, of course, all the fineness of those taken under ordinary conditions, still they are regarded as very satisfactory. Their size is that of an album-carte. With regard to focussing, this, being impossible for each view, is done, once for all, in advance on an object distant about 100 metres. The distinctness is then general from that point to the horizon.

The natural caves at Roquefort (Aveyron) are an interesting formation, of which the following are some particulars from a recent account. From the north slope of the plateau of Lazac rises the mountain of Cambalou, with an abrupt escarpment on the north side. At some epoch undetermined, part of the oolite rocks of this hill slipped down, following the motion of the clay beds on which they rested. The strata tumbled about in great blocks, formed a new irregular ground, with numerous fissures. The air entering these forms currents in various directions, while the percolating water of rains affords abundant moisture. It was on this new ground that the village of Roqnefort was built, at an altitude of about 2,590ft. It is those faults or fissures and the fresh air circulating in them that have been utilised for the preparation of the cheese produced from the milk of the sheep in that region. The natural grottoes were the first caves, and at their mouths were afterwards formed larger spaces, which are the present caves with their accessories. The temperature of the caves varies between 4 and 8 degrees C. from day to day, and from one cave to another. The air coming through the faults is charged with moisture, showing, on an average, 60° in the hygrometer. It is these relations of temperature and moisture that give the caves their high value for the industry referred to.

The influence of snow on the temperature of the lower strata of air has been shown by Herr Billweiler from a comparison of the last two winters at Zurich. There were very much the same general conditions of weather, long prevailing barometric maxima with abnormal heating of the upper air and frost in the lower; but, whereas, in 1879-80, the temperature at Zurich sank to − 13 °C. early in December, and repeatedly reached −9·5° and − 10·5°, last winter the extreme colds were only − 3·5° and − 4·2°. (The extremes for Switzerland in the two winters were, −20° and −8·5° respectively.) Now, these winters were greatly in contrast (and especially in December), as regards snowfall in Central Europe. The influence of the snow cover consists in its breaking, as a bad conductor, the connection between the ground and the air. In December the ground is considerably warmer than the air, which is thus slowly heated from below if snow is absent, but the snow interrupts this transference of heat almost entirely. The surface of the snow cools greatly by radiation, and this cooling is shared directly by the air.

The sense of hearing in insects has been recently studied by Herr Gruber. Of air-insects he found the cockroach (*Blatta Germanica*) very sensitive. On sounding a violin-note when a cockroach was running across the floor, the creature always suddenly stopped. Again, a number of these cockroaches were enclosed in a glass vessel, and on making a strong sound, there was evident agitation and excitement; some would fall down from the glass, as if paralysed. A cockroach was hung by a thread from its hind leg; when it was quiet, a bow was drawn sharply over the violin-strings at the distance of about 4ft., whereupon the insect was greatly excited, and struggled round, getting its head uppermost. Beetles also were readily affected by sounds; but grubs and ants gave no certain indications. Of aquatic insects, various kinds of *Corixa* were tried. These would often remain quite quiet for several minutes, but on tapping the glass with a glass tube, they rushed about in much agitation. A disc at the end of a long rod, drawn to and fro in the water near a quiet Corixa produced no effect; but on conducting the sound of a struck bell into the liquid by the rod, there was lively reaction; similarly, when a glass bell, stroked with a bow, was brought to touch the water. These creatures were also sensitive to high violin notes in air, to the sound of a metal plate struck with a hammer, &c. Still more sensitive to sound were various aquatic beetles (*Laccophilus*, *Laccobius*, *Nepa cinerea*, &c.) On the other hand, various larvæ, especially of ephemerides, were unaffected; but these were sensitive to mechanical agitation of the water. Herr Gruber considers the response the insects made to sound an indication of true hearing, and not mere reflex action.

From experiments recently made on plants, Mr. F. C. Phillips concludes (1) that healthy plants, grown under favourable conditions, may absorb through their roots small quantities of lead, zinc, copper, and arsenic; (2) that lead and zinc may enter the tissues in this way without causing any disturbance in the growth, nutrition, and functions of the plant; (3), that the compounds of copper and arsenic exert a distinctly poisonous influence, tending, when present in large quantities, to check the formation of roots, and either killing the plant, or so far reducing its vitality as to interfere with nutrition and growth. Mr. Phillips' paper appears in the *Journal of the Franklin Institute* for July.

M. Alph. de Candolle has recently called attention to an interesting point (hitherto overlooked) regarding Batatas, one of the species of Convolvulus. The enlargements or tubercles belong, in it, to the lateral roots, whereas in the other species known it is the primary axis that becomes a tubercle. Now, this corresponds to a distinction of properties. The roots of Batatas are formed mainly of a cellular tissue filled with starch, and have a saccharine taste. Axile tubercles, on the other hand, have a remarkable complication of vessels and cells, which secrete resinous matters. The Batatas is good to eat, and serves as food in tropical countries. The other tubercles are eminently purgative (*e g.*, jalap and scammony). Generally, in the family, what belongs wholly or partly to the stem, is more or less purgative. The *Convolvulaceæ* seem to support the law that like parts in a family have properties of the same nature. M. de Candolle thinks a new monography of this family desirable, in which the underground parts should be more considered.

In the French Academy the other day, M. Carré, well known for the freezing apparatus he has invented, and which bears his name, gave a calculation of the cost at which the trichinæ in meat may be destroyed by cold. A machine of his system producing 300 kilogrammes an hour might cool to – 30 degrees 100 cubic metres of ham, that is to say, 60,000 kilogrammes of this meat, by means of 8,000 kilog. of coal, and 27 kilog. of ammonia. One man would suffice to conduct the operation, and the total expense would be less than 500 francs, or about 1 centime per kilogramme. The apparatus would cost 60,000 francs. M. Carré urged the application of this system to making raw meat wholesome (as that is so largely now given to invalids). M. Fremy, on this occasion, desired information as to the facility of assimilation of raw meat. M. Vulpian said the theory of the action was not complete. M. Bouley thought albumen coagulated by cooking more difficult to assimilate than the fluid albumen of raw meat. But M. Fremy considered that on entrance into the stomach, and contact with the acids of gastric juice, the fluid albumen must be coagulated.

Some interesting observations on snow and ice under pressure at temperatures below 32° Fahr. are described by Mr. Hungerford in a recent issue of the *American Journal of Science*. He finds that broken prisms of ice at temperatures far below 32° will firmly reunite if the faces of fracture are brought together and moderate pressure long applied. Snow is converted into ice under long-continued pressure not exceeding 2,000lb. per square inch, and probably much less, and at temperatures near zero Fahr. No satisfactory evidence was found of the presence of moisture in the snow thus treated, though great pains were taken to detect it; still, there may be a local development of it in centres of contracted pressure. The evidence is not inconsiderable in favour of time as a factor in production of continuity between ice-fragments and snow crystals; and this, so far as admitted, militates against the idea of liquefaction and regelation at those temperatures.

A Constant Battery.—Mechanical agitation has been adopted sometimes to render the current from certain voltaic batteries constant by disengaging the gases which collect on the negative plate. Heating has been recently applied by an Italian engineer, Signor Gaudini, with a like effect in the case of a cell consisting of a cast-iron pot or vessel containing a porous clay vase in which was placed a plate of carbon, while a zinc cylinder surrounded the vase as a positive electrode. The exciting liquid was a saturated solution of chloride of sodium, and the depolariser a super-saturated solution of bichromate of potash and sulphuric acid. When in a cool state this cell gives a strong but rapidly falling current on being worked continuously. If, however, it is placed over a small gas heater so as to raise its temperature to about 100° C., the current keeps very constant and is very powerful. Crystals of bichromate of potash dropped into the depolarising solution from time to time serve to keep up the strength of current. When cool, such a cell gave an electromotive force of 2·10 volts and an internal resistance of 0·82 ohms. When hot, the electromotive force rose to 2·44 volts with a resistance of 0·71 ohms. Heating, therefore, increases the electromotive force of the cell, and the conductivity of its solutions, while at the same time it lessens the polarisation of the electrodes.—*Engineering.*

Professor Loomis states that the heaviest rainfall is met with in the rain-belt which surrounds nearly the whole globe lying between the north-east and south-east trade winds.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

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CATALOGUE OF SUSPECTED VARIABLE STARS.—V.

(*Continued from page* 475.)

[20333.]—**Lepus — Libræ — Lynx — Lyra—Monoceros—Ophiuchus—Orion.**

	Lepus.	h.	m.		°	′		
202.	ε Leporis	5	0	–	22	32	3·1	Gould.
203.	II. B. 16		6	–	12	2	5½ – 7½	Espin. Morton.
204.	L. 2168	6	5	–	27	7	6·0	Gould.
	Libra.							
205.	20 Libræ	14	15	–	24	41	5	Franks.
206.			33	–	20	43		Peters.
207.	ε	15	18	–	9	53	5½	Gore.
	Lynx.							
208.	P. vi. 174 Lyncis	6	34	+	59	34	Comes. Var.	Struve.
	Lyra.							
209.	B. 448 Lyræ	18	28	+	36	54	8 – 9	Birmingham.
210.	O.Σ. 525		50	+	33	49	Comes. Var.	Otto Struve.
211.	γ		54	+	32	32	3	?
212.	P. xix. 13	19	4	+	37	43	Comes. Var.	Webb ?
213.	B. A. C. 6624		13	+	40	5	7½	Franks.
	Monoceros.							
214.	B. 147 Monoc	6	24	–	2	56	5½ — 8	Birmingham.
215.	12		25	+	4	56	6·3	Gould.
211.	B. A. C. 2306		55	+	11	10	5½	Franks.
212.	19		56	–	4	3	5·5	Gould.
213.	23						5·8	Herschel.
214.		7	23	–	1	39	4½ — 9	Olbers.
215.	L. L. 15374		46	–	5	6	6·4	Gould.
216.		8	23	+	0	20	9·0	Dreyer.
	Ophiuchus.							
217.	δ Ophiuchi	16	8	–	3	22	Var. Colour.	Secchi.
218.			15	–	7	25		Schönfeld.
219.	χ		19	–	18	10	4·3 — 4·7	Gould.
220.	B. 379		20	–	12	8	7½ — 9	Birmingham.
221.	B. 391		45	–	5	58	8½ — 0	Birmingham.
222.	51	17	23	–	23	51	4·8 — 5·6	Gould.
223.	B. 420		48	+	1	47	7½ — 0	Birmingham.
224.	B. 422		52	+	2	44	7 — 8½ Var. Col.	Birmingham.
225.	68		55	+	1	18	5·1	Gould.
	Orion.							
226.	π^1 Orionis	4	43	+	6	44	3 — 5	Gould, Espin.
227.	5		46	+	2	18	5·6 — 6·6	Gould.
228.			48	+	7	34	6·0	Gould.
229.	L. L. 9418		53	+	3	25	6·2	Gould.
230.	L. L. 9462		55	–	0	32	6·6	Gould.
231.	L. L. 9767	5	5	+	0	21	7·0	Gould.
232.	ρ		6	+	2	42	4·6 — 5·1	Gould.
233.	γ		18	+	6	14	1·7	Gould.
234.			23	–	1	7	9	Argelander.
235.	λ		21	+	9	50	3·5	Gould.
236.	L. L. 10527		28	–	6	5	5½ — 7½	Gould.
237.	L. L. 10529		28	–	6	5	5·8	Gould.
238.	42		29	–	4	55	5·5	Gould.
239.	45		29	–	4	56	6·1	Gould.
240.			29	–	3	20	6·8	Gould.
241.	θ		29	–	5	28	Comes Var.	(?).
242.	B. 118		36	+	2	18	Var. Colour	Birmingham.
243.	κ		41	–	9	42	2·3	Gould.
244.			41	–	0	2	12 — 14	D'Arrest.
245.	56		45	+	1	49	4·9 — 5·5	Gould.
246.	L. L. 11382	5	53	–	3	4	5·1 — 5·9	Gould.
247.	W. B. 262	6	10	+	5	8	6 — 8	Gould.
248.	L. L. 12104		13	–	2	53	5·4 — 5·9	Gould.

T. E. Espin.
W. H. Gage.
T. Read.

FEATHERY MIST ON THE MOON.

[20334.]—Last evening (July 17) I again saw the "feathery mist or cloud on the moon," the same as written of in letter 20151, of May 20th, as then seen on May 19th. It lay, as then, on the terminator, just over the westerly edge of the Mare Crisium against the Promontorium Agarum, and seemed to extend itself longitudinally, parallel with the Promontory, of height apparently equal or greater than the mountain range, partially obscuring the mountains from view.

My notion now is that the cloud forms at that place during the lunar night of every lunation, and can only be seen on one particular evening about 60 hours (more or less) after conjunction (new Moon) just as the rays of the sun, rising over the mountains of the Promontory, become sufficient to illuminate the mist, and yet the increasing warmth of the lunar mountain has not had time to dispel it.

The fact that the moon is then but a slender crescent, necessarily low in the haze of the horizon, and seen but an hour or so before setting, must be the only reason why it has not been more frequently observed.

I missed it, on account of clouds in our own horizon, after the New Moon in June, and only caught it through the rifts last evening, but quite sufficiently to be sure of the presence of the phenomenon, as above described, and to be confirmed in the impressions formerly had of the extent and importance of the appearance as indicative of the present physical condition of the moon.

I marvel much, however, that it has not been noted elsewhere ere this, and am anxious for other observers to be giving their attention, since the magnitude of the cloud far surpasses anything of that character heretofore noted, and its importance must be acknowledged by all as soon as witnessed.

During the old age of last moon, I watched the same lunar region, with the terminator at the same place, as the sun was setting upon it; but no mist or cloud was seen. The Mare Crisium, however, with the setting sun shining horizontally across it, showed a different formation from what had previously appeared from the other side; for the bottom of the Mare did neither run in horizontally, abutting against the base of the Promontory, nor rise against it by what might be called "foot-hills;" but there seemed to be a roll of land in the Mare parallel with the Promontory, and between the two a deep dark gulf; from which conjecture might indicate comes volcanically the "misty cloud" under discussion.

Allow me to add, in conclusion, that the moon's orbit was less inclined southward in May than at this time; and the moon consequently remained much longer above the horizon than now, allowing of a much more perfect view in a better light. The appearance seemed so prominent then that, methinks, a skilful spectroscopist could have readily obtained a spectrum of it.

It will be very interesting, when observers get the matter in hand, to catch by observations encircling our globe the time of first visibility of the cloud, and the time of and phenomena attending its disappearance. **J. G. Jackson.**

Sunset Cottage, Hockessin, Delaware, U.S.A., July 18th.

P.S. of July 19th.—I caught view of the moon again last evening through rifts of cloud; but the Terminator had moved rapidly forward. The sun was shining full and clear over the "Promontorium Agarum" and the plain of the "Mare." *No vestige of the mist remained.*—J. G. J.

P.S. of July 21st.—Observations of the "Promontorium Agarum" continued, seem to show on the slope of the Promontory next the "Mare" what looks like long, narrow openings, not noticed a month ago, at which time it was carefully observed. I am much impressed with the idea that volcanic action is constantly going on in that vicinity of a very interesting character, and that the evanescent "cloud" is but one of its manifestations.—J. G. J.

THE JULY ANDROMEDES — REAPPEARANCE OF THE MARKINGS OF JUPITER.

[20335.]—On July 24th, 11h. 30m., I saw a small stationary meteor at R.A. 7°, Dec. 38° N. It evidently belonged to the shower of July *Andromedes*, which many observers have seen at this epoch. It appears to be a rich display of swift, streak-leaving meteors, and the radiant is one of long duration, as the following list of observations show:—

		α	δ	
1867-8	July 21—	11°	+ 38°	Schiaparelli and Zezioli.
1877	July 6—Aug. 16—	7	+ 36	37 meteors. D. No. 49, 1877.
1872	July 15—Sep. 14—	10	+ 33	45 meteors. D. from Italian obs. 1872.
	Aug. 1—Sep. 30—	11½	+ 34½	140 meteors. Heis.
1870	July 27—	7	+ 32	Tupman, No. 45.
	August 23—	0	+ 33	Tupman, No. 45.
	July 28—Sep. 3 (?)—	8	+ 36	Greg. and Herschel, No. 103.
1878	July 25-31 and Aug 10—	6	+ 37	23 meteors. D. No. 7, 1878.

The mean of the eight positions is at 7½° + 35°, which we may conclude is very close to the centre of the astronomical radiant of this prominent shower.

On July 29, at 14h., I turned my 10in. reflector on Jupiter for the first time this season. Definition was not good, the planet being very low, and his light much enfeebled by fog. I saw the middle of the red spot came to the central meridian at 14h. 18m. It was very faint and ill-defined. The following end of the spot was estimated central at 14h. 48m., but I cannot rely upon these times being accurate, owing to the great indistinctness with which the details were seen. I had computed that at this date the brilliant equatorial spot should follow the middle of the red spot about 1½h., and I soon detected the former object in the position assigned. I was surprised at its brilliancy as it came to the c.m. at 15h. 49m. Considering the very unfavourable position of Jupiter, this bright spot was certainly as conspicuous as I had ever seen it. It will come to conjunction with the red spot on the night of August 5, so that the extraordinarily rapid motion of this object relatively to the red spot has been well sustained during the last few months. for I had indicated last December (*Monthly Notices* R.A.S., Vol. XLII., p. 99), that the two markings referred to should come to conjunction on Aug. 4, 3h. 14m., a.m. The spots may be well observed on the morning of Aug. 6, at 3 a.m., when they will be nearly central on the planet.

While observing these features on July 29, I also noticed two very dark spots on the equatorial border of the great southern belt. They were to the E. of the bright spot, and very similar to markings seen in the same position during the last opposition. These should be watched, for they appear to drift rapidly westwards, and temporarily obscure the bright spot.

Bristol, Aug. 1. **W. F. Denning.**

SCIENCE AT SOUTH KENSINGTON.

[20336]—Will you kindly permit me to make a few remarks on the article which appeared under the above title in the English Mechanic for July 28? Let me say at the outset, that, regarding the amount of money spent by the Science and Art Department, I know nothing; but, as regards the other "facts" you give, I can say something, and I speak from experience.

You say that "artificers are extremely scarce among the competitors." If this is so now, things have changed very much of late years; for when I was at the school the number of working men—and by this I mean men who had been in the habit of earning their living in the workshop—was by no means small. I myself came under that head, and was selected direct from a workshop, and that, too, with the full knowledge of the Department. While at South Kensington I received instruction and gained information which has enabled me to take such a position as would have been impossible from private study only. And this was not peculiar to me. I know a number of men now holding important positions in both pure and applied science, who could not have hoped to have attained to such positions had they not have been fortunate enough to get to South Kensington. One is a teacher of science under a school-board, another is in a corporation surveyor's office, a third chemist in a large chemical works, a fourth science master in a grammar-school, and so on, to say nothing of the great number earning a living as science teachers under the Science and Art Department. I will venture to say that had it not been for this department, the majority of these men would have still been earning their living in a workshop; and I say this from my thorough knowledge of the men. I am the more anxious to correct your statements regarding the selection of artisans, as they are calculated to deter working men from competing, and so tend to bring about the state of things you profess to deplore. I am not prepared to deny that pupil-teachers were present, but I do say that the proportion was not unduly large. Indeed, it seemed to me that great care had been taken in the selection, both as regards the class and the districts from which they had been selected. The students seemed to be chosen from many trades and professions. Thus there were artisans, clerks, pupil-teachers, one from an actuary's office, one from a surgeon's laboratory, and another from a drawing office, and so on.

The remarks you make concerning the qualifications of teachers under the Department are not very complimentary to a large number of your own subscribers, for I know that many of the science teachers are subscribers to the English Mechanic. Ten years ago there would have been some truth in your remarks concerning their qualifications; but the Department was aware of this, and to meet the want of better-qualified teachers the Science School at South Kensington was instituted, and since it opened hundreds of competent teachers have left its walls, and been sent all over the country.

You give a number of absurd statements which were given as answers to questions in physiography. Surely, you know that a few such answers taken from the worked papers give no just idea of the quality of teaching given to the students. Not even the teachers themselves, much less the Department, can be held responsible for these answers. Granted that the answers show that cram has been resorted to, it by no means follows that the cram was the teacher's, but rather that the students had not paid attention to the lessons through the session, and then about a week before the examination he finds he must read hard if he is to make any show at the examination. That this is the case in many instances is too well known by all teachers, and if you can suggest a remedy you will be conferring a boon on them. I remember while at South Kensington one of the answers to a question in Physiology—viz., "What is the medulla oblongata?" was, that the spinal cord was fastened on to the brain with the medulla oblongata. Surely you would not lay the blame of that answer upon Prof. Huxley? That the teacher of the student who gave the answer was not responsible I know, for he was thoroughly competent and conscientious. In conclusion, allow me to ask is it honest and dignified to attack the department in the way you do? It is a little singular that no other paper finds it necessary to take up the attack. I by no means contend that the department is perfect, and where criticism is just by all means criticise. **Edward Jackson.**

Birmingham, July 29, 1882.

[20337.]—I am glad to see that you have taken in hand the misuse of the funds granted to the department at South Kensington, and hope you will follow the matter up. The following items from 1881 Blue-book may perhaps be of service to you. The cost of inspection and examination was £14,968. There were 70 officers employed, so each got about £200 for his work. The number of teachers was £1,700, and the grant £44,000, thus giving each teacher an average of £23, or little more than one-tenth of what was paid to inspectors; yet the teachers do the real work. Even in the prizes to students the jobbery creeps out, for the candidates are not allowed the benefit of the 2d. in the shilling discount allowed on books; it would be interesting to know where this goes to, or rather *whom* it goes to. Again, it is well known that the standard of examination is being raised most unfairly, rendering it more difficult to make anything satisfactory now than it was years ago, while the method of payment *merely* by results directly encourages cram, and yet the examiners have the impertinence—I can use no other word—to complain of *cram*.

Again the subdivision of the subjects is radically bad. Except mathematics, all the subjects are cut down or stretched out to the "three stages," regardless as to whether they are suitable or not.

A curious item appears in the Blue-book just mentioned.

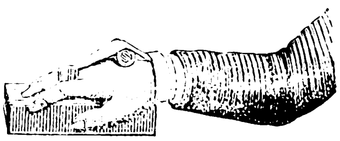
"Simkins' defalcations £6,233 3s. 3d." Who was Simkins? And was he caught and punished? Or was the deficiency made up by so many fewer passes?

I sincerely hope you will not let the matter rest, but continue to call attention to the jobbery prevailing.

Some time ago the department raised the number of lectures required from 25 to 28. Of course no increase in grant was made for the 12 per cent. extra work. **Science Teacher.**

AMATEUR SURGICAL APPLIANCES.

[20338.]—About 30 years ago I had the misfortune to tear asunder the patella of my right knee by the mere effort to save myself from a fall. The separation between the fragments was, and has remained, great—at least 1in. The rupture was very imperfectly amended by ligamentous tissue. However, for many years I suffered comparatively little inconvenience from the accident. The advance of age, and of late years, frequent attacks of serious illness, have wrought their usual effects upon me, and in consequence, I have felt much pain and trouble from my fractured patella. The imperfect union, and consequent inadequate strength, of the extensor muscles do not afford sufficient resisting power to that of the flexors. To meet this difficulty, I have tried various plans with little success. However, I hope I have now contrived an apparatus which is effective; possibly, the invention may be an old one, though my medical attendant, Dr. Pullin, who admires its simplicity, is not aware of any such appliance. In the hope, therefore, that it may be of service to some other sufferer, I forward a description of it to you for insertion, at your pleasure, in the English Mechanic. The apparatus consists of a long gaiter of *thick* cloth, buttoning *tight* to the leg from the upper part of the thigh to near the ankle. At the back of this a long pocket is made, which contains a spring of steel. I have used simply one, or if one is not strong enough, two ordinary steel "busks." When, therefore, the knee is bent by the too-powerful flexors, I have thus given them something more to do than to overcome the weakened extensors, and make them store up power to aid their enfeebled antagonists. I can now, I think, report favourably of the action of the apparatus, having for some time worn it daily. In connection with the foregoing, I may, perhaps, mention that when in bed (not then wearing the gaiter) I have found a sling of "list" attached to the foot, and of sufficient length to reach the hand, of the greatest service in enabling me to move the leg into different positions, with little consequent pain. To the above, I add that some 22 years ago I unfortunately nearly severed the extensor of the middle finger of my right hand. In consequence, the finger dropped, and I feared that all organ playing was at an end for me. However, I then contrived a somewhat similar plan to that adopted for my broken patella, and attached an artificial extensor to the finger made of ordinary "elastic." I found this most fully to answer the intended purpose, and I was at once enabled to play the organ. Of this contrivance I forward an account and photograph for the benefit of any of your readers who may have met with a similar accident. To a band of leather, which is buckled tight round the wrist, three pieces of "elastic"



3in. long by ½in. broad are sewed. These pieces of "elastic" are fastened to a large cork, cut about ½in. from the wrist. Underneath the cork is an oval pad of thick soft leather, which lies across the back of the hand and relieves it from pressure. The cork acts as a fulcrum, and gives upward tension to the "elastic." Again, the ends of the "elastic" are sewed to a piece of ½in. tape. This is passed under a ring of soft leather fitting tight to the lower part of the finger. Under this the tape is passed, and thus the "elastic" can be drawn to the necessary degree of tension and there fixed. **N. S. Heineken.**

COLOUR.

[20339.]—I agree with much that is in Mr. Smith's letter (20307, p. 453), and can confirm some of his experimental results; but I do not believe in any theory of *three* primaries. I do not think "Sigma's" letter (20324, p. 477) an adequate or correct reply to Mr. Smith's; and as to Mr. Holmes's letter (20325), I consider it to be rendered quite unworthy of reply, by its arrogant and discourteous tone.

It is quite impossible to give a complete or satisfactory explanation of colour-vision in the compass of a short letter; but I may refer present readers to some letters of mine on the subject in the "E. M.," beginning 24th April, 1874. Later study and observation have confirmed and developed the views I then held, and have enabled me to add to my experiments for elucidating the subject.

I am convinced that, whilst the wave-lengths concerned in producing colour sensations are innumerable in variety, the distinct or different simple colour sensations are limited; but I am equally convinced that no part, however small, of the spectrum, produces a pure or perfectly simple sensation of colour, excepting, possibly, parts at the extreme ends.

Two objective colours may seem to produce the same colour sensation, and yet be quite differently composed. The green tapes of green Venetian blinds are generally made as close a match as possible; but if they are looked at through glass which is commonly termed deep blue, but which is really violet-blue, the glass being coated with gelatine coloured with picric acid (all other light being carefully excluded from the eyes), the tapes will appear red, whilst the slats will appear of nearly the same green as before. A white cloud looked at through the same combination appears greenish-grey, and with another combination, consisting of special green and purple glasses, the cloud looks to be of nearly the same greenish-grey, whilst crimsons or reds, very slightly inclined to the pink side, appear violet-blue; and many pairs of objective colours which appear identical in ordinary light, are quite different when looked at through either of the combinations. Looked at through the combination first described, grass and green leaves appear to be scarlet.

The objective colours of a landscape are quite differently composed from the objective colours of the pigments used to represent the landscape. It is a remarkable fact, that whilst different persons must differ greatly as regards their vision of colours they do not see corresponding differences in the colours of pigments, owing, no doubt, to the circircumstance that the pigments in ordinary use have gone through a process of natural selection add survival of the fittest for average eyes. Great differences are, however, seen in landscape (and some other) colours; and, consequently, artists unsciously show us (but, of course, only approximately) in what respects their several visions of colour differ from the average; one artist painting a given landscape quite differently from another as regards tone and general and particular colourings.

An instructive way of testing colour vision comparatively would be to provide a few carefully-selected bright pigments and request the various persons to be examined to paint with those pigments the best representations they can of the spectrum obtained by means of a prism. Professor Piazzi Smyth did something of this kind a few years ago (but for a very different purpose) in a paper he communicated to the Royal Society of Edinburgh. In the "Transactions" there is a plate which I have been told was carefully prepared under the professor's supervision, in which he gives us his representation of the spectrum. This representation shows that he is colour-blind to the violet or purple of the spectrum—a fact which he may not yet be aware of, and which he may not believe. The plate also seems to show that whereas the professor does not properly see the true violet of the spectrum, he can see purples and violets when produced by combining the red and blue of the spectrum.

I believe that a large proportion of people are more or less colour-blind to the violet of the spectrum; and in connection with this it may be noticed that the violet of the spectrum is to be found in pigments and other natural objects in a very small proportion as compared with other colours, although there are plenty of violets and purples composed of red and blue. I think it very probable that Clerk-Maxwell was, to some extent, colour-blind to spectrum violet, and, in my opinion, Mr. Benson, the author of treatises on colour, is so also. Quite recently Professor Stokes has described the colour of the phosphorescent light of calcium sulphide (Balmain's luminous paint) as "deep blue," whereas to my eyes it is a blue-violet. Clerk-Maxwell, Benson, and others, who have advocated the three-primary theory, with red and green for two of the primaries, have persisted in calling the third primary "blue"; whereas it is held by many authorities that the colour of the third primary must be that of the most refrangible end of the spectrum, which is undoubtedly to normal eyes a colour very different from pure blue, and which, I think, should be called purple.

No theory of colour vision can be accepted which does not admit of complementaries being deduced from its first principles in a manner to agree with the complementaries actually obtainable. The best way of obtaining actual complementaries independently of theory, is by means of polarised light passed through quartz; but the precise thickness of the quartz is a matter of great importance, and even at the best it is only an approximation that we can get. It is necessary to see all the colours at once, in order to obtain anything like satisfactory results. For this purpose, I have used a concave conical surface of suitable inclination, coated with a black varnish or japan, which I find to be as good as, if not better than, any other reflecting polariser, this concave cone being combined with a smaller convex cone of the same inclination, arranged so that rays parallel to the axis of the two cones are reflected from the concave cone to the convex cone, and are by the latter reflected so as to be again parallel to the axis. This combination gives us a circular field of reflected light, which is polarised at a different angle for every diameter; and if it is looked at through a tube containing at the front end a piece of quartz, and at the back or eye-end a Nicol prism, one sees each diameter coloured differently; and if the quartz is of suitable thickness, a complete graduated series of colours is shown. I have the quartz cut into a pair of wedges, by adjusting which the effective thickness can be varied. If the quartz is of a thickness such that rays at the violet end are brought to coincide with rays at the red end of precisely double the wave-length, a defective colour-field or disc is shown, green being almost absent, and it follows from this that in colours there is nothing agreeing with the octave of music. I adjust the thickness of the quartz so as to get the colours as uniform as possible throughout the series, and the colour then seen by a normal or perfect eye at any diameter is very approximately the true complementary of that at the diameter at right angles thereto. Having got at a correct thickness of quartz in this way, a double-image prism may be substituted for the two cones, and will show any pair of complementaries by themselves.

With the apparatus thus indicated, I find that the true complementary of pure blue is not pure yellow, but a decided orange or golden colour; and, therefore, pure yellow, when combined with pure blue, should not make white; and if it seems to do so in such very defective experiments as Tyndall's, and as others put forward by some persons, some other explanation must be found for it than that ordinarily given. As regards such explanation, however, I will defer further remarks to a future occasion.

Glasgow, July 29. **E. H.**

[20340.]—I would inform Mr. Westwood Oliver and "X. N. X.," that there is a vast difference between despising the aid of science and differing from some of the dogmas of the scientists. Some people say a man despises religion if he happens to doubt anything told him by a priest. The scientists are the priests of science, and as such are entitled to respect, but the best of them are not infallible.

"X. N. X." is mistaken in supposing I wrote to trouble Sir John Lubbock for information in the sense in which he puts it. I simply wrote to a gentleman for whom I have a great respect, upon a subject about which I consider my knowledge, in some few points, may be superior to his. Surely, it is not unreasonable to suppose that one who devotes himself to a single subject, professionally, is likely to obtain a more comprehensive knowledge of it than even a cleverer man, who, in the leisure he can spare from business, studies the same subject, amongst many others, as an amateur.

With regard to my statement that a mixture of blue and yellow invariably produces green (which I strictly adhere to), "X. N. X." writes, "this is altogether untrue of mixing blue and yellow lights"; and then suggests an experiment to prove his assertion, but stipulates for an important point; he writes, "choose blue glass, not cobalt blue." Now, in the first place, I am afraid he rather lets the cat out of the bag here. Does he mean that if the glass used is of the hue he understands as cobalt—in fact, something approaching pure blue, the unfortunate result may be green? (I am afraid any of our readers will find it difficult to obtain anything approaching a blue glass, the blue of which is not cobalt. If "X. N. X." does know of any blue besides cobalt suitable for staining glass, I shall be greatly obliged for any information about it.)

2nd. If the round spot shown through "X. N. X.'s" wheel is compared to a second portion of the same light, shown through a piece of the yellow glass only, it will be seen that the mixed light is darker than the yellow. It is, therefore, unscientific to say that the blue added to the yellow has made it white, for a tint that is darker than yellow cannot be white.

3rd. No transparent blue or yellow glass is made, that will stop all free white light, and the success of the experiment entirely depends upon this circircumstance; for any free white light will tend to obliterate the green otherwise visible, and I am afraid that any coloured glass our readers are likely to obtain would let through as much or more free white light than colour.

4th. Instead of only allowing the light to show through a small hole, it should be thrown over the whole of the screen, giving a shadow of the whole of the revolving disc; when, if the coloured glasses are not too impure, the shadow of the affair will not only be darker, but greener than the rest of the screen. In this case the colours are not really mixed, and I should imagine, from experiments I have made, that the resulting hue would be yellower than if the colours were fairly mixed or superimposed. I do not consider the experiment as a fair method of showing any colour mixture, and certainly should not expect to obtain a vivid green by such means. "X. N. X." not only stipulates that the blue must not be too pure, but requires the experiment as usual to be performed in the dark. It is impossible to form a true judgment under such circumstances, and I maintain that all experiment in forming compound colours by flashing single ones before the eye, are likely to mislead any one who has not formed a sound judgment on the subject by long practice with coloured pigments. Indeed, this method of dodging different colours before the eye, savours much more of sleight of hand than of sober science. No experiment in colour-mixing can be fairly judged of, that cannot be shown in open daylight with stationary colours.

I had written the greater part of this letter last week, but waited until another number of the "E.M." was published, to see if there was anything else to reply to at the same time.

I am glad to see Mr. George Smith's letter, if only to show there are people who are not afraid of being sat upon, for daring to speak their own minds, when they differ with the recognised authorities; I am sorry I was not a reader of the "E.M." when Mr. Smith's former letters appeared. The theory that a mixture of all the colours made white, though evidently unsound, was not very easy to refute, as any neutral tint may be called white, if it is much the lightest object visible; but in propagating the novel methods of producing white and yellow (by the bye, no one has troubled to defend the latter discovery), the scientists have furnished weapons for their own defeat. I consider the experiment of producing a more or less neutral light with so-called blue and yellow, is rather a proof that colour and light are quite distinct, for the stronger the light the weaker the colour, and the stronger the colour the weaker the light. I hold that a coloured light is an imperfect one, and if a number of imperfect lights are concentrated upon one spot, whether the weak lights are coloured or neutral to start with, the result must necessarily be a brighter light.

I take it that the best test for the white or green question would be, not to try if any blue and yellow lights can be found that do not give a green, as this may be owing to various reasons, such as the impurity of either of the colours, or to the surplus white light; but by showing that a green can be produced by using intensely strong blue and yellow with a minimum of light, and then obtaining a fair judgment of the green by comparing it with a white light of the same power as that used for the blue and yellow. The green rendered visible by these means must not be expected to be very intense, as, according to my theory, the blue and yellow light simply drive away their equivalents of complementary colour from the black or shadow which was previously on the screen, so that as the blue light drives away its equivalent of red and yellow, and the yellow light its equivalent of red and blue, there may be very little blue and yellow left; but as more red was driven off than either of the other colours, the resulting light will certainly be green, however faint. We here see that any surplus white light, or any impurity in the blue or yellow in the direction of red, will tend to destroy the green effect otherwise visible.

If we combine red and blue lights, we find the resulting light is a purple (in this experiment it is essential that the blue is not a purple, to start with; that is to say, it should be free from red), which may just as reasonably be called white, as the mixture of blue and yellow light.

I do not suggest combining red and yellow lights, as I find so many—indeed, most—people, accept a red orange for a red, and a yellow orange for a yellow, and, under these circumstances, the orange obtained by the combination is liable to be more successful than the green.

Mr. Smith remarks that, "the eye cannot distinguish between yellow and orange." This is certainly true with a great many people; but is, I think, greatly due to defective education.

It is very common to have one or more of the senses less developed than the others, and I am sure many people who may not be suspected of colour-blindness have a very imperfect sense of colour; and I think the power and delicacy of one sense is often cultivated at the expense of another. In my own case, I regret to say that my sense of smell is very imperfect. This I am only aware of by believing other people, when they call my attention to scents of flowers, &c., which I am often unable to appreciate. For instance, even an escape of ordinary illuminating gas has to be very strong before I am able to detect it.

It would be interesting to have an examination of our professors of colour for colour-blindness, and to know how many of them are incapable of distinguishing the hue of faint semi-neutral colours; but I must say I should decline to be examined under the misleading conditions in which these experiments are usually tried, and should claim to examine by comparison.

Finding the scientists made such a stand upon the rotating system of so-called mixing colour, I have made a number of opaque discs, and succeeded in making various good greens. A mere scientist, starting with a knowledge of blue-and-yellow, and a desire to make green, might also succeed; but if he starts with the determination that they shall not make green, and with a very hazy notion that any hue in which blue predominates must be blue, and then tries his experiments in the dark, he may easily go astray.

It should be understood that pure blue means a certain fixed colour, free from red or yellow; while green, on the other hand, being a compound colour, embraces an unlimited number of hues, and signifies any mixture or shade in which blue and yellow predominate; though red may enter largely into its composition, neutralising its brightness, and tending to form black.

In my earliest experiments, I found a difficulty which I had not anticipated. A disc which I had painted with equal quantities of blue, red, and yellow, and their combinations, purple, orange, and green, with the idea of producing a grey, happened to have a remarkably strong orange appearance when rotated; and another, which I had expected to appear vivid green, was not remarkable for its success. At these results, I must own I did feel a little low-spirited; but on thinking the matter over, I found it was a success, and not a failure. I had discovered one of the rocks, or rather mud-banks, on which so many scientists had been wrecked. It appears that with this flashing or dodging method of seeing colour, the bright hues, such as yellow, orange, and red, have a much greater effect upon the eye than dull ones, such as blue, green, and purple. As, for instance, we know that a scarlet coat is distinguishable at a much longer distance than one of a darker hue. I also found that blue has the strongest effect upon the eye when washed very thinly over white paper, and that the blue must have a considerably larger surface than the red or yellow to hold its own in the combination. I here discovered why the scientists always prepared their discs with such pale chalky colour.

If the red and yellow are intense, and of equal surface to the dark blue, the disc appears strong orange, and not the celebrated (philosopher's) white; but if the colours are all very pale, it is more an effect of light than of colour. The blue is better able to stand its ground, and helps to form a neutral grey, just the same as it does when the colours are mixed, before being painted on the disc. It is a great mistake to suppose that a coloured surface only reflects colour: it also reflects white light (this can be demonstrated with a prism). A coloured disc, especially if the colours are weak, reflects a greater quantity of light than colour, and although the colours neutralise one another to form black, the surplus light will also be visible as a degree of white. The experiments with blue and yellow on a disc require much the same explanation. If painted in strong colour over equal surface, on being rotated, the disc appears bright yellow, with a tinge of green grey; the yellow having so much greater effect upon the eye, that the dark blue is almost lost.

This explains how easily a tyro may be misled when experimenting in the dodgey manner.

In all experiments of so-called mixing colour, by presenting different hues alternately to the eye, it must be borne in mind that all the colours should be of about the same tint, as regards light and shade; and to arrange this is a very delicate matter. It is not reducible to writing, and can only be learned by experience. In fact, there is a great deal respecting colour that it is as impossible to learn from books as it would be to learn the taste or smell of anything by a written description.

If alternate segments of the purest blue and yellow obtainable are washed thinly over a very clean white surface, the blue having nearly double the surface of the yellow, a decided green effect is obtained, especially if the centre and border of the disc are left white for comparison. A slight taint of red in the blue, insufficient to be recognised by the unpractised eye, will spoil the green, and render its hue greyish olive colour.

Finding that a blue surface reflected so much more light than colour, I set to work upon some transparent discs, as it is easier to get an intense blue by refracted, than by reflected light. Having failed to obtain stained glass with anything like purity in blue, red or yellow, I made mine of tracing-paper mounted on wire hoops; these I fastened on a fly-wheel, something after the bicycle pattern, about 12in. across. To avoid the colours running I painted the blue and yellow on opposite sides. Penny cakes of Rowney's gamboge and Prussian blue will do, although both colours are inclined to red, especially the gamboge, if it is laid on at all thickly. See that everything is kept as clean as possible, and do not let the colours overlap. I painted the blue and yellow in 80 equal divisions; but finding on rotating the wheel that the yellow overpowered the blue, producing only a greenish yellow, I pasted strips of tracing paper one inch long over the yellow, round the outer part of the disc, and found the blue stood its ground much better when the yellow was thus darkened. I then covered the yellow with thicker paper (foreign note) for another inch round the centre; so that I had three varieties of green, with the same quantities of blue and yellow, simply by regulating the light in the latter colour, the hues ranging from yellow-green to blue-green. The colour is well seen by daylight, with a white window-blind for a background—of course with the disc between you and the window.

It is interesting to watch the change of hues according to the position in which the revolving disc is held. For instance, when held up against the blind, the yellow has much the strongest effect upon the eye; but if the disc is held so that one-half has a dark and the other half a light background, it may be observed that what appears yellow-green in the latter case appears blue-green in the former. So that we have in this position six varieties of green at one view, all with the same quantities of blue and yellow. This shows another example of the liability of error in experimenting with moving colours.

Now for any of our readers who may be willing but unable to try "X. N. X.'s" experiment (being unable to obtain suitable glass) I will suggest a much simpler and certain test.

Prepare pieces of yellow and blue glass as follows, say about three inches across. Put about $\frac{1}{4}$oz. of gamboge in 1oz. of methylated spirits, shake occasionally, and in a day or two pour off the clear portion into about $\frac{1}{4}$oz. of thick but clear spirit varnish. To coat the plate, warm it slightly over a lamp and pour on the mixture, returning the surplus to the bottle; then dry the plate carefully over a lamp, holding it at an angle of about 45°, to prevent any surplus varnish from flowing back and spoiling the surface. For blue I used an aniline dye, dissolved in water and thickened with gelatine, the plate being coated much the same as the other, only that it takes much longer in drying, and must not be made too hot, or it is liable to crack and leave the plate. This blue is unfortunately not very pure, as it contains a perceptible tinge of red, especially if the plate is coated thickly; but the two make a very fair green, and are quite good enough for our present purpose. Next, paint two surfaces of white paper, one with gamboge (and water, not spirit), and the other Prussian blue. The aniline blue is not suitable for this, as its red hue is so much more apparent on paper.

Now, it is only necessary to let the shadow of the blue glass fall on part of the yellow paper, or the shadow of the yellow glass fall on part of the blue paper to see the true result of mixing blue and yellow. This is best seen in broad daylight. In fact, the better the light and the steadier the things are held, the better the result.

I was lately shown one of the philosophers' discs by daylight, on which were pasted about 48 segments of tinted paper (it was made at a well-known scientific depot.) This, upon being rotated, produced a muddy effect, which the owner was pleased to call white. This disc had a black centre to set off the mixture; I leave the centre white in my discs for the same reason. The gentleman said these were the old kind, and then showed me another disc, which he said was of a more recent make, and with the same colours produced a *better* white. So it would appear that the old white was not altogether satisfactory. The new pattern disc had a much smaller number of segments (as I remember about seven or eight), and only one of each hue. As it happened, all the colours on the disc were miserably impure and chalky. The red, for instance, I should have described as red, yellow, and blue, mixed with a white body to prevent its being too dark; but what struck me most was that the greater part of the disc was covered with pale, almost neutral tints, slightly tinged with blue, purple, and green. The segments nearest approaching strong colour being much the smallest, I asked the gentleman what colour the largest division, about $\frac{1}{4}$ of the disc, was supposed to represent, but he did not know, or was afraid of committing himself. Upon being rotated slowly, the disc produced a painful effect upon the eye; the intermittent light producing much the same impression as you experience when walking with a paling between you and the sun.

The proud owner then rotated the disc so rapidly as to prevent the various muddy combinations from being separately recognised, and said triumphantly, that "it was the purest white that had ever been produced." I then covered half the disc with a piece of paper, and showed him that his white was considerably darker than a piece of tinted paper covered with writing.

It was quite evident the poor fellow, from misguided education, accepted as white what in reality was as near an approach to black as the small quantity of colour on the disc could produce.

The scientists say that blue and yellow make white; also that blue, yellow, and red make white. Now, do they maintain that red added to white does not affect its hue, or have they a number of whites of different hues?

It is really quite time for the old dogma of white being composed of colour, to be exchanged for a more rational theory. Newton's error was excusable, as a proper mixture of colours will produce a neutral tint, which may be called white, or black: according to its surroundings; but no mixture of pure blue and yellow will make anything but green. The fact is, green is composed of blue and yellow, exactly as much as brass is composed of copper and zinc. It is argued that it takes a greenish blue and greenish yellow to make green; this is equivalent to saying that it takes a brassy copper and brassy zinc to make brass; but the educated eye will as readily estimate the quantities of blue and yellow in any green, as a chemist may estimate the quantity of copper and zinc in a sample of brass.

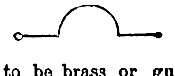
S. Calton.

GRAVITY - ESCAPEMENT CLOCKS: THEIR WEIGHTS, PENDULUMS, PINIONS, DIAL, &c.

[20341.]—When I was young, twenty to thirty years ago, there was, in Thirsk, a watch-maker named Groux. One day he called me in, and showed me a clock he had made, and which he said, owing to its construction, could only vary very slightly.

I was then mechanically minded, but knew nothing of clocks, so I saw the clock and did not know its merits. Of late I have taken to reading how to make clocks, and have tried to make one; and I then remembered this clock of Groux make. He left Thirsk twenty years ago or so, and it was sold amongst his other effects. I tried to find it, and have done so, and it seems to possess some features that although they are new to me may not be new to many:—

1. The pinions are of pinion wire, not lanterns.
2. Its hour hand is stuck on the winding square. Fig. 1 is where eleven usually is.
3. Its weight is on three strings, and measures only $7\frac{3}{4}$ by 2, falling 5in. in 24 hours; the calculated weight would be under $9\frac{1}{2}$lb.
4. The pendulum rod is wood gilded, the bob is round, $8\frac{1}{2}$ by 2.
5. The pallets are apparently brass wire No. 16, or so, bent to shape, which is not the shape shown in Sir E. Beckett's book, but this shape. The 'scape



wheel appears to be brass or gunmetal, and I think not quite 3in. diameter. The measures are accurate, but the other is only what I saw of the clock in its case. Is not $9\frac{1}{2}$lb. a light weight for such a clock? Its present owner says it goes well.

W. N. B.

THE FOREGROUND IN SKETCHING.

[20342.]—I am afraid "Country Sketcher" will not have had his difficulties removed by any of the answers up to the present. Beginners are very apt to be puzzled by their foregrounds; it is so seldom that a view from nature composes well without management. An old hand, if he does not find what he wants on the spot, sticks in some odds and ends out of his pocket-book, which every artist should have well-filled with bits of rustic life—a group of peasants, of children, old stumps of trees, &c. I believe, on one occasion, Turner stuck in an island in the middle of the Rhine which never existed, simply because he found himself embarrassed with too much water. If this anecdote be true, it is carrying license very far. I will now make two suggestions: 1. If "Country Sketcher" will paint in his four fields, and place, say, a hay-waggon in the first, it will nearly hide the four fields, improve the distance, and add a bit of interest to his sketch; or 2. Let him paint his distant building standing up, then let him sit down, or even crouch down, and paint his fields. This will foreshorten them, and by introducing a few large weeds in the very front of his picture the trick is done. Theoretically this is wrong, as the perspective of his buildings is, of course, altered; but *practically* the difference is imperceptible, and I very much question whether anyone who knew the place ever so intimately would spot the trick. It is hardly possible to introduce too much detail in the immediate foreground; but he must beware of making the colours too glaring. They may be as dark or as light as he likes, but the tones must be low, the tertiaries preponderating.

G. W. S.

[20343.] — Apparently, what "Country Sketcher" (letter 20291, p. 451), wants to know is whether, in sketching a distant scene, he shall represent it as being immediately near him! It is rather a curious question, and one which evidently answers itself. If Green's book fails to give him what he requires, and the lengthy reply he has had to the particular point he raised, has not satisfied him, he has but one thing to do—viz., use his own judgment in the matter. I should like to say that if he wants a truthful representation of the scene, he must portray it as a photograph would; but that, if a picture be required, or the scene idealised, discrimination must be used in what is included or omitted; and this resolves it solely into a matter of personal taste. I do not wish to be ill-natured, but I think that the information generally included in "Country Sketcher's" own letter is amply sufficient for the guidance of any ordinary intelligence in drawing from nature.

A Casual Sketcher.

RAILWAY SIGNALS.

[20344.]—Apropos of this question, allow me to suggest that a real improvement would involve a radical change. At present a signal "line clear" means either an arm hung at an angle or concealed altogether, while the stop-signal is an arm extended at right angles, the normal position of the semaphores. I cannot help thinking that it would be much better to reverse this order altogether, and to make the signal a positive one to come on—not as if giving permission, but a positive order. Thus if line is not clear no signal at all would be shown —nothing but a bare pole; if, however, line is clear the arm would be put out, and it would be the duty of the driver to go past. This arrangement would avoid delay and provide for accidents; for if the chains or wires broke the signal-arm would fall. No inconvenience need follow, as drivers could be signalled as now by flag from the box, and as they would by means of an indicator see that the gear was out of order, they would pass the outlying posts and pull up at the boxes or cabins. A special signal for danger might be employed, which would, probably, be more efficient than the present arrangement, as it would be exhibited only when danger existed and it was imperatively necessary to stop. The objection to these suggestions is the radical change in working, which might for a time produce confusion. It is not a little singular that the old hand-signal for "all right" or "come on" is an arm extended at right angles to the shoulder, and I have often wondered why, when the semaphores were introduced, the position known as "on" was not adopted to indicate that the road is clear. The Great Western had, and still has, I believe, a compound signal, by which the driver is told positively to come on. This is a pole carrying a cross-bar to represent "danger," and a disc to represent "safety," so placed that when the bar is turned end on, parallel with the line, the disc faces an approaching train, and the driver has a positive signal to come on. When the bar is placed at right angles to the road, the disc is seen only on edge. I have been unable to discover why, when Gregory's semaphores were introduced, the position with the arm extended was chosen to indicate "danger." I imagine it was a mere arbitrary arrangement, which has been persisted in out of mere follow-my-leader imitativeness; possibly the idea was taken from the G. W. "danger" cross-bar. However, if Mr. Stretton, H. Stooke, or any other of your readers can point out any substantial reason for maintaining the present style (save the objection to change) I should like to read it. By the present arrangements, to put it briefly, drivers proceed unless "obstructed." I think it would be better to allow them to proceed only when positively signalled to do so, and there need be no delay or any trouble in working on that system, which obviously would lend itself equally as well to the electric slot and interlocking arrangements as the present.

Nun. Dor.

[20345.]—The idea of Mr. Stooke (letter 20267, page 427) is very good in theory, but in practice it will never do to lay down a hard and fast line of angles. The drawing shown gives the "all-right" arm too much lowered. The best authorities, and also many drivers, wish the "all-right" signal to be the old "caution," or angle of 45. The angles should be taken from the under side of the arm, not from the centre. I also wish that all lines would fix the signal-posts always on the left-hand side of the line to which they refer, not as now—some on one side and some on the other.

A Driver.

THE SECTIONS OF THE MIDLAND RAILWAY.

[20346.]—In reply to your correspondents, "V.," "C. R. M.," and others, I shall be happy to give the sections of the Midland Railway for which they ask if space can be found for their insertion.

[We cannot find space for the graphic delineation of railway sections. We give a general description of the section kindly sent by Mr. Stretton, which reaches from Leicester to Desborough. Starting from the former, the line is level for a short distance, and then for three miles rises about 1 in 400 to Wigston North Junction. Passing that there is a short sharper gradient, and then with a level interval a steady rise of about 1 in 200 to within half a mile of Glen station, which is on a falling gradient of 1 in 220; about a quarter of a mile past Glen the line rises to Kibworth North Box 1 in 165 for about a mile and three-quarters. Then commences the Kibworth Bank, which with level places here and there falls at an average of 1 in 150 for about four miles; then for 2½ miles the line goes up and down with level intervals until Market Harborough is reached, where a short fall of 1 in 132 leads to the Desborough Bank, which for four miles rises 1 in 132, and then falls to Desborough station, 21 miles from Leicester.]

In addition to the up and down main lines, there are two up goods lines on the up side of the main lines between Knighton South Junction and Wigston South Junction.

A down goods line on the down side of main lines from Wigston South Junction to Wigston North Junction. There is also an up goods line upon the Desborough Bank between Little Bowden Junction and the North Box, Desborough.

July 28th. **Clement E. Stretton.**

THE PRESSURE OF WIND.

[20347.]—Some misconception appears to exist as to the wind-pressures mentioned in a paragraph which appeared on p. 413, and I observe that Mr. Romanes, p. 478, has ventured to remark that "the figure in the 'E. M.' is evidently a misstatement." If so, the Astronomer Royal is responsible for it, as the paragraph is obviously taken from the Greenwich Visitation Report. There may be some "erroneousness" in the registrations of these high pressures; but the mere suggestion that such is the case is not sufficient, whether made by Mr. Hawksley or any one else. The instruments at Greenwich may be defective and obsolete; but one would think there can be no difficulty in arranging an instrument to record with accuracy the exact pressure on the surface of an exposed plate, whether that plate is 1ft. or 20ft. in area. The report of the Astronomer Royal is clear and distinct. He says: "A velocity of 61 miles an hour was recorded on October 14th, and one of 58 miles an hour on April 29th, these being both greater than any recorded in previous years." Now, I happen to know that on April 29th the wind did not blow steadily, but came in terrific gusts of such a character as to be rather alarming to passengers in the trains running up the bank from Nunhead to Honor Oak on the Crystal Palace line. Clearly the report gives the average for the hour, not the velocity during the middle of one of the terrific gusts, which must have been vastly greater, and may have reached Mr. Simmons's rate on his recent balloon voyage—about 130 miles per hour. Similar remarks apply to the statement of the Astronomer Royal that "the greatest pressure was 53lb. on the square foot on October 14th. . . . On April 29th, a pressure of 49½lb. was recorded at a time when the hourly velocity was 50 miles." That appears to me to be definite and distinct. The hourly velocity—that is, the average speed during one hour—was 50 miles; and during that hour—it may have been only for one minute, or even a second—the pressure was recorded as 49½lb. For all that the Astronomer Royal says to the contrary, the velocity of the wind at the instant when the record was made may have been 100 miles an hour. The formula and table given by Mr. Romanes are, therefore, worse than useless, for they may mislead. For instance, a builder or an engineer in working out his calculations might say the highest velocity recorded at Greenwich was 61 miles an hour; and the corresponding pressure by formula and table is something less than 21lb. If, then, the building is calculated to resist 42lb., it is practically thoroughly safe. But the pressure-gauge recorded 53lb., and if the builder trusts to 42lb. his structure will come down in one of those violent gusts as the Tay-bridge did. The only trustworthy data are the actual pressures registered, for houses and bridges are not like reeds, that can yield to the blast and jump up again; hence, "velocity per hour" is misleading when pressure applied for one second will destroy.

F. M. S.

[20348.]—Mr. Shaler Smith, in a paper read to the American Society of Civil Engineers last year, quoted an instance of wind-pressure of 93lb. per sq. foot, and another of 83·3lb. The former gust overturned a locomotive. According to Mr. Hawksley's formula, this represents an enormous velocity—hardly credible, indeed.

July 29. **J. A. Westwood Oliver.**

SMALL DYNAMOS.

[29349.]—As the following remarks bear on the subject of small dynamos, which have of late been denounced on account of their supposed inefficiency by Mr. Lancaster, I think it would be well for the benefit of the many readers of "ours" who are interested in the subject, that they should be published.

Being anxious to obtain a small dynamo for experimental purposes, I looked in the advertisement column, and saw there advertised castings and wire for dynamo to drive six 10-candle incandescent lamps. I determined to see what these were like; but before I did so, I saw the note that small dynamos were useless, or thereabouts. Instead of deterring me from my purpose, it spurred me on, intending as I did if not up to description to expose the whole thing. Well, I inquired, and finding a small dynamo made of similar castings as advertised, I requested that I might see what it would do. My request was at once complied with, and the machine being driven from a foot-lathe, produced current enough to light up well five 10-candle power incandescent lamps. I must add that there were only five in the shop, or else we should have put six—the full number—on at once. After seeing that the machine would really do what was said about it, I asked the loan of it to try certain experiments by myself, and so thoroughly test the full power of the machine. The maker, after ascertaining that I was an electrical engineer, connected with a well-known London firm, readily consented to my proposal, and accordingly I took it to my own place, and having steam-power at hand, put to it what I calculated about a quarter-horse. I found that running at about 1,700 revolutions per minute, it drove at their full power six five candle-power lights. Increasing the speed to 2,000 revolutions, it drove from four to six 10-candle lamps; and to further test the machine I increased the speed to about 4,000 revolutions), and (contrary to the maker's expectations), drove two 20-candle power Swan (parallel), five 10-candle power (two in series), and four five-candle power (all in series). I must own that in the latter experiment the light given out was not their full power, whereas in the previous experiments the lamps gave as much light as they should do, to last their proper length of time.

I had no more opportunities for testing them; but was informed that the same machine would drive a small arc-light with three or four millimetre carbons. However, I shall soon be able to take the measurement of the current and E.M.F. of my own machine, which I am having made in the same style as the one I tested.

Although our friend, Mr. Lancaster, has denounced these small dynamos, I trust readers of the "E.M." will not be discouraged, but go on and succeed, as I firmly believe success is attainable. I would willingly give any other information in my power to any one who may need it. I may add, that with the castings of machine with which I have experimented, directions are given how to proceed to complete it.

Tried.

THE BERLINER VIOLIN.

[20350.]—Since I sent you the violin to be criticised, I have been told how risky it was for me to do so, not only on account of the prejudice existing against innovations on this instrument, and not only because it is an easy matter for a player to produce an unfair comparison between two instruments, but also because of the thousands of violins on which a high value is set by their owners, and who would enter into an alliance of self-defence to decry the innovation and seek out every argument to sustain their ground. But this is unavoidable, and I am perfectly satisfied that there are many others who will fairly test an improvement offered, in the face of the difficulties which now beset violin making, and which my invention is intended to overcome.

If, however, as is done by Mr. Schucht, assertions are made based upon mere hearsay or tradition, and which cannot be sustained by scientific principles, I am bound to defend myself. Mr. Schucht says that in the ordinary violin "gravity" is used to produce tension on a small quantity of wood. Can anyone explain this? Or, will Mr. Schucht point out a single action of gravity on the fiddle he plays? He further says "that no such pressure as 75lb. being exerted upon the new violin, it must be deficient in quality or intensity of tone." This is mere theory! Supposing I have a simple sounding-box, to which I apply a tuning fork, will that box resound louder if I compress it between two opposite points? Not much! As far as quality is concerned, one player prefers this, one that kind of sound for a violin; but the general demand is for a free and sympathetic tone, and I have not found a single instance in which this was not the case when a resonator was applied.

Loudness of tone, however, is depending upon the age and sonority of the wood, and with the G and D strings upon size of strings and the bass bar. Furthermore, the general "graduating" of thicknesses and other points in workmanship have a good deal to do with it.

The violin sent to you was a cheap factory-made one, on which no special care or graduation is usually applied, and which is made of unselected new wood, and if it sounds free and sympathetic and fairly loud, these qualities are the right ones, and they are but rarely found combined in any violin.

Far-reaching power comes as the wood seasons, and the violin is played upon a while.

I hold the difficulty in making a good sounding violin (or two violins alike good) lies in adjusting its structure and quality of wood to the compressing influence of 100lb., a pressure which must necessarily affect the fibres and their molecular vibrations, and the reason why old violins are better-sounding than new ones is because the wood by long seasoning has acquired stiffness of fibre and porosity of texture (hence of greater sustaining power), the two prime qualities of good violin wood. In taking away 75lb. pressure of the 100, the vibrations at once become free and pure, and the violin can be subjected to such alterations as the new string holder admits of. Such changes will be that we can reduce the thickness, and that graduations can be modified so as to enhance the quality of the tone regardless of danger arising now from the pressure of 75lb. tension.

That Mr. Anderson, by putting a light mute on his violin, produced "a similar quality of tone" as in my violin, merely says that his became soft and sympathetic, and most likely it is otherwise, a loud but hard-sounding instrument; but if it is meant to indicate that the tone of my violin is "muty," this is against the experience of other critics who would not have hesitated in making known so glaring a fault.

Let me say in conclusion that before long I will enter upon such challenges with "first-class old violins" as will leave no doubt of the superiority of my device, and, until then, I am ready to meet those critics who base their arguments upon a scientific basis; but I must leave it in future to the intelligence of your readers to refute the criticisms of all who argue with such loose theories as Mr. Schucht. **E. Berliner.**

"A BLIND MAN'S VISION."

[20351.]—The insertion in No. 901 of my lines respecting A Blind Man's Vision, incites me to send you a description of my two discoveries.

As I have said, when I have long observed the sun without sight-protection my eyes are deeply insolated; if, then, I turn my back to the sun and look at the white ceiling of my room, I see all the solar phenomena reproduced but in reverse colours—that is to say, I see in black what was white, and *vice versâ*. If I shut my eyes and look—so to say—through the eyelids, I again see the same phenomena, but the colours are not the same. If, then, I place my hand over the eyelids to shade them, the same phenomena persists, but again their tints are changed. If I strongly contract the eyelids, new tints are the result. If I go in a dark place—a cellar—then again the phenomena are altered, and light replaces darkness. For several days the central visual point forms a dark disc through which I can discern nothing—I can only see objects in a diffused light round the dark disc. After a few days the disc changes, and instead of black appears coloured. The colour is not constant—it changes, and, on repeating the above operations, numerous changes of tints are observed. The darkness of the disc gradually fades away, and the changes agree with the scale of the spectrum colours, and concords with the complementary colours. The effects are innumerable and all very curious.

The insolation persists about two months. Having most attentively observed all the physico-physiological facts produced, and seen in what manner the insolation decreased, I suspected that by reinsolating my eyes successively, not with solar light but with coloured light, and following the spectrum colours and their complementary ones, I could shorten the period of deinsolation. I tried and completely succeeded, so that ten minutes or thereabouts after a complete insolation, I had obtained a thorough deinsolation.

Such was my first discovery. Since, I never failed; therefore, I consider this process as suppressing the consecutive actinic action of light on the organ.

On the 17th of May last I observed with unprotected eyes the partial eclipse of the sun, and as it lasted long, I made four successive observations. Not only could I see perfectly the eclipse phenomena, but in the mean time I observed a spot on the sun with all its details. After these four observations my eyes were not only deeply insolated but also deeply fatigued and painful. I deinsolated them as usual in about fifteen minutes, but I remarked that a sort of reddish disc remained, which did not vanish for several days. At last it disappeared, but then I observed a sort of cloudy shade in the right eye, not in the left. How shall I describe it? It was something like a drop of milk in a glass of pure water. After a few days it seemed to settle. A sort of delta-like shading was nearly in the centre. On moving the eye the whole cloudy matter moved; but I observed that the delta was not on the same plane as the circular shade. It was evident that the circular shade was in front on the border of the crystalline, and that the delta was at the bottom of the eye towards the retina.

I then took a small optical instrument, which is something like that which Robert Houdin named Retinoscope, in which my eye can see its own internal image. Then I saw plainly that the phenomena were caused by a coloured substance swimming in the vitreous humour, part of it on the brim of the crystalline and part on the deep part of the eye. Then, by a peculiar contraction of the eye, I could realise by the effect of light that the cloud was composed of microscopic circular rings formed by an internal dark line bordered by light each side; these rings were swimming in the vitreous humour. The delta had become thicker and was of a dark brown, also lighted each side. I arrived at the conviction that it was part of the brown pigmentum that coats the choroid, that had been dissolved and diluted by the powerful action of the solar light, and, in my opinion, M. Plateau's blindness has no other cause. It is his eye's pigmentum that has been totally dissolved, separated from the hyaloid membrane, and is expanded in the whole extent of the vitreous humour, and thus prevents light reaching the retina's fibrils; hence no sight possible, but shaded tints passing through the dissolved pigmentum still act on the retina, and quite naturally after such action, the reaction of the retina produces the complementary colours.

Having arrived at this conviction, I could not help thinking that a cataract, which, of course, was much thicker than my cloud, could be dissolved, removed, and cured by electricity. But in this case could I expect that the fluid would carry off the substance or recoating hyaloid? This seemed rather too much. But I thought that it could act so as to move the matter and carry it in a place where it would not much interfere with vision.

Unfortunately, I live in a small village where I can procure nothing of a scientific order, and I had not any electrical apparatus at hand. I possess two small magnets. Directly, I thought of applying them to my eye. I used both of them, uniting for a greater action their like poles. I shut my eye and placed the north pole on the centre of the eyelid and the south on the cheek, expecting that a repulsion would occur towards the south pole. The first effect I observed was the production of a great brightness (*clarté*) at the place of contact of the north pole, which brightness interfered largely with the cloudy substance, which was agitated. The small rings were disappearing, forming a sort of milky cloud. The delta seemed darker, and bordered by a bright line. Presently I saw discharges, the forms of which were similar to those produced by the electric spark on a looking-glass. At first I felt no sensation, but after a short time I felt a gentle tickling gradually increasing. I wetted the magnet's poles with saliva, and the tickling was transformed into a prickling sensation. Opening the eye, I put the pole in contact with the mucous membrane and the sclerotica wetted by lachrymal fluid; then the prickling intensified, the intermittent discharges became painful; some were so strong that my hand moved in consequence of the sensation. The action of the magnet was self-evident. There is not the least doubt that it acts powerfully on the fluids and liquids of the eye. Mine is now almost entirely cleared, the diluted pigmentum is confined on the brims of the crystalline and hyaloid, and the delta, which is smaller and darker, is now situated on the right towards the bottom, and does not prevent sight, although remaining visible.

For the present I will say no more. I leave it to medical men to experiment for themselves.

Ch. Rabache.

MEDICAL REPLIES.

[20352.]—Oatmeal Porridge Again.—Letters continue to reach me asking for information as to oatmeal and oatmeal porridge; the writers generally saying that they have mislaid their numbers of the English Mechanic, or cannot find my articles. I cannot undertake to look up the index of the "E.M." and write private letters on this ground. Such writers should send 2½d. in stamps to the publisher, and ask him to forward by post the number containing any article that may be referred to. The index of the "E.M." gives "subjects," but not "author's names," and therefore querists must look, not for author's name, but for the subject, when they want to refer back to any such letters. My letter upon oatmeal porridge will be found in No. 848 (June 24, 1881, [43944]), and some supplementary remarks will be found in No. 852 (July 22, 1881, page 479. I observe two *errata* at page 479, where (last line in first column) "best" should read *test*, and (last line but eleven in second column) "table" should read *talk*. These queries upon oatmeal porridge being, however, of such general interest, I reproduce some of my former remarks.

1. Oatmeal porridge and milk is one of the most digestible and sustaining of all foods. For growing young people it provides the "bricks and mortar" which are required for building up solid bone and healthy tissue. For dyspeptics, with some rare exceptions, and for people who have defective teeth, it saves dyspepsia and maintains the patient's strength. For nursing mothers it is *the* food which makes the very best milk with the least strain to the mother's system. For intellectual or physical workers it meets every requirement at a minimum of digestive effort. The limitations which I observe in my own practice are these. Full-grown adults, who require repair rather than additional building, do not benefit so much by it if their teeth and stomachs are robust. The finer meal, in which a larger proportion of earthy matter has been eliminated, should be chosen by persons who no longer have their teeth and bones to build. Some dyspeptics cannot take the porridge without getting souring of stomach. In most cases of this kind the souring is due to the use of bad oatmeal, or to bad cooking of the porridge. In others it is due to the fact that the stomach and system are damaged by the use of alcohol, tobacco, or by the abuse of tea. There remain a few cases in which, however, it is found not to agree. In most cases, after alcohol, tobacco, and tea have been left off for a week it agrees perfectly. The souring will be remedied by taking a small teaspoonful of heavy calcined magnesia in a cupful of ginger-tea whenever attacks of souring and flatulency come on.

2. To make good oatmeal porridge, four things are necessary—clean boiling water, a clean saucepan, good meal, and some good sense. When young people will not eat oatmeal porridge and milk, it is a sign that the mother has not been provided with all these requisites, and it may be safely assumed that the fault lies in the porridge. As to the saucepan, it must be not only "clean" in the vulgar kitchen sense, but it must be fit to drink out of. Breadstuffs and milk can never be nice unless they have a saucepan to themselves. Saucepans in which meat or vegetables have been cooked never again are got into such a state that one would like to drink out of them. There is always a coarse flavour adhering to the saucepan. As to the meal, it should be clean, dry, coarse-grained, and so sweet that one is tempted to eat of it. It must be bought from some shop where the master knows "what is what" in the shape of meal, where it is stored properly so that mice, beetles, or mildew do not get at it, and where, there being a large sale for it, it is always to be had fresh. The consumer, again, should store his meal in a dry jar or large bottle or tin, as carefully as if it were tea or coffee. Now, having clean water boiling upon the fire in a clean saucepan, and your meal in a basin (2 or 3 ounces to each pint of water) draw the saucepan off the fire, and as soon as the water ceases to boil sprinkle the meal in through the fingers, free from lumps, and so that the meal is fairly distributed in the water. Then push the saucepan back on to the fire and boil briskly for a few minutes, so as to mix the water and meal thoroughly up before it has time to thicken or get lumpy. After this, the saucepan may stand aside and be allowed to boil slowly for three-quarters of an hour, the porridge being kept on the move by stirring with a clean wooden spoon. The porridge should be boiled so that its starch granules are all burst, and the meal efficiently cooked; and being neither burnt, nor smoked, nor lumpy, it should be poured out into a vegetable-dish, and put aside uncovered until it sets like a jelly. It should then be eaten with cold rich milk, and if the porridge be right, and the milk be good, no nicer, purer, or more nourishing breakfast or supper can be had than a saucerful of this porridge with a half-pint of milk. A little salt may have been put into the water according to taste. The porridge, when taken upon the plate, should be a

soft tremulous jelly, uniform in consistency, and not damaged in flavour by burning, smoking, or by dirty cooking. With young children, and with adults not disposed to corpulency, a little treacle or golden syrup may be put upon the porridge before the milk is poured over it. Such porridge keeps perfectly for twelve hours, if put away carefully, and it comes in well for supper or for a light scratch meal.

3. As to the standard of what I call "good meal," and as to getting good meal, the following data will start any one who wants to begin right. The meal for my own household is obtained from Jackson and Co., 45, Piccadilly, and I know of no one more up to "what is what" in table knick-nacks, preserved meats, fish, fruits, biscuits, &c., than Mr. Jackson. He sells various grades and qualities of meal, all very choice, and which make delicious porridge. After my first letter on this subject, a specimen bag of nice meal was kindly forwarded to me by Thompson and Sons, 5, Leven-street, Edinburgh. I found their meal everything that could be desired, and by sending 2s. 6d. in stamps to either or both of these firms, a sample bag of meal will come on at once. Some persons like a finely-ground meal; some a clean, coarse, granular meal, quite free from flour. In all cases, the oats must be of the finest quality, free from foreign seeds, and perfectly cleansed from grit and husk before they are made into meal. Another meal which is very choice is the "A B C" meal. This is put up in packets by the "American Breakfast Cereals Company." It is very fully dried and partially cooked in long iron tubes, heated by high-pressure steam-jackets, and the meal is forced through by an Archimedean screw, which keeps the meal always on the move. I found the A B C meal expensive but very choice. It goes much further than undried meals and needs much less boiling, but to my taste it is not cooked sufficiently in the "ten minutes' boiling," which is prescribed on the label.

Tender Feet (47497).—Indigestion (47498.)—Read former replies. Querists need to get personally examined, so as to define the cause of their sufferings and learn something about their constitutions and mode of life. If I were to prescribe for patients who, without ever yet having learnt what is the cause of their disease, have "tried everything, including homœopathy and allopathy," whatever these two things may be—I should only be standing in the way of many well-meaning writers who are always ready to prescribe remedies of which they know infinitely little, for diseases of which they know infinitely less—their practice being, I suppose, based upon the principle of *similia similibus curantur*, or likes by likes are cured. **James Edmunds, M.D., &c.**

Grafton-street, Bond-street.

LEGAL REPLIES.

[20353.] — Intestate (47503). — The state of things described as existing by this question is an instance of the confusion caused by the omission to take legal advice at the proper time. It is not easy to make out what happened. If the wife survived her husband she should have taken out letters of administration to his estate, and divided it so as to take one-third for herself, and portion the rest amongst the children. But this apparently was not done; and as matters now stand, any one of the children, if of age, can take out administration to the estate left by the father or mother, and, after payment of debts, divide it between himself and the other children in equal shares. The elder brother can only claim his share, as this is personal property, and his marriage does not prevent the other brother having his portion; while the house, being in the elder brother's name, has nothing to do with it, presuming the house to be no part of the estate.

(47519.)—The words of the will, as quoted in this question, are quite correct and valid, and are indeed the proper legal phrases to use by a man who wishes to leave his wife all the property, both real and personal, of which he may die possessed. It was once the law that a will only spoke from its *date*, and consequently did not pass any real property acquired by the testator after that date. But this was altered by the Wills Act, 1837, and since then it has been, and is the law, that every will is to be construed as if it were made immediately before the death, so that its date becomes so far immaterial. If a testator specially referred to property then in his possession at date of will, it would be different, but here the words are general, and would pass all he had at his death.

(47536.)—The form given in this question is very badly drawn if it were intended as an acknowledgment of rent; for the word "rent" is not even mentioned as it should have been, with a description of what rent, when due, where, and the like. But, in fact, the paper is far more than an acknowledgment. It is really a promissory note, and should have been written upon a threepenny stamp. Regarding it as a promissory note, the want of a stamp cannot be cured afterwards. But looking upon it as an agreement, which it is also, it should have a sixpenny stamp, and this can be put on it within fourteen days afterwards. If, however, this time has elapsed, then a penalty of £10 must be paid before it could be used as evidence in a court of law, with a further £1 if actually stamped in court.

(47547.)—Contracts in general restraint of trade are wholly void, as being contrary to the policy of the law. But a contract in partial restraint of trade, if made for a valuable consideration, is perfectly valid. If, therefore, it is agreed between master and servant that, in consideration of the employment, the servant will not, either during or after his engagement, set up in the same trade within certain defined districts; this is a contract that will be legally binding on the parties. The form quoted is very badly done, and is insufficient, as it does not state the consideration for B.'s promise, while the word "encroach" is too vague to be of much use. But I really cannot draw an agreement of this kind without further facts.

[47354.]—The magistrates having made their order upon the husband to pay so much a week for his wife's support, and having done so upon the application of the parish, the husband's only course is to give notice to the workhouse authorities that he will apply to rescind or revoke that order, and to apply accordingly. If the husband means by the word "misconduct," that his wife has committed adultery, there would be a good ground upon which to ask to have the order revoked. Should this be the state of things, the husband had better proceed at once with his notice and application, and have his witnesses ready to prove his wife's adultery before the magistrates.

(47557.)—By the last Real Property Limitation Act, which, though passed in 1874, did not come into operation until the 1st January, 1879, it is enacted that actions to recover possession of land cannot be brought after 12 years from the time when the cause of action first accrued, instead of 20, as it was before. If, therefore, the neighbour has been in possession of the piece of land in question for 14 years, he would have a good defence by pleading the statute to the action. The date from which the 12 years reckon would be the time when he obtained possession. If "Loser" has looked on for 14 years without asserting his rights, he has only himself to blame. But even should the mistake have been mutual, and although he has only recently discovered it, the statute would run from the day when his neighbour got possession, and so bar his remedy.

(47559.)—In this case the querist should take out letters of administration to his mother's estate; as, until he does so, he has no legal right to proceed for the recovery of her property. As administrator, he should then bring an action in the Chancery Division against his brother for a declaration that the houses in question form a portion of his mother's estate. If what he says as to the houses having been bought with her money, and being about to be transferred to her name just before her death can be proved by him, the Court will declare them to belong to his mother's estate, and he will then, as administrator, be able to sell the houses and other property under the order of the Court, and the estate will afterwards be divided between himself and his brother equally.

Fred. Wetherfield, Solicitor.

2, Gresham-buildings, Guildhall.

TRICYCLES.

[20354.]—I am glad to see the subject of tricycles is not quite dead in our favourite "E. M." I quite agree with H. A. White, that tricycles are not fully developed yet; but they are making rapid improvements. I have been experimenting for some months. I have just completed the arrangement Mr. White speaks of. I tried my machine last night, and found a decided difference in regard to the power obtained. I set my cranks back 3in., and handles forward 2in.

In respect to the handles being placed directly over the axles, I do not agree, as you would be liable to tip forward in going down hill, and get an ugly spill.

I may have something to say soon about brakes

July 30. **Ex.**

GAS-ENGINE EXPLOSIVES.

[20355.]—In No. 903, July 14th (20274), "Ll.B A." says:—"I should like to hear the opinion of other correspondents on these points, which are of great interest." He had said before: "If we burn one gramme of hydrogen with sufficient oxygen to form water, we develop *about* 34,000 (gramme degree centigrade) units of heat. Now, Sir, science admits of no *about*, it being unscientific. If you would kindly permit me to intervene in the question, I would first say that the number of calories elicited by such combustion, are not *about*, but exactly 34,560, which, so far as I know, is not yet known to scientists. At least, I never noticed it in any English text-book or other publication. There have certainly been many figures given as the true one, but all are empirical, and not stœchiometric — *physical stœchiometry* being still at this moment unknown to chemists and physicists. In a communication to the Académie des Sciences, 7th February, 1881, I said: "Récemment M. Berthelot informa l'académie qu'il avait observé que la combustion de H_2 *produit* 69,000 calories; mais il ne dit pas *avec quoi* elles sont *produites*, ni pourquoi c'est 69,000 plutôt que tout autre nombre. Si H_2 produisent 69,000, H produit 34,500. Est-ce bien là le véritable nombre? Quels en sont les constituents? Comment le prouver? Selon quelle loi physique et quelle stœchiométrie? De nombreux savants se sont préoccupér de ci sujet, tous ont obtenu des résultats différents. Laplace et Lavoisier ont obtenu 23,352 calories, Clément Désormes a trouvé 23,294; Despretz, 23,640; Dulong, 34,601; soit moitié plus, ou 3 au lieu de 2. En 1843, Andrew trouva, 33,613; en 1845 Fabre et Silberman trouvèrent, 34,462; en 1860, Pelouye et Frémy trouvèrent 30,000; en 1872, Thomson trouva, 33,971; en 1877, Than trouva, 33,867; Schuller et Warter trouvent, 34,126; et M. Berthelot, 34,500. Tous ces chiffres si dissemblables ne peuvent être vrais; en est il un seul qui le soit? Aucun de ces habiles expérimentateurs ne donne *le mode de production de ces calories de cause à effet selon une loi*, n'en indique *les éléments ou équivalents constituents et leurs proportions*, de sorte que tout contrôle *scientifique* est impossible, et qu'il faut *croire*, non savoir, *douter*, ou *nier*. Mais de tous ces savants également habiles, lequel croire? Le mieux n'est il pas de *douter* encore? Les quantités poids, et volumes der gaz employés, celle de l'eau produite, sont exactement les mêmes pour tous. Pourquoi donc la chaleur développée diffère-t-elle de 2 à 3, et ne se ressemble-t-elle chez aucun? Évidemment les élements constituents *chimiques* et *physiques* de l'eau et de la chaleur sont les mêmes pour tous. Qu'advient-il de la chaleur qui manque chez les premiers expérimentateurs? Le savant doit au public ces explications précises, incontestables, et autant qu'elles sont connus.

> "Ex nihilo nihil; in nihilum nil posse reverti,
> Omnia mutantur, nil interit.

"De tout les chiffres donnés, celui qui se rapproche le plus de l'exactitude est celui indiqué par M. Berthelot, bien qu'il ne sait par exact. Celui de Dulong est trop élevé, celui de Fabre trop bas. Qui donc indiquera le chiffre vrai? = qui? — ce sera *la loi physico chémique* et *les deux Stœchiométries chimique et physique*. Ce sont elles qui donnent l'équation incontestable qui suit:—

"$1 \times 3 \times 4 = 12 \times 12 \times 12 = 1723$; $\times 20 (= 4 + 16) = 34{,}560$ ou $34{,}560 \times \frac{2}{3} = 23{,}040$.

"34,560 calories sont obtenues quand la combinaison est obscure, et 23,040 lorsqu'elle est lumineuse; les proportions et équivalents constituents qui produisent la lumière sont exactement ceux qui manquent à la chaleur. Les premiers connue les derniers expérimentateurs ont donc également à peu-près autant raison l'un qui l'autre; leur empirisme approche de la loi. Les chiffres de l'equation ci-dessus ni sont point de fantaisie, ils reposant sur les faits, les corps, leurs formes, leurs volumes, leurs poids, leurs éléments constituents chemiques et physiques, pondérables et impondérables en proportions fixes et absolues de leurs équivalents. M. Berthelot a lieu d'être fier d'avoir approché la vérité a 0 000 près. Mais il ne sait pas pourquoi." Your correspondent thinks that the combustion of the two gases HO invariably produces the same quantity of calories in every possible combustion; but he is mistaken. The same quantities of the same gases contained in bodies composed of the same chemical elements in same proportions, but differently arranged, do not produce by combustion the same heat, and a calculation based on the chemical atomic weight exclusively will not prove correct. Imponderous elements acting as factors of heat must be accounted for. *Heat is not produced by chemical or ponderous substances*, but by their imponderous elementary constituents. Bodies of exactly the same chemical composition, the ones odorous, the other inodorous, or of different smell, do not produce the same number of calories—e.g., essence of turpentine and essence of lemon are both composed of $C_{20}H_{16}$; but the density of the first is 0·864, the second 0·847, their odour differs, and their combustion does not produce the same heat. The difference in the arrangement of the constituents of smell makes the difference of heat. I submitted to the Académie a table of eleven different states of bodies composed of $C_4H_4O_4$ = weight 60, the combustion of which did not produce the same heat. On page 416 there is an article on "The best Gas for the Gas-Engine," in which details are given of empirical experiments respecting the correspondence of light and heat produced by gas-combustion, in which the author takes no notice of the respective elementary constituents of these two fluids. Of course coal, as well as all other combustible substances, by combustion elicits light and heat, which are in a right ratio with the proportions of the constituent elements of each they contain, and their arrangements. If, therefore, a chemist knows *the elementary constituents of heat and light, the quantity of them contained in the combustible and combinant bodies, and their special arrangement*, he is sure to be able to tell and explain a priori what quantity of light and heat will be elicited by their combustion; but vice-versâ, he would be mistaken who would believe that all sorts of coal always produce a same given quantity of same gas—that cannel coal, for instance, always produces the same quantity of gas of the same quality—that is to say, always produces the same number of calories and of candle-lighting power. These vary according to circumstances, and the manner in which the gas is extracted. If, for instance, the retorts are heated under 800° C, there will be a great quantity of coal-tar produced, but less gas of middling lighting and heating properties. If at 800°, it will be superior both in quality and quantity; if above 900°, 1,000°, the quantity will be greater, its lighting properties will be inferior, its heating ones will be superior. In such case a quantity of carbon oxide is produced which increases the volume of gas and its heating properties, but diminishes its lighting ones. In all cases the proportions of heat and light in gas are in correct ratio with the respective proportions of elementary constituents of each fluid contained in it, provided nothing else interferes. Therefore I repeat that any one who knows which are these respective constituents will be able to tell beforehand the proportions of heat and light that will be elicited in their combustion; and this is simple and easy to any one who knows chemical and physical stœchiometry, but is totally impossible to any one who is ignorant of them. Every one knows gunpowder explosions; but who knows in what they differ from boiler explosions? who can explain it according to a law by mathematical equations. Textbooks say nothing of it. I will here explain gunpowder explosions, which can be controlled, but, for fear of committing blunders in writing English chemical terms. I will express myself in my native language. La poudre à canon est = $KOAzO_5, C_3S$. L'azotete de potasse $KOAzO_5$ a la formule $KOAz.\overset{+}{O}\overset{--}{E}_5$. Le soufre $S = S\overset{-}{E}_3$, et le charbon $C_3 = C_3\overset{-}{E}_9$. 1°. Le potassium se combine avec le soufre $S\overset{-}{E}_3$ et les équivalents négatifs $\overset{-}{E}_3$ du charbon, et devient du sulfure de potasse $K\overset{-}{E}_3S\overset{-}{E}_3$; 2° Le carbone C_3. Se combine avec les O_6 restant, et forme l'acide carbonique C_3O_6. L'azote Az devient libre. En admittant un atome double de poudre on obtient les résultats suivants:

$$K_2O_2Az_2\ \ \overset{+}{O}\overset{}{E}_{10} + C_6\overset{-}{E}_{18} + S_2\overset{-}{E}_6 = K_2\overset{-}{E}_6S_2\overset{-}{E}_6 + C_6O_{12}\overset{+}{E}_3 + Az_2\overset{-}{E}_2 + \overset{-}{E}_{10} + \overset{+}{E}_7. +$$

L'explosion est produite par les équivalents $E_{10}E_7$—devenus libres. Elle produit peu de lumière et beaucoup de chaleur

$$3\ \overset{-}{E}_{10} + 3\ \overset{+}{E}_7 = 4\ \underset{-\ \ +}{\overset{+\,-}{E_2E}} = \underset{-\,+}{\phi} \text{ Lumière} + 13\ \overset{+\,-}{EE}_2 =$$

θ = Chaleur. $E_{10} + E_7 = EE_{17} = \psi_4 + \theta_{13} = \psi\theta_{17}$. Until now gas-engines could only be used in places where gas can be procured from gas-works. Owing to my process for producing gas on the spot, without gas-holders, and in successive quantities proportional to the supply of every piston-stroke, it is possible to use them anywhere. Besides, a day will soon come when coal will be replaced by water for heating and other purposes, either by my system or by instantaneous transformation in gas, or by any other more perfect one. Then setting the Thames on fire will no longer be nonsense—it can easily be done now. Then it will no longer be the ship that will carry her own combustible, but the combustible that will carry the ship. This will cause a great revolution in industry at large, in which I feel happy to think I shall have my share.

Ch. Rabache.

Morchain, par Nesle, Somme, France.

CROWN-GLASS ACHROMATISM.

[20356.]—I SHOULD have sent this note sooner, but have been waiting with the expectation of seeing more particulars about the crown-glass telescope proposed by your esteemed correspondent, Mr. W. G. Penny. To my mind, it completely proves the impossibility of making such an instrument achromatic.

Let us turn to page 273, on which appears the equation of achromaticity, viz.:—

$$(f_1 - d)^2 = f_1 f_2.$$

Since the dispersive power varies inversely as the focal length f_2 must be less than f_1; for if not, the convex chromatism would exceed that of the concave when the lenses were in contact, and the error would be increased by separation.

Also, in order that a real focus may be formed, it is absolutely necessary that the reduced focal length $(f_1 - d)$ of the first lens shall be *less* than the focal length f_2 of the concave lens; for if not, the rays would diverge on emerging from the second lens.

Can these two most essential conditions be satisfied by the preceding equation?

By taking the square root of each side we have:—

$$(f_1 - d) = \sqrt{f_1 f_2}.$$

Now, since f_1 is greater than f_2, the square root of their product must be greater than f_2; therefore $(f_1 - d)$ is *greater* than f_2. But we have just seen that it ought to be *less*; therefore, the two conditions *cannot* be simultaneously satisfied.

I trust "W. G. P." will examine the matter, and see if I have in any way misunderstood his reasoning. Like a valued friend who writes thus to me—"I cannot yet see Mr. Penny's telescope a success, but I should like to be wrong."

Orderic Vital.

REPLIES TO QUERIES.

◆

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[46744.]—**Marble.**—Thanks for replies. I have been told that Kilkenny is paved partly with its black marble. Could "H. O'B." tell me where the variety known as "Irish Green" is found? I think it would be interesting and useful if readers of "ours" would say where marble from different quarries can be seen in public buildings. What do English marbles cost per foot (cubic) at the quarries? Is there no blue marble?—MURANO.

[47059.]—**Iron Chimney Rusting.**—If "J. R." will mix soot and boiled oil together to the consistency of thick paint, and put that on to his chimney, I think he will find that it does not come off, except close to the bottom of the chimney. The bottom part of the chimney requires painting once a week. Occasionally rub the chimney over with an oily cloth or cotton waste.—W. J. B.

[47174.]—**Pedal Reeds.**—To MR. J. H. HUXLEY.—Would you kindly give an outline sketch of the arrangements adopted in the instrument named on p. 385 for the pedal work, showing windchest, bellows, &c.?—J. H. T.

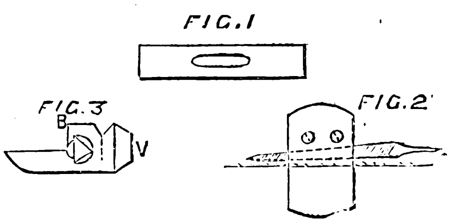
[47215.]—**Embossing Glass.**—According to "Phonetic's" account he has either got hold of peculiar glass or does not give long enough time. If the etched parts are wanted clear, the glass must be in contact with the acid. What does querist mean by saying he used the acid "pure"?—A. B.

[47219.]—**Textbook of Physiography.**—The best books for this subject are Archd. Geikie's "Lessons in Physical Geography," and Huxley's "Physiography," both published by Macmillan. If you study those books thoroughly, you will be able to answer more questions than some of the examiners themselves could.—S. R.

[47223.]—**Bird-Cage Making.**—You want a pair of cutting-pliers, an archimedian drill, and two boards, in one of which you have a number of pins stuck in zigzag fashion to straighten the wire, and the other for sticking pins in to bend the wire to the shapes required.—T. P.

[47226.]—**Picture-frame Making.**—In reply to "Beta," I may state that I made my shooting-board after the pattern of those used by professionals, thus:—Take a piece of inch stuff, say 3ft. long by 10in. broad, plane it up true, on top of this glue and sprig another board same length, but say 4in. narrower, and about ⅜ thick when planed up. On top of this and in the centre of its length, glue and screw a piece at an angle of 45°, say 1½in. deep by 2½in. wide. From "Beta's" query it appears that he drives his plane alternately with the right and the left hand; but this is not according to "Cocker." Place the thumb on the piece of moulding, and the rest of the fingers against the opposite side of the angular piece, and squeeze firmly; then turn the moulding end for end, and ditto ditto. Memo.—Ascertain by means of a square as is square. (Amateurs' squares are not, as a rule, more than nearly square; and should you, or any other man, doubt my assertion, you or the other party need only to plane up carefully the edge of a board, and place the square against it; draw a fine line with a sharp chisel, then reverse your square, and adjust your error, which it is extremely probable will appear.) By means of this adjusted square, ascertain if your trying plane, when lying on its side, is exactly at right angles to the part where the moulding lies, as I had to sprig and glue a thin strip along the outside edge in order to adjust this error. Finally, have a fat goose for dinner as soon as possible, and preserve the grease to put on the sole and side of your plane, and you will find these directions to be "plane" sailing.—J. J. A., Liverpool.

[46748.]—**Sharpening Carpenters' Saws, &c.**—Just a little more to conclude this subject. Last, but not least, in the sharpening of saws, of whatever class, they are apt to get out of order—that is, in hills and dales, and they will need the doctor. The following sketch will give you an idea. Fig. 1,



a piece of ash or beech, 1½in. by 2in. by 6in.; a mortise cut in it, and a flat, oval pebble inserted, held against a circular-saw to show where it runs out; touch up where wanted with a file until true; the other, Fig. 2, a piece of ash, birch, or any firm wood, 2½in. by 2in. by 1in., about 1½in. from the crown A; bore a hole in the centre of edge, the size that a piece of saw-file will drive in, and cut as shown. B and C, Fig. 3, show it in operation.—JACK OF ALL TRADES.

[47230.]—**Unhealthy Trades.**—Wool-sorting, fork-grinding, and similar occupations, are the most unhealthy. I should say it is decidedly not impossible, though probably very difficult.—S. R.

[47231.]—**Insulating Material.**—Yes; insulite. This substance was described under head of "Scientific News" a few weeks ago, but I cannot refer you to exact place.—H. STOOKE.

[47239.]—**Deafness.**—"Another F.R.M.S.," in replying to the above, at page 481, advises the querist to "take one-half of his vegetables after their conversion into beef or mutton," on the plea that "the vegetable food he is groaning under is, without doubt, deficient in bile elements." As the question is of great interest to many, perhaps your obliging contributor, Dr. Edmunds, would say whether there are valid grounds for this dictum. My experience is the other way. For years I suffered from sick headache about every six weeks. Cure: bed, and 5-grain blue-pill, with seidlitz powder next morning. Ultimately, the attacks culminated in a sharp attack of congestion of the liver. On recovery I determined to make a complete change in my diet, taking meat only as gravy with my vegetables, winding up with some light pudding and no pastry. Under this *regimen* my headaches vanished, although I sometimes "see stars" on suddenly stooping. I have always thought that what is called "biliousness" arose from an overplus of bile, and not from a deficiency, as we are now told. Further elucidation on this point would be of great interest to many, as well as to—H. J. NOLAN, Clifton Villas, W.

[47239.]—**Deafness and Vegetarianism.**—"Another F.R.M.S." seems to think he has a capital argument against vegetarianism. However, I imagine he is not a vegetarian himself, but has been totally deaf for twenty years. As a fact, I have never before heard of a deaf vegetarian, though I know many flesh-eaters who are so. I have myself been a vegetarian ten or twleve years, and certainly have full use of my five senses. My hearing is very acute—I can distinctly hear the "dtt dtt dtt" or "sst sst sst" of the bat, which I read, I think, in "ours" was a test for hearing, and my sight also is very good. I have frequently distinguished objects at a distance when people with presumably average good sight said they could see nothing. I have counted 15 or 16 stars in "Charles's Wain," and I am by no means wanting in taste, touch, or smell. However, I never had beer, wine, spirits, tobacco, coffee, or tea before I was 16 years of age, and I practically abstain from them now. Never drink spirits, and not smoke quarter of an ounce of tobacco yearly. I cannot say I have ever felt evil effects from wine, but I always eat plenty before drinking it, and should not think of taking it when I had any great strain on mental or muscular powers, nor in very hot or cold weather. I should fancy Mr. Ollard takes, or has taken, largely of tea, coffee, or some drug or drugs, which has injured his digestive organs. Let him try oatmeal porridge before breakfast (a plate of porridge and a basin of cold milk, and have your meal from the Highlands. A miller advertises in the "E. M." who supplies excellent meal, and not too coarse). Have good bread made of the whole of the wheat, ground very fine—if it can be got, or Vienna (Hungarian) bread. I have a great dislike to the coarse whole-meal bread myself. Why is it recommended so? The only time I ever had heartburn it was caused by eating a loaf of this bread for tea. Mangoe chutnee would be, very probably, beneficial. Try a third of a shilling-bottle every day at dinner for a week. It is nice with rice boiled in water, with sugar.—MURANO.

[47239.]—**Deafness and Biliousness.**—Life is what we make it, and I should be indeed ashamed if such slight inconveniences as deafness and biliousness were to take all life's enjoyments away. What I wanted was an answer from so sensible a man as Dr. Edmunds as to the best exercise, and if I might use such a term, "natural cures," not artificial, such as drugs, &c., which, except in extreme cases, are my abomination. I am certainly anything but groaning under a vegetable diet. Life has never been happier to me. I never took ale, very rarely wine, and left off spirits (which I used to take occasionally) by the advice and orders of an F.R.C.S. They are the worst things for an invalid stomach. I cannot refrain from a few words as to vegetarianism. People who know nothing about a thing are always the first to abuse it, as they do not believe in what they have never tried. They think that others are committing nothing short of suicide by following what they cannot understand. When a flesh-eater (I still take all animal products) I had a double curvature of the spine, inflammation of the lungs (three attacks), and lastly, a severe attack of chronic catarrh of the digestive organs (from which, owing to the skill of my kind doctors, I am better). I turned vegetarian purely by accident, and before I even knew of a vegetarian society. Before becoming a vegetarian, I was never free from the kind care of my doctors, and for some years never passed a day without taking some concoction intended to make the digestive organs perform feats they were totally unable to do, owing to my having given them stuff which they could not naturally digest. Since becoming a vegetarian, I have banished pepsine, pills, &c., as I never now need a digestive or purgative, only once having had a bottle of medicine. On what plan my stomach is built I leave anatomists to say, but it certainly declines to take vegetables in any other than their natural conditions without serious inconvenience to its owner, and is far better, and so is its owner now, that instead of getting a chop (4-5ths of which are water) it has only a plate of lentils and haricots or potatoes. I should have thought that a man who has been deaf for twenty years without hardly feeling it, would have tried or fully convinced himself of a thing before publicly attacking it. Personally, I cannot speak too highly of a vegetable diet, and were a little common-sense exercised by others to try, they would, as I have done, 'bout ship, not for a month or two, but for many, very many months. Although fond of alcoholic drinks, and passionately fond of smoking, since becoming a vegetarian, I have voluntarily given them up, as I have felt no desire for the use of the one or the other. My letter is far longer than I had intended, and I hope the Editor will pardon me. I suffer chiefly from biliousness at the change of weather. I have never heard of a vegetarian who spoke badly of the diet. I always hear the same. I was never so well as when a vegetarian. I would further state a fact I had forgotten—that, before I became a vegetarian, I suffered fearfully from flatulence. It is a thing of the past.—JOHN ALEX. OLLARD, F.R.M.S., Enfield.

[47240.]—**Oil-Silk.**—I don't know the trade way of making this material, but I suppose it can be made by dipping silk in linseed oil, and hanging it up to dry between each coat.—H. G. R.

[472744.]—**Illuminated Clock.**—In his reply to the above (page 455), Mr. Phibbs mentions certain necessary precautions that should be taken before applying Balmain's paint to iron. Would Mr. P. kindly give further particulars on the point?—H. J. NOLAN, Clifton Villas, W.

[47247.]—**Product of Brick-burning.**—Is it possible that it is dust from the fuel, as it is only on the surfaces exposed to the draught? Have you analysed the substance?—E. G. M.

[47251.]—**Carriage Varnishing.**—Possibly the underground was not properly finished, and absorbed the varnish. It is impossible to say what is the cause without examination. See a recent article on "Cart and Wheel-making," where the art of painting and varnishing is fully described.—T. L. W.

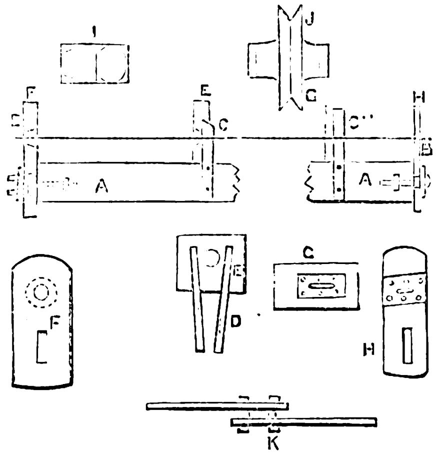
[47255.]—**Lacquer.**—You might try dipping into best French polish, or best pale paper-varnish. For lacquer you require to heat the objects, and that would be as objectionable as the brush.—UPSILON.

[47263.]—**Boiler-Cleaning.**—If I had a steam-boiler it would never receive 56lb. of cutch per month if it were as large as the *Great Eastern*. All that any steam-boiler wants is as pure feed as possible, and regular washing out. The water should certainly be filtered, and as much of the lime, &c., as possible taken out of it; then an occasional dose of common washing-soda will do all that is needful, and the boiler will last twice as long. Cutch or catechu contains nearly half its weight of tannin, and will certainly injure boiler-plates. About 1 to 2lb. of soda dissolved and added to the feed will be enough for any ordinary-sized boiler per day; but the quantity obviously depends on the quality of the water as well as on the number of gallons used per day.—ESSAR.

[47267.]—**To Chemists.**—CaO and H_2O mixed in proper proportion would probably do what you want, and do it in less time than six hours after mixing; but that could be arranged, I think, by putting the H_2O under such conditions that it could not reach the CaO until after the lapse of some time. You may ask the query again, and get no better answer; but as, from the last sentence of the query, you appear to think that you are entitled as of right to a reply, I send the above suggestion.—VIDEO.

[47271.]—**Waterwheel Grease.**—What is partly working in water—the journal you want to grease? What sort of waterwheel is it—only 30in. diameter? Railway grease, tallow, or one of the heavy shale oils might suit, but can't say unless have more particulars of conditions.—LUBRICATOR.

[47285.]—**Gymnastic Apparatus.**—I think it is very doubtful whether you will get a machine for the purpose you want, and therefore forward the following sketch, which, I have not the least doubt, will put you right. A A is a batten 6in. by 3in., 14ft. long, or a deal 9in. by 3in. if you like it better; but I think the first strong enough if bolted to three uprights in the ground, the top jacked up true. Do not touch the other part, as it will be more likely to cast. At B B are two tenons, B′ for cone chuck or headstock, B″ for guide for drill; C″ C″, horns joggled into the side, 2in. wide ⅜in. thick, of ash, beech, or oak, C to hold the other cone chuck; these—cone, head, and chuck—should be made of hornbeam beech. A good hard piece of mahogany will do 1½in. or 2in. thick. In these bore a conical hole at about an angle of 65°. The position of horns is shown at D C″; carry the other guide-plate, G, thus, and the end may be ½in. or ¾in. thick, with an iron plate screwed upon with a mortise through ½in. by ¼in. full; the first guide near the chuck should be about 8in. from it, the other, H, at the extreme end. When you have bored as far as you can get, remove the end one; the headstock and guide at the end are put upon a tenon, the same as a bedstead, with a nut let into a mortise, and a bolt and plate through. Soak your chucks either in linseed, or, what is better, put a warm iron over them with some paraffin wax, and lubricate ends with soft soap and powdered French chalk made into a paste. Your bars being square and straight, make the angles (see I) with a chisel to fit cones as near as you can; put pulley upon square, J being a pulley the size you require, with a square hole in it, and hooped at each end. K is two pieces of wood 1½in. wide and 8in. long, with two 5-16 nuts and bolts to hold the drill with to push it into the work, and pull out for clearance, to be used at first between C″ and H′. Let your drill be 1ft. longer than your job, or more if necessary. When you have jacked up your battens true, strike a line and make it deep from end to end through the centre to set your other fittings to, and make all square and lineable. When boring, do not be too greedy, and clear very frequent, for you must have a bit strong enough to stand the twist, and therefore but little clearance. Your tool must be sharp, but not too proud, or it will pull itself in, and it will take you all your time to get it out, unless you split your job.—JACK OF ALL TRADES.



[47292.]—**Mildew on Vines.**—Will Mr. Albert Smith kindly say how "permanganate of potassium" is to be applied to vines? "Nemo's" plan I have tried, but it has failed with me. I have just met with a person who has treated his vines much the same way as that recommended by "W. B. L." (leaving out the manuring and slabs of glass with sulphur), and this year he is quite free from the pest. I shall therefore adopt "W. B. L.'s" advice, and prepare the vines as he describes for next season. Thanks to all three for their kind replies to my query.—AMATEUR GARDENER.

[47363.]—**Watch Cylinder.**—My instructions to "Hall" for putting in a cylinder plug are genuine, and, as far as the working part is concerned, the method is quite as satisfactory as turning them in; in fact, in some instances it is superior. At any rate, as far as an amateur is concerned, I will undertake to say that he would be more likely to succeed with the file than with the graver. The following are full instructions for putting in a cylinder plug with the file:—First remove old plug, shown Fig. 1. A is the punch, B is the plug, C is stake, D is cylinder; you see that the hole in stake is slightly chamfered at top on which the cylinder rests, while the plug has a free passage right through the stake. Fig. 2 is the punch (A, Fig. 1) and is about the size. Now make the plug: take a piece of steel wire (a pivot drill if you have one large enough) about the temper of a pivot-drill, put a ferrule on one end and a small piece of brass rose on the other, take your graver and turn the face of brass rose true—this is easy; and then you have Fig. 3; but before you face the rose you make two true small centres as follows:—place the piece of steel wire in the turns and file a piece off each end with a 3-square file. As the file cuts through it will find its own centre; now file down the end outside the rose to half the size of plug required—this is to be done in the turns; now remove rose and file down body of plug—i.e., where the rose came off, until it enters into the cylinder, as shown Fig. 4; now mark it where shown by the arrow. Replace and cut part of the way through with a file; now measure length of new plug by the old and cut off end, not shorter; of course, allow for pivot, now break off new plug, put it in the mouth of cylinder, and drive in new plug the same way as you drove out the old, only using a smaller hole in the shake. Now make a hole in the end of a piece of brass plate, Fig. 5, of sufficient thickness to allow for length of root, now place it in the turns, as shown Fig. 6, and file down pivot; polish and round off in the usual way; Fig. 6: A is ferrule, B body of cylinder. Fig. 5; D end of root intended for pivot, E piece of turns, F guide-screw for file; place the file on D, let the side rest against C, and that will give you the right length for pivot.—A FELLOW WORKMAN.

FIG. 1

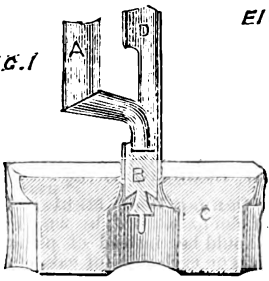


FIG. 2

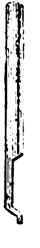


FIG. 3

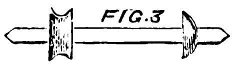


FIG. 5

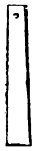


FIG. 4

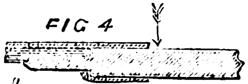
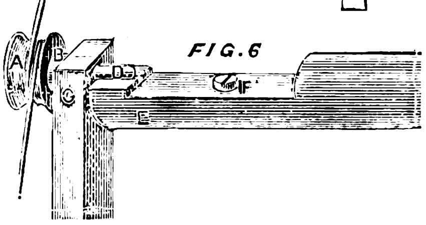


FIG. 6



[47386.]—**Riveting Ships' Kelsons.**—If A. Rutt will get the *Marine Engineer* for July, he will find an illustration showing about ten different applications of machine riveting to shipbuilding.—LONDON RIVER.

[47387.]—**To "Aldebaran."**—It is not every telescope that will raise a spurious disc upon a star, neither is every condition of the atmosphere favourable, and still less could every amateur appreciate such a disc if raised. Rays or wings do not necessarily prove a telescope to be worthless, since they may be caused by a field-lens soiled by the fingers, or by any of the lenses being out of square to the axis of the tube. An apparently sharp definition of bright objects, such as solar or lunar detail, proves nothing more than that an excess of light overpowers such defects, and render them difficult to detect. As it appears your correspondent has separated the lenses of his object-glass, it is very possible that he may not have replaced them in their original position, which, in lenses of the size he mentions, is often a very important item. If there is no mark at the edges to guide him, I should advise him first to make a pencil line showing a certain position, and to gradually turn the crown-lens until a better definition of bright points is attained. A permanent ink mark can then be made for future guidance. I have more than once tried to improve faulty object-glasses by cementing, though I cannot say I have ever been very successful, at least I have never noticed any difference. A little light would be gained, but that would probably be all. Still, if all other means fail, there would be no harm in trying.—Aldebaran.

[47434.]—**Lathe.**—In answer to "Miner," if he will be kind enough to state more clearly what he really desires to know, I shall be glad to render what information he requires. I must plead ignorance in not knowing what is required to Babbitt mandrel-bars.—J. H. Evans.

[47436.]—**Steam Pipe.**—To cut steam-piping the standard pitch for any size is eleven threads to the inch.—W. Bradshaw, Derby.

[47456.]—**Canvas Boat Making.**—The keel should be of elm or oak, 2in. by 2in. For a canvas boat there should be, instead of planking, six or eight stringers on each side (of oak, elm, or larch, ⅝in. broad, by ¼in. thick), running in a fore and aft direction. A gunwale of oak or ash, 1½in. by 1in., should be fitted to the top of the boat, and fastened to the stern post, &c. The ribs should be ½in. wide and 3-16in. thick, of ash, and placed every 6in. The ribs of some canvas boats are made out of hoop-wood, such as can be got off casks and butter tubs. A few yards of new stout sail-cloth would do for the skin of the proposed boat; and one of the following receipts for waterproofing from "Yacht and Boat Sailing" (Mr. D Kemp), would make her quite water-tight: "Boil 12oz of beeswax in 1 gallon of oil for two hours; paint the cloth with this mixture twice or thrice. If black is required, add the necessary quantity of black for the second and third coats." The following plan is recommended in America:—"To waterproof cotton-drilling, boil a mixture of 6oz. hard yellow soap, ½ pint water, ¼lb. patent driers, 5lb. boiled linseed oil." If L. Nelson wishes it, and will advertise his address, I could supply him with more information and particulars of one or two other canvas boats, &c.—Nemo.

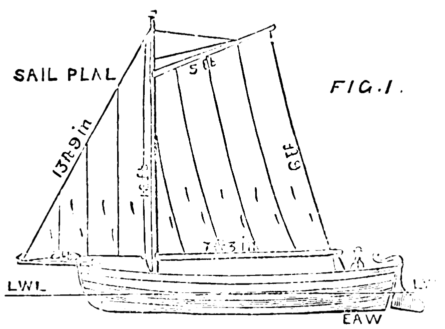


FIG. 1.

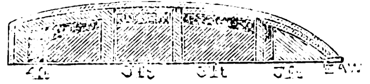


FIG. 2.

[47463.]—**Change Wheels for Screw-Cutting.**—I would advise "Try Again" to purchase one of Calvert's Almanacs. There is a list of change-wheels in every year, and they are only 4d. each at any bookseller's.—W. Bradshaw, Derby.

[47463.]—**Change Wheels for Screw-Cutting.**—Suppose we require to cut a screw 24 to the inch, the leading screw having 4 threads to the inch, we proceed in this way. Now, it is quite evident that the lathe-spindle must revolve 24 times, while the leading screw revolves four times; we then multiply these numbers by 5, to make them correspond with the wheels usually in stock; therefore, a wheel of 20 on the lathe-spindle, and a wheel of 120 on the screw, would cut 24 to the inch; but as these wheels would be too far apart to gear, we must make use of the stud to gear up; so if we put a wheel of 20 on the lathe-spindle, and one of 120 on the stud, then on the same a wheel of 80, and another of 80 on the lathe-screw, we have a train that would cut the required pitch. Now, as the wheels all increase by 5, we have not two of 20 teeth each; therefore, we must select some others. To do this, arrange the wheels thus:— $\frac{20}{120}\ \frac{80}{80}$. To keep these relations correct, whatever number one of the upper or driving wheels is divided by, one of the lower or driven wheels must be divided by the same; therefore, let us divide by 4, and we have a train thus—$\frac{20}{30}\ \frac{20}{80}$, which will not do, because we have two wheels of 20 teeth each. If we now multiply by 5, we obtain the required train, thus—$\frac{20}{150}\ \frac{100}{80}$. The wheel of 20 teeth drives one of 150 on the stud, and on the same stud a wheel of 100 driving one of 80 on the lathe-screw.—Thos. J. O'Connor, Dundalk, Ireland.

[47468.]—**Transit of Venus.**—There is probably no better place than Jamaica to get a good view of the transit from ingress to egress. The times given in *Nature* for a spot in the Blue Mountains, long. 77° 30′ W., lat. 18° 5′ N., are Dec. 6, local M.T. First external contact, 8h. 52m. 37s. a.m.; sun's altitude, 30° 15′. Last external contact, 3h. 0m. 22s. p.m.; sun's altitude, 28° 29′. The Bermudas are also a suitable locality, and will form a nice holiday resort for the winter months.—J. R. H.

[47470.]—**Watch Repairing.**—Read my reply to "G. K., Stockton."—A Fellow Workman.

[47471.]—**Watch Repairing.**—You cannot do either without a mandrel. I gave instructions for making one a few weeks ago. My next article will be on jewelling.—A Fellow Workman.

[47474.]—**Astro.-Eyepiece.** — "To Aldebaran."—The ring sometimes seen inside a telescope-tube is only a shadowy reproduction of the object-glass, and is caused by a mutual reflection from its inner concave surfaces, refracted to a smaller diameter. A more striking effect is often produced by the double sets of lantern lenses, when the illusion is occasionally so complete as to lead one to imagine another set of lenses suspended in mid air. A still more remarkable effect is when a bright image is reflected by a concavo-convex or meniscus lens, the convex side being used as the reflecting surface. In this case both the surfaces exposed to the light are convex, from which it might have been supposed the incident rays would have been scattered rather than concentrated as they are to a sharp focus. Perhaps our valued contributor, "Orderic Vital," will kindly explain the phenomenon. The nominal power of a telescope is calculated from the solar focus of its object-glass, though its actual power must vary according to the angle of the entering rays, or, in other words, in proportion to the distance of the object viewed. The closer the object the more divergent will be the rays. This will result in a longer focus and a larger image; hence, if the focus of a gas-flame be 41in. and the eyepiece equal to a single lens of 1in. focus, the power would be 41, whereas celestial objects might, with the same telescope, be increased to 30 diameters only.—Aldebaran.

[47477.]—**Waves.**—Mr. White's "Manual of Naval Architecture" has an article on waves which might perhaps be of use to "The Sea." The following is taken from "Yacht and Boat Sailing" (Mr. D. Kemp).:—"Captain Molter, of the French Navy, measured a wave in the North Atlantic 2,720ft., or half a mile from crest to crest; and Sir James Ross, one 1,920ft. long. In the Bay of Biscay, where the sea is usually turbulent, waves have been seen 1,300ft. in length. . . . . Dr. Scoresby measured some Atlantic storm waves with lengths of 500ft. to 600ft. . . . . Professor Rankine, in his work on "Naval Architecture," speaks of waves on rocky coasts rising to 150ft., and waves have been known to fly over the Eddystone Lighthouse. However, the greatest heights of deep-sea waves measured by Dr. Scoresby, and other accurate observers, have been 48ft.; but it is rare to find waves exceeding 30ft. in height. Ordinary storm-waves, such as met with in the Atlantic of about 200ft. in length, have a height of about one-twentieth of their length; but the ratio becomes lower as the length of the waves increase, and waves of 1,000ft. in length have been observed with a height of 10ft. On the other hand, waves of 600ft. in length, have been observed of unusual steepness, and with a height of one-eighth of their lengths. . . . . The speed of waves is generally proportional to their length. Thus a wave of 20ft. long will travel 6 miles per hour, and one 50ft. long, 9 miles; 120ft., 15 miles; 200ft, 19 miles; 400ft. 27 miles; 600ft. 32 miles; 1,000ft., 42 miles."—Nemo.

[47488.]—**Indigestion.**—I am no doctor, but I can help you. Your diet is not nourishing enough. Abstaining from food will not cure indigestion. Tea is very injurious. A friend of mine suffered wretchedly from indigestion, but owing to the following treatment is now completely cured. For three months this diet was persevered in without any change. Dinner and supper: the lean middle of a grilled mutton chop, juicy, and rather underdone; bread; one tablespoonful of pale brandy in two of warm water. Breakfast and tea-time: No tea or coffee, but a small cup of cocoa, made with milk, and bread and butter or toast—if toast, either dry or buttered cold. After three months, this strictness was a little relaxed in favour of light milk puddings, eggs, boiled chicken, &c. You should give up tea, coffee, sugar, and beer. Sugar causes much acidity of the stomach.—J. E. A.

[47490.]—**Loco. Engine with Broken Crank-Shaft.**—You pack the driving-wheels under the boxes on the stays or keeps, whichever you call them at your shop, which lifts them clear of the rail, and then you back on the top of the leading and trailing boxes.—W. Bradshaw, Derby.

[47498.]—**Indigestion.**—Tea is most injurious to a weak stomach, as well as the nervous system. Cocoa-nibs, boiled for about five hours, taken with milk, I find from experience the best stomachic. Next to it, Schweitzer's cocoatina can be made in a moment with boiling water; and in violent stomach attacks, where solids give pain, it is sufficiently sustaining, if taken frequently. I find sleep and all wonderfully improved since leaving off tea. The cocoa can be varied with coffee and milk in the morning, for instance, if it agrees. Tidman's Sea-salt in the bath is very invigorating.—C. M. Y.

[47501.]—**Clock-Wheel Cutting Engine.**—What is the reason a circular cutter will not answer if passed through at right angles with the plane of the wheel? It will cut them true, and finish them off. A snapping machine or punch will not make a job of them; a slotting machine is out of the question, and where are you going to get, or how make, a filing machine with file, whose section is what is required—i.e., shape of tooth?—Jack of All Trades.

[47502.]—**Transparent Photographs.**—The process which the querist describes as a "secret," and having been "recently introduced," has been well known among photographers for a number of years. In the first place, two unmounted photographs of the subject to be operated upon must be procured. One of them is then rendered transparent with a mixture of castor-oil and oil (not spirit) of turpentine, in equal parts; this is rubbed into the *back* of the photo three or four times a day, for three days; at the end of that time it will be sufficiently translucent. The next step is the colouring. The transparent one must be coloured very finely, putting in as much detail as possible; the other photo. is to be coloured very strongly, without any detail. Now take some hot melted white wax, and dip the transparent photo in it; then take it out and press it against the previously cleaned glass, holding both over a hot stove. This must be done very carefully, or failure will be the result. It is best to commence at the corner, and work gradually over the whole surface. A pad of cotton wool, covered with chamois leather is best to do this with; if any bubbles appear it must be pulled back, and a fresh attempt made. When this is satisfactorily accomplished, it is allowed to cool; when cold, the opaque photo. is placed at the back of it, so as to register in the same place, and be seen through it; a piece of gummed paper is then passed round the edge, and the process is complete. I should advise the querist not to commence with concave glasses, but try with flat ones, as it is very difficult to make the photo. adhere to the glass without air-bubbles; but patience and practice will soon overcome that difficulty.—C. Huffell.

[47502.]—**Transparent Photographs.**—I should think it scarcely worth while to pay five guineas for the secret of making the paste with which to fix the photographs to the concave glass when it can be bought for a shilling a bottle. Evidently "Greenhorn" does not live near London, or he would know how general this so-called art has become, and how easy it is to obtain materials and instructions. I tried to find out for myself how to get the photo without mark or air bubble on the glass, wasting much time and many photos—then I took a 5s. lesson, which taught me all I wanted to know. Materials, with papers of instructions, can be got in London at a moderate price; but I see it is against the Editor's rules to print any such addresses, so I can only advise querist to find out for himself, and to avoid any professional who pretends to hold a valuable secret. Materials required are paste with which to fix the photo to the glass, parchment paper, a piece of wood called an extractor, by means of which, having placed a piece of parchment paper over the photo, you extract as much of the paste as possible, commencing from the centre and working carefully and slowly towards the edge of the glass, looking constantly on the right side to see that you are getting all air bubbles out; fine sand-paper to remove as much as possible of the paper from the back of the photo; a cake of wax, sold on purpose, which is made hot, and in which the photo must remain an hour, and ordinary oil paints for painting. There is no occasion to buy the specially prepared colours which the professionals try to persuade you to do, if you know how to use the others.—M. E. F.

[47505.]—**Hot-Air Engine.**—The simple engine described in No. 796, p. 369, will, I should think, suit Mr. Smith, especially as he only wants to work a blowpipe—that is, presumably, a bellows. —Essar.

[47506.]—**Cement for Knives in Handles.**—Black rosin and a little red brickdust.—W. W. W.

[47506.]—**Cement for Knives in Handles.**—There is nothing better than a mixture of powdered rosin and bathbrick.—Essar.

[47506.]—**Cement for Knives in Handles.**—Use rosin and bathbrick, both finely powdered, about equal parts, but rather more of the rosin; heat the metal, and push it into the handle into which you have previously shaken the above powder. A few minutes will harden it for use.—H. O'B.

[47506.]—**Cement for Knives in Handles.**—Fill the socket with a mixture composed of equal parts of powdered rosin and bathbrick, then heat the end of the knife and thrust it into its socket and allow to cool. When set it is not liable to become detached by putting the handles in hot water.—C. Huffell.

[47506.]—**Cement for Knives in Handles.**—"Mater" will find the following answer his purpose well:—Fill up the hole in handle with finely-powdered shellac; make that part of the knife which fits in handle sufficiently hot to melt the shellac, then, while hot, place the knife firmly in handle. When thoroughly set, scrape off the overflowing shellac. This method, which is very simple, will not fail to give satisfaction, if done as I have described. I have fastened knives in handles in this way, and have found them last for years.—G. Fryer.

[47506.]—**Cement for Knives in Handles.**—"Mater" will find the following good:—Powdered rosin 4, brickdust 1, beeswax 1. Fill the handles with the above mixture, and having made the tang of blade nearly hot, plunge into handle, and keep it upright till cool. This plan will last for years, if the knives are not thrown into hot water when dirty, as is usually the case, loosening the blades, and cracking and discolouring the ivory handles. If the blades *only* were wiped with a wet cloth previous to cleaning, instead of being thrown anyhow into boiling water, knives would no doubt last three times as long.—Ape.

[47506.]—**Cement for Knives in Handles.**—The best cement that can be used is shellac, well crushed, and mixed with about an equal proportion (or less) of bathbrick-dust. Scrape out of the socket in the handle any loose material or dirt. Scrape also the "tang" of the knife-blade. Fill the socket with the above-mentioned mixture. Then heat the tang (not red-hot) in a gas flame, and run it gently, firmly, and quickly into the socket, "working" it a little to make set in a good position. You can plunge it into cold water to insure the cement being hard. Shellac is superior to common rosin for this purpose.—Murano.

[47508.]—**Weight of Girder.**—You may make the models of any materials you please, and compare the strength of various combinations, taking care, of course, that the several models are made under equal conditions. The question of the best form of girder, box, and plate was very fully experimented upon before the Britannia bridge over the Menai Straits was erected, many years ago, and the results may be found in Fairbairn's "Application of Iron to Building Purposes," and other works.—Ditton.

[47510.]—**Cistern.**—I have not gone into the details of affair, but premises covering about the same area, found for years a cistern in the ground, built of bricks and lined with cement, 8ft. deep, 8ft. long, and 5ft. wide, was all that they required. Jack of All Trades.

[47513.]—**Water Filter.**—A good deal would depend on the position of the filter; but at least an "Enquirer" will not depend on charcoal alone to take out the lime and iron. As much as possible ought to be caught by hair, felt, or woollen screens. Thus, suppose it possible to arrange an inclined trough, the filtering materials would be arranged as diaphragms sliding in grooves in the sides. The water would first reach the screens, and lose its mud, &c., and would then pass the charcoal, which might be solid slabs or fragments packed between wirework.—Nun. Dor.

[47515.]—**Dry Collodion.**—Sensitise and prepare the plate as for wet process, wash in distilled water, and dry in the dark; when dry, pour uniformly over the plate a two-grain solution of pyrogallic acid. If the plate turn brown, more washing in distilled water will be necessary; these plates are not so sensitive as when wet.—Nerog.

[47515.]—**Dry Collodion.**—There are several preservatives for collodion plates, but I will give the querist the one I am best acquainted with. The plate is coated and sensitised in the usual manner. On coming out of the silver bath it is thoroughly washed with distilled water, and the following solution is applied—Coffee, 1dr.; hot water, 1oz.; let stand till cold, and filter. The first application must be poured away, but after, the solution may be returned to the bottle. When the film has been thoroughly permeated with it, it is reared up to drain and dry. When dry it is ready for use. The exposure I have known to be as long as a quarter of an hour on a dull day. Before developing, the plate is well washed. Develop in a flat dish with the ordinary iron developer, or else it is liable to stain. But the querist may take my word for it that after years of experience I have found nothing to equal gelatine emulsion.—C. Huffell.

[47524.]—**Acetic Acid.**—The sp. gr. of acetic acid at 15° is 1·0553. If water be added the sp. gr. rises at first, until a liquid is obtained containing 70 per cent. of the pure acid. On a further addition of water the sp. gr. remains unaltered, so that the aqueous acid containing 76·5 to 80 per cent. possesses the same sp. gr.—viz., according to Roscoe, 1·0754 at 15·5°. The sp. gr. then diminishes, so that the acid containing 43 per cent. has at 15° the same sp. gr. as the anhydrous acid. Hence it follows that the concentration of the aqueous acid cannot be determined (as that of alcohol can be) by the sp. gravity, but you must triturate with an alkali.—Caius.

[47524.]—**Acetic Acid.**—The following is an extract from Oudemann's table of the strength of acetic acid, corresponding to its specific gravity. The entire table is given in "Bayley's Chemist's Pocket Book," published by Spon, price 3s. 6d.:—

$C_2H_4O_2$ Per cent.	Sp. Gr. 60° F.	$C_2H_4O_2$ Per cent.	Sp. Gr. 60° F.
1	1·0007	35	1·0470
2	1 0022	40	1·0523
3	1·0037	45	1·0571
4	1·0052	50	1·0615
5	1·0067	55	1·0653
6	1 0083	60	1·0685
7	1·0098	65	1·0712
8	1·0113	70	1·0733
9	1·0127	75	1·0746
10	1·0142	80	1 0748
15	1 0214	85	1·0739
20	1 0284	90	1·0713
25	1 0350	95	1·0660
30	1 0412	100	1·0553

If "Phosphorus" has a specific gravity apparatus of sufficient nicety, he may determine the strength of his solutions from this table; but the usual plan is to neutralise the acid with a standard alkaline solution. This may be prepared by dissolving one equivalent in grains—(viz., 106gr.) of pure dry carbonate of soda in 10,000 grains of distilled water, and adding from a Mohr's burette to a measured quantity of the acid liquor until it fails to redden blue litmus paper. When the acid is nearly neutralised it should be heated to expel the carbonic acid which has been absorbed during the operation, and the addition of the alkaline solution cautiously continued. The quantity of the latter required is then read off from the burette, and each grain measured corresponding to ·0106gr. of carbonate of soda will represent two equivalents, or ·012 of acetic acid ($C_2H_4O_2$). If great accuracy is required, it will be necessary previously to estimate the sulphuric acid, which is present in all commercial acetic acid. This may be done by precipitation, in a measured quantity, with barium chloride, the resulting barium sulphate being dried, ignited, weighed, and calculated into H_2SO_4. In making the alkalinity estimation, it will then be necessary to first add enough standard alkali to neutralise the previously found quantity of H_2SO_4. Further particulars if required.—E. S. Beaven.

[47527.]—**Microphone.**—In a small room it is nothing out of the common, though not very loud. —Nerog.

[47528.]—**Sowing Conacre.**—This is an inaccurate expression. Letting and taking in conacre is when a farmer lets, at a rent, a small piece of ground tilled by him, and ready for manure, to a poor person who supplies the manure, and plants, or assists to plant, the ground (with potatoes generally), and takes the crop, after which the land reverts to the farmer. Legally there is no tenancy, but the practice is very common in Ireland.—J. F. E.

[47528.]—**Sowing Conacre.**—It is customary in Ireland to let out fields in "conacre" for potatoes or other crops, i.e., the farmer holding the field gets it divided into quarter acres, and these are taken for the crop only by other people, who supply the labour and seed themselves. A whole field let for one crop to one single person is not, strictly speaking, let in "conacre." Generally speaking, any field let by the holder to another for the crop only is let in "conacre," and this letting by conacre is not considered in law as a breach of the usual covenant against subletting, introduced into leases. "Sowing conacre" is the action of the person who plants the crop; "Letting" or "Setting conacre" is the act of the farmer to whom the land belongs.—C. M. W.

[47530.]—**Softening Hard Water.**—Simply boil and expose to the atmosphere; then pour off the water carefully from the sediment, as the neutralised lime, when freed from its extra quantity of carbonic acid, falls to the bottom of its own weight.—Camera.

[47530.]—**Hard Water.**—I should think the best method of softening your water would be Dr. Clark's process; allowing lime water to flow into the water to be softened, when the lime combines with the carbonic acid which is in solution, forming chalk which is precipitated, together with the chalk which rendered the water hard; the precipitate sinks to the bottom and the clear water can then be drawn off.—Caius.

[47530.]—**Softening Hard Water.**—If the hardness is due to carbonato much of it can be taken out by the addition of cream lime; that is known as temporary hardness. If it is permanent hardness, due to the presence of sulphates, for instance, it would be necessary to know the exact nature of the hardening salts before a remedy could be suggested—if then. If due to calcic or magnesic sulphate, washing soda will soften to a certain extent, but the addition of that might be objectionable.—Nun. Dor.

[47535.]—**L B. and S.C. Locomotives.**—"The Terriers."—The class of 6-coupled tank-engine Mr. Tratman asks about are known as "Terriers." One of them was sent to the Paris Exhibition. Full dimensions were given in back vols., I think in 1877, but I have not time to hunt them out in my copies—all unbound. The East London Railway is worked by the L. B. and S.C. Co., consequently the engines belong to that company, and were built at Brighton. I think "Wapping," No. 71, is one of the first built, which was in 1872. A great many were built in 1874 and 1875.—Murano.

[47513.]—**Hardening Hammer-Faces.**—I would suggest that probably your smith has faced your hammers with ordinary blister-steel; this will not stand to strike cast-steel gads. Have them faced with double shear-steel, and cool in running water; never mind the salt.—J. J. A., Liverpool.

[47543.]—**Hardening Hammer-Faces.**—See reply 47383, Hardening. But you need not use more than one of prussiate potash to 6 or 8 of salt, and do not make them too hot. A bright cherry red ought to be sufficient, but you cannot depend upon the steel you get for your jobs.—Jack of All Trades.

[47544.]—**Electrical Measurement.**—To "Ll. B. A."—I am afraid "Student" has hardly yet grasped my last answer. First, let me remark that by altering the resistance in a circuit of a *constant* battery, we do not alter the E.M.F., which depends only on the materials of the battery. To take the case, however, which "Student" mentions, let us first get a deflection of 10° in one circuit; now we know that this means so many ampères. Now, 1 volt gives 1 ampère through 1 ohm, and 10 volts give 1 ampère through 10 ohms, and n volts give 1 ampère through n ohms, so that even if we get the same deflection in another circuit we cannot tell what the E.M.F. and resistance are, unless we are sure of one, when we can find the other. The current is merely the ratio of the E.M.F. to the resistance; and hence tells us nothing of their true magnitudes. The galvanometer only measures current; hence the same deflection only shows that the same ratio exists in each case, between E.M.F. and resistance, and tells nothing beyond this. I hope I have made this clear; if not, do not feel afraid to ask further help.—Ll. B. A.

[47544.]—**Electrical Measurement.**—"Student" is a little confused. Given a current of so many volts, ohms, and ampères, that is $E/R = C$; he assumes "that if we insert a galvanometer, *we know* that it alters the resistance, and also the E (E.M.F.) in proportion." This *knowledge* is absurd and *perniciously* misleading, because there are cases where E varies, as R is changed; but the variation is due to other causes, which must be considered exceptional. If $60/4 = 15$ ampères, then $60/6 = 10$ ampères, and for a right comprehension of the law of Ohm, we must insist that the variation of R has no effect whatever upon E. All laws have their qualifying aspects, and "Student" would not say that a balloon has no weight or gravitation, because it recedes from the earth. We may imagine the force or *potential* of a column of water, *of small area*, determining a given current, through a given resistance, and in that case the potential would vary in the ratio of the quantity discharged, or of the diminished resistance. This is quite true of electricity, under analogous conditions. The second point is equally confused, because $60/4 = 15$ ampères just as $120/8 = 15$ ampères. To think that the same quantity of current must imply "the same E.M.F. and resistance" only shows that "Student" must be very young.—Eclecticus.

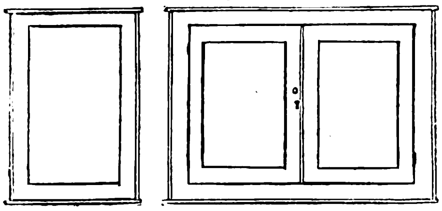
[47549.]—**Bloater Paste.**—Is usually made from red herrings; it can be made from any salted herrings, except those oily midsummer fish. I do not know that there is any special way of taking out the bones; but if expense is no object, it would be advisable to take only the back and most fleshy parts of the sides, leaving the ribs attached to the backbone. Pound up with a little bay-salt and cayenne pepper, rub through a sieve, and put up in pots, excluding the air.—Yarmouth.

[47561.]—**Pot-Pourri.**—Dry your rose-leaves, sprinkle a little salt on them, and put them in a covered jar until wanted for use. Take of rose leaves 4oz., dried lavender-flowers 8oz., vanilla cloves, storax, and benzoin, all bruised, of each 1 drachm, ambergris 20gr., otto of rose 20 drops; mix.—Amateur Mechanic.

[47561.]—**Pot-Pourri.**—Prepare your rose-leaves in the following way:—Spread them out in the sun or in a warm room to dry them, sprinkle a little salt on them, and put them in a jar, in which they are to be kept covered up till wanted for use. Take of these rose-leaves 4oz., dried lavender flowers 8oz., vanilla, cloves, storax, and benzoin, all bruised, of each 1 drachm, ambergris 20gr., otto of roses 20 drops; mix.—J. W. Bond.

[47562.]—**Meat Safe.**—As "Fritz" does not say, I presume it is to stand under cover. You want it a foot from the ground, and for convenience of removal, I should make a frame of 2in. by 2in. stuff, with four legs a foot high, separated from the safe. The safe should be made of good yellow deal 1¼in. thick, 1in. top and bottom, ¾in. back; 1 shelf in the middle, to be in two pieces, so that they can be taken out to hang a joint of meat up. The end is a separate frame from the front, but a return bead is stuck on the front edge, and half a dozen 2in. brads or lath-screws put in; a bead is also stuck on the meeting stile of one door to break the joint. The doors and ends are rabetted on the inside, and a ½in. bead worked on the outside. Put the zinc in, and brad or screw a ½in. bead in the rabbet; the top and bottom to project ½in. all round, and slightly rounded off. When finished, stain, size, and varnish satin wood. I send sketches, hoping they will suit you. They are ⅓in. to the foot, front and side elevation, with sheets of perforated zinc where shown.—H. B. C., Lambeth.

SCALE ⅓ IN TO THE FOOT



[47567.]—**Slide-Rule.**—If "Mechanicus" will give sundry examples of such calculations as he requires to solve by slide-rule, no doubt many of your readers will gladly furnish the information sought by means of the "E. M.," or on application by post.—Buttershaw.

A Small Ice-Machine.—An ice-machine suitable for private houses, especially in India and the colonies, or for steamers, ambulances, and so on, has been devised by M. Raoul Pictet on the principle of his larger machine. It is capable of producing 2lb. of ice in 15 minutes, or about 10lb. per hour, with an expenditure of less than a horse-power of energy. It consists of a compression pump actuated by the motor employed to yield the power; a freezer surrounding the cylinder of the pump; and another in which is placed the vessels containing the water to be frozen. These parts are all grouped into a machine standing about 4ft. high and 18in. square. The process is as follows: Sulphuric anhydride is placed in the freezer around the cylinder, and on working the pump the evaporation absorbs a large quantity of heat from a well of glycerine constituting the freezer by which the water to be frozen is surrounded. The sulphuric anhydride is carried by the pump into a condenser, where it is liquefied, and in the act yields up a certain quantity of heat. The condenser is kept cool by the circulation of water.—*Engineering.*

Patents in 1882.—The number of applications for patents during the first six months of the present year amounted to 3,102, exhibiting a marked increase over those of the corresponding period in 1881, when only 2,865 applications were recorded. London furnished 775, or almost exactly a quarter of the whole, 397 came from the United States, 261 from France, and 250 from Germany. The number of foreigners who seek the protection of the English patent laws is greatly in excess of the number of Englishmen who take out foreign patents, and the disproportion appears to be gradually increasing. As regards the subject matter of the patents applied for during the period above named, the electric light and velocipedes seem to be the most popular.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

46996.	Italian and Spanish Locomotives, p. 271.
46998.	Organ, 271.
47005.	Bank of England, 272.
47017.	Tricycle Making, 272
47028.	Slow Motion for Lathes, 272.
47031.	Blocking Brass Musical Instruments, 272.

47208.	Chamber Organ, p. 363.
47213.	Camel's Hair Brushes, 363.
47221.	Dyeing, 364.
47229.	M.R. Engines, 364.
47235.	Immersion Objectives, 364.
47248.	Wind Pressure, 364.
47254.	Electric Commutator for Intermittent Action, 364.
47260.	Compound Engine, 365.
47266.	Locomotive Engines, 365.
47272.	Drill for Boring Fireproof Floors by Machinery, 365.

QUERIES.

[47568.]—**Legal.**—Will Mr. F. Wetherfield kindly state whether, in a three years' agreement to take premises, a clause or an endorsement giving the tenant option to remain a further term is binding? Whether an agreement holds good if for a longer period than three years, unless it bears a stamp the same value as required on a lease? Can an additional stamp be added at a future time?—B. R.

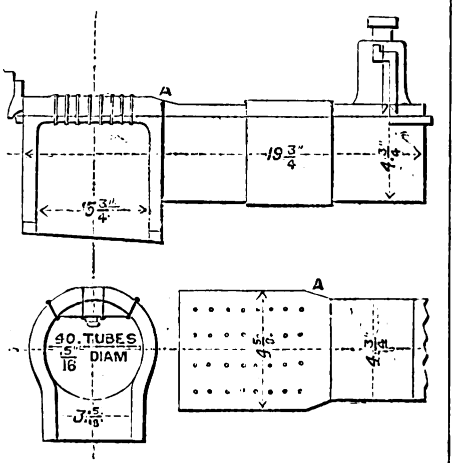
[47569.]—**Barrel Piano.**— Will some reader kindly give description and, if possible, sketch of the action of a barrel piano, and also of barrel harmonium?—Musa.

[47570.]—**Bronzing Cardboard.**—Will some one kindly explain the best way of bronzing cardboard?—J. J.

[47571.]—**Polishing Bobbin-Ends.**—I wish to make a machine for polishing the ends of ordinary thread-bobbins after being dyed black or any other colour, and should esteem it a great favour if some correspondent would give me a sketch and particulars of such.—H. J.

[47572.]—**Midland Tank Engines.**—I have noticed lately a new class of tank engines running on the above line, one of which is numbered 1553, I believe. Will any of ours kindly give me dimensions, and, if possible, a sketch of same?—F. B. W.

[47573.]—**Model Locomotive Boiler.**—I should be much obliged to any reader who would tell me how to make the boiler in sketch? There is a bend at A, which I have been unable to make as yet. I have tried several ways, but none will answer;—hard soldering will not do. Should the rings of the barrel be made in one or two plates? Will 40 $^5/_{16}$in. tubes be too many? The shell is of brass $^3/_{32}$in. thick. How can the steam-dome be fastened on?—for, if riveted on, I shall be unable to get at the regulator-valve, which is at the top of the dome, or very nearly. Working pressure 100 or 120 on the sq. in. Any information on the subject will be acceptable.—Shakespear.



[47574.]—**Pressure.**—Can any of "ours" tell me whether it is possible for a horizontal engine to work at a pressure of 500lb. to the sq. in.?—Steam.

[47575.]—**Electric Pendulum.**—Would Mr. Lancaster be so kind as to inform me how to make an electric pendulum for a clock, with quantity of wire and size for bobbins? I also wish to know the simplest method of transmitting the motive-power of pendulum to the clockwork? I wish the pendulum to vibrate half-seconds, or length about 19½in.—T. J. O'C.

[47576.]—**Arsenic.**—In my business I frequently have to perform an operation which necessitates my keeping my finger-ends in a 5°/o solution of arsenious acid for some hours at a time. Every time that I have yet done this, the ends of my fingers have been sore for about a week afterwards. The pain on pressing the nail or finger-ends is similar to that caused by having the nails cut too short. The nails which have been immersed turn a bright yellow colour. Can any reader explain to me the action of the poison in this case, as its effects never seem to get further than my finger-ends? Also, what is the cause of the yellow colour?—Bertram T. Ord.

[47577.]—**Watch-cleaning.**—Will any one kindly give the best way to remove oil and grease from watch movement before using chalk and brush, and also the best way to clean watch-cases?—Anxious One.

[47578.]—**Egg-End Template.**—Will some reader oblige with description how to make an egg-ended template?—B. M.

[47579.]—**Deal made to Imitate Maple.**—I have had a wardrobe made in deal. Will any reader inform me the best and cheapest method by making it to imitate maple?—J. G,

[47580.]—**Nightmare.**—Will Dr. Edmunds or any reader kindly inform me what is the best to do to prevent nightmare, as the writer's mother has it repeatedly, leaving her much distressed and exhausted?—J. G.

[47581.]—**Large Lathe.**—Could any one tell me who has got the largest lathe in England or the Continent, and oblige?—W. Bradshaw, Derby.

[47582.]—**Casting Small Articles in White Metal.**—To "Jack of All Trades."—Thanks for your answer so far, but I should feel obliged if you will inform me in the following:—What are the mixtures, if any, and should the mould be warm? I find a difficulty in running them in thin places.—Metal.

[47583.]—**Glazing Sanitary Pipes.**—Will some one kindly favour me with particulars how sanitary pipes are glazed?—W. M.

[47584.]—**Coil.**—To Mr. Tolman.—Will you please give me length and breadth of core, weight and size of wire; in short, full particulars of how the small coil you speak of in reply 47449 was fitted up? Also, what battery did you use with it?—Electrician.

[47585.]—**Electro-motor for Tricycle.**—Will some one notice the anxiety felt by thousands for the application of electricity as a motor-power for tricycles? I had hoped that Mr. Tolman would have led the way; but unfortunately, he seems to have given it up. Will no one try to give such a great boon?—W. L. Ollard.

[47586.]—**Pure Silver.**—Will any of "ours" kindly tell me how to procure chemically or absolutely pure silver from some odd scraps I have, about 2oz. How can I test it when obtained?—Ape.

[47587.]—**Crossbow.**—Can any of "ours" tell me the best wood to form bow of for crossbow? I want it about 3ft. long and powerful spring.—Ape.

[47588.]—**Moss-covered Steps.**—The steps (stone ones) are in a passage which runs along the side of the house, and are from time to time covered with moss. Is there any method of preventing this?—Camera.

[47589.]—**To Mr. Lancaster.**—In last week's "E. M.," in an extract from the *Electrician*, it is said:—"Two rapidly revolving discs, not in contact, but so close together as to admit only of an air-space between them, develop electricity in a most powerful form from the rubbing together of the molecules of air between the discs." Can this be applied practically to a small machine to work by hand?—Camera.

[47590.]—**Honours Chemistry.**—A sample of air free from carbon dioxide, which measured 651·4 volumes at a pressure of 537·4mm., and at a temperature of 4·0°C. was mixed with hydrogen and exploded. After the addition of the hydrogen the bulk of gas at 0°C. and 760mm. was 657·06 volumes, and after explosion it measured 374·73 volumes. Calculate the per-centage of nitrogen and oxygen present.—L. B. S.

[47591.]—**Indiarubber.**—Is there a method of melting old indiarubber soles, taken from tennis shoes, so that it may be used again? Any information would be thankfully accepted. Also, how is the cement made for fixing them?—W. H. S.

[47592.]—**Telescope.**—Could any of the optical readers of ours inform me what two telescopes 2in. aperture, 36in. focus, mounted as a binocular, would equal? I want to know—not think. I think they should show object faint enough and points minute enough to strain a 3½in. single telescope. There would be less strain upon the eyes, as both would be used, which would greatly aid vision.—M. Herbert Bridle, Phila., Pa.

[47593.]—**Paper-making.**—Can any of your chemical readers kindly inform me how to obviate the wire mark? Has the shake-motion, suction, couching, or length of stuff anything to do with it?—W. D. T.

[47594.]—**Chemical.**—Can any of your many chemical readers explain the action that bisulphite of lime has upon wood when boiled under pressure? I want to know what products are produced by the action of the bisulphite upon the resin and other extraneous matters in the wood. Also, what would be the action upon the silica of straw if boiled under like conditions?—W. D. T.

[47595.]—**Copper-Plate.**—How can I tell if one I have is worn out or not? I inked it with thin printing ink, rubbed it well with a rag, and then rubbed a piece of tissue-paper well on with my hand, without any effect whatever. How can scratches (deep) be repaired?—Murano.

[47596.]—**Legal.**—To Mr. Wetherfield.—A. insures B. for a certain sum of money to be made payable at the death of B., A. knowing at the time of entry that B. was suffering from a severe illness, from which B. died three months later. The agent continued receiving payments the whole of the time, and did not examine B. to test the state of B.'s health. Can A. recover the amount insured for?—Telewag.

[47597.]—**American Organ.**—Will some reader please give method of making and attaching Octave coupler, and also for adding one or two rows of reeds to instrument now containing one row?—J. P. C.

[47598.]—**Electrical.**—Will "Sigma," Mr. Lancaster, or some other of our electrical correspondents, explain the following experiment, given in Guthrie's

"Magnetism and Electricity," Art. 112? It is given to prove that, although a di-electric may readily allow the inductive effect to take place through it, its own electricity may undergo comparatively slow decomposition. An insulated and charged ball is placed on one side of an ebonite plate, which can rotate on an axle. Opposite to the first ball another ball, also insulated, and connected by a wire with an electroscope, is placed. The leaves of the electroscope diverge, but gradually collapse. If, however, a fresh portion of the plate is brought between the balls, the leaves again diverge. I can understand the experiment as far as the first divergence of the leaves, but I do not see why the collapse should then take place. I do not understand the explanation given with it, nor does any one else whom I have asked. It is probably due to some circumstance that I have overlooked, but I cannot see any such. If the question is not improper, might I ask "Sigma" if he intends to give us a second volume of his electricity now? He gave us an intimation of his intention to begin a new volume or edition a few weeks ago, and I would like to know if he intends to carry out the intention mentioned in his preface, as I have been asked about it?—A Student.

[47599.]—**Drilling Bicycle Hubs.**—Will any of ours kindly give sketch of a simple method for drilling bicycle-hubs in the lathe?—Ex.

[47600.]—**Deodorising Paraffin.**—I have tried mixing scent with the paraffin used for lubricating my lathe, as recommended by one of your correspondents, the result not being satisfactory. Will some of your chemical friends oblige with suggestions?—Amateur Mechanic.

[47601.]—**G.W.R. Engines.**—Can any reader give me the dates and principal dimensions of the following engines?—9, 455, 619, 730, 866, 981, 1,016, 1,070, 1,219, 1,452, and 1,514.—C. H.

[47602.]—**Turkey Red.**—I should be greatly obliged if any of your readers could inform me what stuff is used or means are employed by Turkey-red dyers to obtain the soft oily feel they impart to red twilled cotton cloth? —A Constant Reader.

[47603.]—**Plating with Gold Inside and Silver Outside.**—Will any one tell me how to electro-gild a small metal cup gold inside and silver out? I understand gold and silver plating, but not how to put two on one article.—A Amatube.

[47604.]—**Bicycle Tires.**—Will any reader kindly give me some information respecting fixing on bicycle tires? I bought some cement, cleaned the rim and rubbed it with turps, heated it on an iron stove with coke fire, poured in the cement hot, rubbed a piece of hot iron round the rim to spread cement, and quickly put on tire and held on red-hot irons against the rim. But it is needless to say it is a queer-looking job from the cement sticking to outside of tire, which makes it look so unsightly. I cannot think of riding the machine. Is there any means of cleaning off cement without injuring tire, or a more practical plan of fixing on the tires, as I do not think mine has stuck any too well, and I have the other wheel to do? I have no gas.—Apprentice Boy.

[47605.]—**Probable Errors.**—Can any mathematical reader enlighten me as to the following points? I can find no satisfactory explanation in Merriman's "Method of Least Squares":—1. Suppose that a quantity z is expressed in terms of some unit whose mean value is a, with a probable error r—how can the mean value and the probable error of z be determined? To take a simple example: the graduations on a scale professing to give hundredths of an inch correctly are found to be each = 0·0101 $\pm$ 0·00005in. Six measurements of a certain line (taken with a vernier reading to tenths of a graduation and assumed correct) give these results:—0·783, 0·785, 0·791, 0·780, 0·783, 0·782. What is the most probable length of the line and its probable error? 2. Suppose that q quantities connected by p conditional equations are made the subject of n observation giving n observation equations; that from the p conditional equations the values of p quantities in terms of the others are found and are substituted in the observation equations; that then the mean values and the probable errors of the other $q - p$ quantities are determined in the usual way; and that finally the mean values of the remaining p quantities are found by substitution in the conditional equations. How are the probable errors of these values of the p quantities to be determined? To take again a simple example: the angles of a plane quadrilateral A B C D are observed as follows:—A = 6° 15′ 1″ (mean of 3 observations); B = 59° 4′ 3″ (mean of 4); C = 168° 59′ 59″ (mean of 5); D = 125° 40′ (mean of 6). Eliminating D by means of A + B + C + D = 360°, we get the adjusted values A = 6° 15′ 21″ $\pm$ 18·3″; B = 59° 4′ 18″ $\pm$ 11·7″; C = 169° 0′ 11″ $\pm$ 10·4″. Then by substitution D = 125° 40′ 10″. But with what probable error? 3. How may De Morgan's criterion be applied to the observations in 1, so as to determine the true weight that should be assigned to each?—J. H. G.

[47606.]—**Brake Power on Goods Trains.**—I shall be glad if any one will inform me if experiments have been made on any railway with the ordinary tender and one van hand-brake with heavy coal trains, as in many instances they are very deficient in brake-power.—A Driver.

[47607.]—**Kitson's Steam Brake.**—Please state if Kitson's steam brake was tried at Newark, as I do not find it mentioned in Mr. Reynolds's useful new book? Was a water-jet attached to the Midland engine 892?—A Driver.

[47608.]—**Preserving Rhubarb.**—Can any of ours oblige with recipe for preserving rhubarb? I saw a recipe some years since, but I did not sufficiently notice it at the time. I believe it was cut in 3in. lengths and dried by some means.—W. W. W.

[47609.]—**Soldering.**—Would some brother-reader tell me of a simple method of heating a soldering-iron at the bench where gas or a fire cannot be used. Could I use an oil-stove for that purpose?—T. J. O'C.

[47610.]—**Defective Sewing-machine.**—I have a sewing-machine, the "Penelope," made by Newton Wilson and Co., and cannot get it to sew. It appears in good order, but when I attempt to work it, the cotton cobbles under the plate. Will some kind friend help me?—Sewing Machine.

[47611.]—**Silicate Cement.**—Would be glad to know the best work to study on this subject. I want to make a very fine description of cement (or spirit varnish loaded with silicate) to paint into small cracks that would bear submersion in water after 5 minutes to dry, become very hard, and stand a temperature of 95° F. Expense of preparation would be no objection.—J. P.

[47612.]—**Re-Whitening Stucco Figures.**—Can any reader inform me the method of re-whitening stucco figures?—Young.

[47613.]—**Photographic Camera.**—To Mr. Parkinson or Mr. Robinson, Junr.—Will any of these friends advise me?—I wish to purchase camera which I shall mostly use for architectural subjects, but should like to be able to take portraits now and again, when I think proper. What is the best kind of camera for this purpose, and at what price should I get a good article? The cost is of first importance to me, so I should like to get a reliable article at once.—Camera.

[47614.]—**Gas Analysis.**—Wanted to know the routine of a gas-works laboratory?—Nina.

[47615.]—**Insanity.**—Will Dr. Edmunds, or any person competent to give an opinion, kindly answer me the following?—I am engaged to a young lady aged 33 years. I have recently been told that 13 or 14 years ago she lost her reason through a bereavement, but soon regained it, and has ailed nothing since. I desire to know is it wise to marry her, or break off the engagement?—Amant.

[47616.]—**Abyssinian Tube Well.**—I am thinking of putting down an Abyssinian tube well, and should be glad of some information in regard to them: as to the wear and tear, whether they are liable to get out of order, also the probable cost with 10 or 12ft. of tubing, and if it is possible to hire one for a trial, also the utility of them generally as a substitute for sinking wells where there is supposed to be plenty of water?—Abyssinia.

[47617.]—**Logarithms.**—Will some one of "ours" assist me by showing how to work the following question out in logarithms, in simple arithmetic? I can work it out by the ordinary method, but do not understand logarithms.—The cylinder of an engine is 3ft. 6in. dia., the stroke is 5ft., and the steam is cut off at $\frac{1}{3}$ of the stroke. If steam be admitted into the cylinder at 45lb. pressure, find the work done in one stroke (log. 3 = 1·0986).—A Student.

[47618.]—**Bill of Sale.**—To Mr. Fred. Wetherfield.—About 12 months since I applied to a "Loan Company" for £20, and received it on signing a bill of sale on my household effects, and agreeing to pay monthly instalments until £29 was paid. This has now been done and duly acknowledged, showing that it is all paid; but certain documents (a fire assurance policy, a tenancy agreement of my house, &c.) which were deposited with them to show my *bona fides*, they have not returned. I take it for granted that they must give these up; but ought I not to have the bill of sale returned to me as well, and if so, how should I proceed to recover it, supposing they refuse to give it up on a second demand? I may mention that I reside in South London, and the loan was obtained when the "Company" had offices in the City. Shortly after having obtained it, I was notified that future instalments must be paid or sent to a country town. An answer will perhaps interest others less fortunate than—Argentomeder.

[47619.]—**Universal Joint.**—Can any of ours tell me what loss of power is incurred in the employment of a "universal joint," as applied to a motive shaft of machinery?—Universal Joint.

[47620.]—**Plumbing.**—Will any one experienced in the matter kindly say in what manner the difficulty arising from connecting tin-lined lead-pipe to continuations of pipes and taps of other metals—viz., iron, lead, brass and copper—is overcome? The danger arising from the use of pure water in contact with pure lead is well known; but the difficulties experienced in making sound joints with connections of other metals is said by some plumbers to be great, and often results in choking the bore with solidified solder.—J. W. B.

[47621.]—**Faded Cloth Cushions.**—I shall feel obliged for information how to restore the blue colour of my dog-cart cushions, which are considerably faded. The cloth seems good, and I should be pleased if only freshened up, as I can't afford new ones.—Old Subscriber.

[47622.]—**Bisulphide of Carbon Prism.**—I wish to construct a bisulphide of carbon prism, and should be obliged if some one with practical knowledge of the subject would kindly inform me whether a tin-plate framework would answer for the purpose, and if so, what would be the best way of cementing the glass plates to the tin, so that the junctions would not be affected by the liquid bisulphide? Would common glue be suitable for the purpose, and would ordinary plate-glass bear the application of a telescope of sufficient power to show the D line double?—Student.

[47623.]—**Electro-motor.**—Will "Conrad" kindly give description of his electro-motor, as promised in letter 19985, as soon as possible?—Electro-Motor.

[45624.]—**Heberlein Brake.**—Can any reader give a description of this brake in its latest form?—A Driver.

[47625.]—**Clock Dial.**—I have a good old American one-day lever clock which has very good works. The dial is in very bad condition, and I wish to paint new figures on it; but before doing so, I should like to re-enamel it. How is this done? What kind of paint must I use in painting the figures? I should like to know of a good black paint that will dry quick, as I want to get the job done as quickly as possible.—G. Fryer.

[47626.]—**Warping.**—I think as you have noticed the fact that the Zuyder Zee is going to be reclaimed, that it would be in the interest of the public if some engineer would tell us the benefits of warping, and the preliminary expense of banking, the warping being carried to such a degree as to raise the surface ground above (all?) floods. The practice of warping in England to raise the surface of the ground more than a few inches, appears to be considered no more than an expensive amusement. In Italy it is practised as a beneficial engineering operation. Is it so in Holland?—F. N. C.

[47627.]—**Pneumatic Bellows.**—Can any reader of the "E. M." give me a hint as to the best way to make the above-mentioned piece of apparatus to move a piston a distance of 1in., to hold it in that position until the pressure of air is withdrawn, and then bring the piston back to its original place? The resistance to the movement will be about 3 or 4oz. The whole to occupy the smallest possible space, and work with the least possible friction, and be moderately durable.—A Harmless Slug.

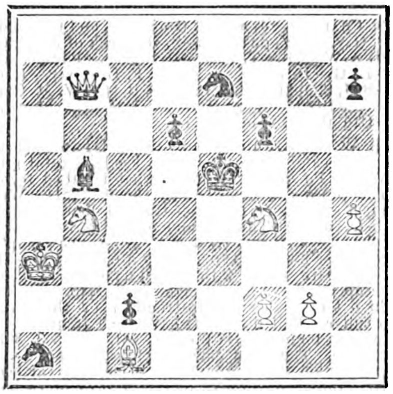
[47628.]—**Private Study of French Language.**—Will some one kindly advise me as to the best course to pursue and books to procure for one who has the ordinary school knowledge of the language (of which, from disuse, much has been forgotten), and who wishes to gain a more perfect acquaintance with it?—Nemo.

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCLXIX.—By G. Hume.

Black.



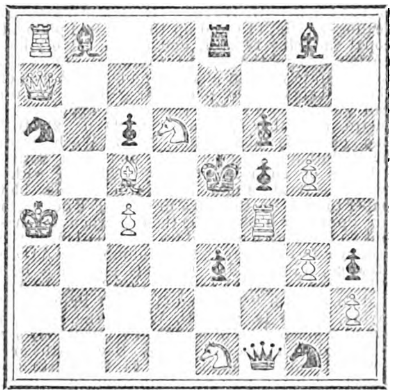
White.

White to play and mate in three moves.

PROBLEM DCCLXX.—By "Per Ardua ad Astra."

From *Brighton Guardian.*

Black.



White.

White to play and mate in two moves.

Solution to 765.

White.	*Black.*
1. K to B 6	1. B to K 3 (best)
2. B to B 8	2. Q B moves (best)
3. Q to K 7	3. Anything
4. Q mates	
	If 1. P to Kt 5
2. B takes P or Q to K 7	2. Anything
3. Mates	

Solution to 766.

White.	*Black.*
1. Q to R sq	1. Kt to Q 4 (ch) (a)
2. R to K 6	2. Q takes Q
3. Kt to B 7 mate	
	(a) 1. Q × Q (b)
2. P takes P (ch) &c.	
	(b) 2. R takes Kt (c)
2. R to K sq &c.	
	(c) 1. Q checks
3. Q takes Q &c.	

NOTICES TO CORRESPONDENTS.

Correct solution to 763 by G. Hume.

Problems received with thanks from F. A. Hill.

ANSWERS TO CORRESPONDENTS.

⁎ *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

⁎ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Aug. 2, and unacknowledged elsewhere:—

J. T. Chapman.—J. and H. Grace.—F. and H. Randell.—E. Gay.—C. V. de Santz.—S. G.—Jack of All Trades.—H. A. Wassell.—T. F. N.—H. Sto ke.—Philip Vallance.—L. G.—B. J.—X. Y. Z.—H. F. L. M yer.—Inquirer.—S. J. Simpkin.—Ignoramus.—B. N.—W. M. Gardner.—Ipse Dixit.—W. A. Hunter.—J. H. Schucht.—J. R. G.—Cantab.—Hosein Ibrahim.

F. B. W. (There are so many that it is impossible to cite the "best." Consult the bookseller's catalogues.)—Young Photo. (You mean what is called ferrotype. The process is described in the manuals. Write to Piper and Carter, 5, Castle-street, Holborn, for a list of their books.)—The Freehold, Minster. (Warm the tube and tap it smartly down. If no effect, empty and refill.)—New Zealand. (They are cut with drills and the groove made with a milling cutter. They are cheaper to buy than to make.)—Quero. (Either you do not remember the instructions or they are very peculiar. Full directions have been frequently given in our columns. See pp. 237, 261, 285, 308, 381, last volume. The arrangement depicted will not do. 2. It is a portion of a Bunsen cell. Place in an earthenware jar. Into the porous pot put a stick of carbon and strongest nitric acid, and into the jar dilute sulphuric acid—that is, 1 to 10.)—Walter L. Nash. (Perhaps he has no time to devote to correspondence; but we believe a letter addressed Clerkenwell-green, E.C., would be delivered to him. If you had read the par. on p. 325, or Mr. Sprague's article on p. 343, you would not have written the last sentence in your letter. At any rate, we are not aware that a man is obliged to forward his address to any person who may choose to advertise for it.)—G. Hayes. (Heat the plates and run sealing-wax in, or grind up the required pigment with copal varnish very stiff, and fill in. Query has been answered many times.)—Electrician. (You can only tell accurately by means of a gauge, and then only to the numbers on that particular gauge. So far as we can guess roughly, the thickest is about one millimetre, and therefore say No. 20 or 21 B.W.G.; the other is about No. 22. 2. Wash over with hot solution of oxalic acid, and then with weak solution of chloride of lime. Go over with clean water several times afterwards, using blotting-paper to take up the moisture. 3. The new edition of Mr. Sprague's book will be the best when it comes out; but you can gain elementary information on the subject by referring to recent back numbers.)—A Constant Reader, Plumstead. (Cassells publish a book on "Drawing for Bricklayers," price 3s., and Lockwood and Co. publish "The Rudiments of Practical Bricklaying," price 1s. 6d.)—D. W. Salter. (The duties are very much those of a general valet or body servant, combined with cook and waiter. Such berths are to be obtained only by application to the masters of the vessels or their deputies.)—John Neville. (Pitman's.)—E. Hall. (There are several things that might be used, but their publication would be neither wise nor beneficial. A moment's consideration will convince you that such information might, if possessed by wicked or foolish persons, do much mischief.)—Aspirant. (All such applications should be addressed to the Secretary of the Civil Service Commission, Westminster, S.W.)—Fair Play. (It is a fact, doubtless, that there are dishonest photographers, just as there are rogues in every trade—"but ours"; but no respectable photographer would do what you mention, and we do not see that it in any way reflects on the honour or honesty of photographers generally.)—H. R. (We should think you would have little difficulty. Why not advertise in the "Sale Column," under the head of "Situations"?)—L. W. (The proposed form of will is legal; but it is advisable to appoint an executor. In your case you would, of course, appoint your wife. 2. Cannot find room to notice queries about hair falling off, &c.)—One Ignorant. (It depends where the land is. If in Cornwall, the license would probably be granted by the Duke. Probably the owner of the land knows.)—Eureka. (It is simply nonsense. Put some phosphorus in water and distil it, and then ascertain, if you can, how much phosphorus there is in the distillate.)—One Whom it Concerns. (It depends entirely on the build of the engine—the uneven road has nothing to do with it. The springs are needed to prevent shocks, but their play depends on the load carried. We suppose 2½in. is the extreme, but it is a question that can be settled only by actual measurement.)—Handy Man. (We do not see the connection between tinplate working and the manufacture of coal-gas, and, as to the manufacture of the latter, what do you mean? You can make a few cubic feet by means of an iron retort, a few feet of pipe, and a holder; but to make any quantity you would require suitable plant and space to put it in. Further, if you had to pay 20s. a ton for coal, you would find it cheaper to purchase of a gas company.)—J. C. George. (What sort of leather is it? If plain dressed, rub in dubbin. If patent or enamelled, coat with one of the varnish blackings now advertised. 2. Ask at one of the county courts.)—Blowpipe. (Send stamped envelope to the Secretary of the Pharmaceutical Society, Bloomsbury-square, W.C., for the syllabus.)—Varix. (See p. 211. No. 867, for a reply by Dr. Edmunds on the subject.)

USEFUL AND SCIENTIFIC NOTES.

The Perception of Light.—M. Charpentier has experimented recently as to the time which elapses between the appearance of a light and the making of a signal announcing its perception. The subject of experiment looked into a large blackened case and towards a window. A hole in the further side of the case was closed by a metallic shutter held in position by an electro-magnet, though not touched by it. A person behind the case broke the circuit of the magnet, so that the shutter fell; his act also produced a mark on a rotating cylinder. On seeing the light the person looking into the case pressed a spring with the forefinger of his right hand, and this act also, by electrical agency, produced a mark on the cylinder. The interval between these marks, compared with the *data* of an electric chronograph, afforded a measure of the so-called "duration of luminous perception." It appears that with the same person, and like conditions, this duration varies, without apparent regularity, to the extent of double. But a constant average may be arrived at from say a dozen observations; this, in the author's case, was 13-hundredths of a second (direct vision). With different persons it varied from 9 to 15-hundredths. The duration is sensibly the same for both eyes (if sound). It is notably increased by other brain occupation—*e.g.*, speaking or attentive listening, during the experiment. It is always greater in indirect than in direct vision, and greater the further the point of the retina struck from the centre. This difference between the two kinds of vision is considerably reduced by many days' practice, but is never entirely suppressed. Practice also considerably shortens the duration of the reaction for different points of the retina. The exercise of an eccentric point affects the different points of the same retinal hemisphere, abridging the duration; but not those of the other hemisphere. Further, this shortening influence of exercise of a point in the inner half of the left retina extended to the outer half of the right retina, while the inner half of the latter retina reacted much more slowly than the same exercised part of the left eye.

A Super-sensitive Thermometer. — Since the days when Mr. Edison brought out his micro-tasimeter, which proved so sensitive to heat, until now, we have had no instrument devised for measuring extremely delicate changes of temperature. Such an apparatus has, says *Engineering*, been recently devised by M. Michelson, and brought, at least in its experimental form, before the French Physical Society. It is based on the principle of bi-metallic thermometers, but ebonite or hard caoutchouc is chosen instead of one metal. Hard rubber is 10 times more dilatable than platinum under heat, and a spring, composed of platinum on one side and ebonite on the other, will curve under the least increase of temperature. At the extremity of the spring is fixed a small glass stem forming an elbowed lever, which abuts against a light mirror suspended by a silk fibre. When the spring curves or straightens, the mirror is deflected, and a ray of light from a lamp reflected from its surface to a scale moves up or down the divisions of the scale. By giving to the spring and lever a relatively great length this instrument can be made very sensitive, and the inventor hopes to be able to measure the thousandth of a degree Centigrade.

As the result of carefully conducted analyses, Professor Ledebur, of the Freiberg School of Mines, gives the following examples of the quantity of oxygen in various samples of iron and steel:—Oberhausen open-hearth steel, 0·035 per cent. oxygen; bochum Bessemer steel, 0·047 per cent. oxygen; basic steel, previous to complete dephosphorisation, 0·068 per cent. oxygen; basic steel, after complete dephosphorisation, previous to addition of spiegeleisen, 0·111 per cent. oxygen; Gute Hoffnungshütte wrought iron, 0·515 per cent. oxygen.

To obtain luminous photographs, a film is made of perchloride of iron and tartaric acid on a surface of softened glass; when it has been exposed, sulphide of calcium, rubbed to a very fine powder through a sieve, is dusted over it. The image is formed in the same way as if it had been dusted with any other powder, and the *Scientific American* says it can then be transferred to paper.

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⁎ Subscribers are requested to order Cases and Vols. through their booksellers, and not to send direct. The regulations of the post-office prevent their transmission through the Post.

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⁎ It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions; and in cases where the amount sent exceeds One Shilling the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement and charged for.

Advertisements *must* reach the office by 3 p.m on Wednesday to insure insertion in the following Friday's number.

Holloway's Pills are admirably adapted for strengthening debilitated and nervous constitutions. Weak digestive organs are invigorated and poor blood enriched by this purifying medicine. The most delicate may take it without apprehension, the most timid need have no fear. The balsamic nature of Holloway's Pills guarantees their strengthening powers.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Wanted, all the back-numbers of the "**Electro**-Metallurgist and Electric Light Journal." **Exchange.**—G. C. T. Carter, 3, Castle-street, Reading.

Boiler (slow-combustion), Hot Water Pipes, &c, wanted, for Heating Coil and cash.—Mr. S. Hewett, South Norwood, London.

128 odd numbers from the 10 first volumes of the "**Eng**lish Mechanic," in exchange for any useful book or numbers the *Builder*, or send offers.—Jas. Levesque, St. Helier's, Jersey.

Organ Bellows and Windchests (new and second-hand), in good condition, ready for wind and pipes.—Address, William Johnson, No. 12, Moxley near Wednesbury.

Bicycle, 52in., **Bown's Æolus Ball Bearings** both wheels, saddle, brake, bag, light, splendid machine, nearly new, condition perfect. Value £8. Exchange Astronomical Telescope or Microscope.—Davies, Giles, and Co., Sedgley, Dudley.

Bicycle, 48in. What offers in exchange value £7?—G. Moore, 59, Westbourne-road, Barnsbury, London.

Street **Electrical Machine**, with bells, mirrors, clock face, indicator, and battery complete, with travelling case, cost £10. Exchange for Lathe or Bicycle.—J. Skinner, Sutton Bridge.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, AUGUST 11, 1882.

A PRACTICAL TEST OF THE RIVAL BRAKES.

THOSE of our readers who study railway accidents and the rival brake systems, are aware that lately two of the best-known devices have been unintentionally submitted to a very crucial test of their merits, and they also know that the automatic pressure brake answered the expectations which had been formed of its capabilities by those who kept their minds unbiased. It may be remembered that an accident happened to an express train on the Great Northern Railway in June last, near Werrington Junction, and the curious accident which happened the other day to a Great Eastern express, will be fresh in the memory. A brief recapitulation of the principal features of the two accidents will serve to impress upon the mind the importance of the conclusions to be derived from them. The accident at Werrington Junction was caused by the breaking of a coupling-rod of the engine, one portion of which damaged the gear of the Smith vacuum brake, and knocked some part away, which, falling on the metals, threw a portion of the train off the line. The speed is said to have been about 45 miles an hour at the time of the accident; and, according to the driver, he applied the brake, or, at least, made the requisite motion for doing so, as soon as he became aware that something was wrong. The tender and coaches were found at a distance of 470 yards from the first indication on the metals of anything being wrong, the tender being on the up-line—its proper place—with the vehicles all off, except the last van, which, strangely, was on the down goods line. The carriages were all still coupled together, but the brake-pipes were broken in several places—an instructive fact. It would seem, from the position of the vehicles, and the condition in which some of them were found, that they must have run for some considerable distance after leaving the metals; in fact, it is clear that some of them were off the metals for the full 470 yards. The engine broke away from the tender, and was brought to rest about 1,100 yards in front of the latter. In his report, Colonel Yolland says he was not able to obtain distinct evidence whether or not the opening of the valve by the driver had the effect of putting the brakes on; but from the comparatively short distance which the tender and train ran, he thinks that some brakes must have been applied to the wheels of the vehicles.

Those remarks will, we venture to think, be read with surprise, not to say astonishment; for, in the opinion of a Board of Trade inspector, 470 yards is a comparatively short distance for a train to run with some of the coaches off the metals all the time, and all the vehicles off for a portion, at any rate, of the distance. Probably Col. Yolland has some special reason for believing that the brakes were applied; but, as the pipes were broken in several places, and the engine separated from the train in all probability directly the coaches were thrown from the rails, it is clear that the blocks could not have remained long on the wheels, if indeed the vacuum was sufficient to put them on at all, for, as we know, it takes an appreciable time to bring the blocks to the wheels with a vacuum brake. There is no doubt that the inspector reported to the best of his judgment and according to his interpretation of the evidence; but he will scarcely be surprised if engineers demur to his dictum that 470 yards is a comparatively short distance for a train to run with some, if not all, of the vehicles off the road, and two turned on to their sides; it is in reality a terribly long distance for the passengers inside, and much too long to be tolerated in days when really efficient continuous brakes are available. The Werrington Junction accident is, in fact, one of those instances, comparatively rare, we may admit, in which vacuum brakes of the simple pattern are utterly useless, and the most complicated arrangements on that principle of little avail. It is probable that the breaking of the coupling-rod was followed immediately by damage to the brake gear, which would effectually prevent the driver putting on the brakes; and as the engine parted from the train, very likely almost at the same instant, the power to apply the brakes, assuming the gear to be in good order, left with it. It is tolerably obvious, we think, that if each vehicle had been fitted with an automatic brake, practically independent of the system when the connection is broken, the train would never have run 470 yards, even if every vehicle had kept on the metals. Those who hold a different opinion may possibly be able to explain why a train on the Great Northern runs 470 yards, while one on the Great Eastern, travelling at the same speed, is automatically stopped in a little over 100 yards. The full details of the Great Eastern accident, near Ely, will not be published until the inspector makes his report, and there are not a few who would like to see Colonel Yolland appointed to investigate the disaster. The Great Eastern accident was an extraordinary one, so far as the direct cause is concerned—almost unique we imagine. The balance-weight of the link-motion of an up-express engine slipped off the levers, and escaping the wheels of its own train, appears to have bounded towards the down-line and lodged in the bogie of a down-express locomotive, which was thrown off the line into a ditch, but not before the driver had time to apply the Westinghouse automatic brake. This balance weight, a lump of iron weighing about 3cwt., appears to have slipped, from the nut of the pin working loose at a time when the levers were in such a position that the pin could escape and leave the weight free to slide off. It seems to have struck and damaged one of the axle-boxes of the second coach; but seeing how quickly wheels follow one another in a train travelling at 45 miles an hour, it is remarkable that the weight should have escaped as it did and bounded across the "six-foot" into the bogie truck of a passing engine. This engine appears to have carried the weight about 70 yards, and after oscillating sufficiently to break chairs and bend rails it turned over into a ditch, about 114 yards from the point of first injury indicated by the rails. The Westinghouse brake acted in a very efficient manner, for none of the carriages were telescoped or thrown on to the others, while the four hinder-most remained absolutely uninjured on the rails. Just in front of them a Brighton and South coast saloon had its headstock and a buffer broken, and the leading wheels off the rails, while the nearest coach to the engine rested on its leading end, the front wheels being gone. The intermediate coaches were upset, but there was no piling up or telescoping—a remarkable result in a train travelling at such a speed. The results of this accident demonstrate in an unmistakable manner the great value of the automatic principle when used in connection with a powerful brake that can be promptly applied, and that the Westinghouse was applied promptly in this case may be gathered from the fact that the train was pulled up in a distance—the "comparatively short distance"—of 114 yards, or about five seconds in time. It will be interesting to compare the report of the Board of Trade inspector on the Ely disaster with that of Col. Yolland on the Werrington Junction affair, for if we transpose the conditions it is not difficult to imagine what a terrible piling-up of coaches there would have been, had the Great Northern engine, instead of separating and running away from its train, turned over after running only 114 yards. The two instances afford a means of comparison which should effectually alter the opinions of some boards of railway directors, for neither the Board of Trade nor the public will be satisfied until a powerful automatic brake, efficient under any conceivable conditions, is fitted to all trains running at high speed, or passing over crowded lines.

REVIEWS.

Light: a Course of Experimental Optics, chiefly with the Lantern. By LEWIS WRIGHT. London: Macmillan and Co.

IN the preface to this work, which many of our readers will recognise as the reproduction, on an extended scale, of certain papers which appeared in these columns, the author alludes to the remark of Prof. Huxley—that there is a great difference between two kinds of "what persons call knowledge." Many teachers, according to Prof. Huxley, have no conception of any distinction, for they think it quite sufficient if their pupils are able to repeat with accuracy the scientific propositions they have learned by rote, whereas the object of the teacher is to convey clear and vivid impressions of the body of facts upon which the conclusions drawn from those facts were based. Mr. Wright has endeavoured in this volume to play the part of teacher from that point of view, and presents the reader with a course of experiments illustrative of the physical realities which underlie the phenomena of light and colour. The fact that the experiments are chiefly made with the lantern is of especial value, because the appearances presented on the screen and visible to a whole class, or to the entire audience, impress themselves on the memory and the understanding with more intensity than those experiments which are made privately in the laboratory without the use of the lantern and the screen. Mr. Wright's book is mainly addressed to teachers and lecturers, but the student and private experimenter will find that the author has never lost an opportunity of assisting them by suggestions as to the construction of apparatus. For many reasons the student of experimental optics will find most pleasure in the phenomena of polarisation: hence, perhaps, about one-half the book is devoted to that branch of the subject, which is freely illustrated with diagrams and plates—some coloured. Our readers, however, have doubtless not forgotten the articles on "Optics with the Lantern," which appeared in Vols. XXXII. and XXXIII., so that we need only say that, in an extended form, well printed, with 190 figures and eight page plates, they form one of the most interesting and valuable works on experimental optics that have yet been published.

The Hall-Marking of Jewellery. By GEORGE E. GEE. London: Crosby Lockwood and Co.

THE author of this work is one of the largest "hall-markers" of silver chains in the United Kingdom, and, probably, at one time, felt the want of such a reference-

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book as he has here given to the trade and the public. The former possess means of finding out what they wish to know, but to the general public the mystery of hall-marking is, to borrow a phrase from Dundreary, "What, no fellah can be expected to understand." In the minds of the public there is a possibly unfounded suspicion that the hall-mark, or what passes for it, is often the means of deceiving the ignorant purchaser, who believes that the article so stamped is of better quality than it would show on analysis. In fact, there is no doubt that many articles are bought with marks of some kind or other on them, in the firm belief that they are pure gold or silver, sometimes with the addition that they are "solid." It is only fair to say that the exercise of a little of that uncommon thing, "common sense," will prevent anyone from purchasing 9-carat alloy in the belief that the article is gold; but it is a question whether the trade would not benefit by a strict law that nothing below a tolerably high standard should be sold as gold, or be stamped with any of the hall-marks. As Mr. Gee tells us, 9-carat gold costing 33s. per oz. is composed of metals in about the following proportion:—Fine gold, 7dwts. 12gr., fine silver, 2dwts. 12gr., and refined copper 10dwts., so that, in reality, it is one-half copper, and is better entitled to that name than to the term "gold." That the laws relating to hall-marking require revision is a proposition which the majority of jewellers would not dispute, and we find the author actually speaking of the "necessity" for reform. "As regards the public," he says, "the present marks are too technical and various to be at all understood. Nine out of every twelve persons would not probably be able to distinguish a German-silver spoon plated with silver from a hall-marked one, on their own general knowledge of the marks, the same number of marks being upon each, and with a great similarity of design. . . . We do not believe there are many manufacturers even who could describe the whole of the marks on a piece of plate, with the purposes for which they are intended, right off, if incidentally asked the question, and we are quite sure that those who would be able to do so amongst our present jewellers would consist of a minority." Mr. Gee has been at the pains to collect a great deal of information in connection with the law and practice of hall-marking, and has given details of the marks and rules of the various assay offices, which will be useful to the trade and valuable to the public, who can refer to this work as a trustworthy guide. Mr. Gee would, however, permit the manufacture of "gold and silver wares in any alloy desired by the purchaser," with a system of optional hall-marking provided by law for all standards alike. The quality would, however, be definitely indicated by a Government stamp, which would give ample security to the purchaser, and leave the trade free to mix the metals in any way which experience might teach to be best for the special purpose of the articles. The hall-marking would be perfectly voluntary; but, if we understand the author, the Government stamp would be applied to all articles by experts under Government control, and Goldsmiths' Hall would be abolished. One executive, in fact, should manage all the assay offices, and the marks of different halls, dates, quality, and other "cabalistic signs," together with the duty mark, should be swept away. The marks would thus be reduced to two—the maker's mark and the Government stamp, which latter might easily be made to contain the date; or, where the articles are too small, the date could be impressed alongside. One great grievance of the trade under the present law is the practice of the assay office in breaking up work which is found to be less than the standard claimed. For instance, if only a quarter of a grain under the specified standard a cup or plate, on which a great deal of artistic labour may have been expended, is reduced to such a state that it is fit only for the melting pot, although a quarter of a grain represents in gold a difference of one halfpenny per ounce, and in silver the eighth of a farthing! Those who are interested in the question, or who require information as to hall-marks, will find Mr. Gee's work a valuable handbook, and if it should help to bring about a much-needed reform it will have served a double purpose.

The Theoretical and Practical Boilermaker. By Samuel Nicholls. Blackpool: The Author, Yorkshire-street.

We are glad to welcome an enlarged and revised edition of Mr. Nicholls's "Boilermaker," taking it as evidence that his labours have been appreciated by those whom they were intended to benefit. On p. 603, Vol. XXIII., we reviewed the first edition at length, and we may now say, to those who are unacquainted with the work, that it stands out by itself as the only practical treatise on the subject. It is, in fact, a vade-mecum for the practical boilermaker. The chapters on geometry and orthographic projection, or in other words on templating, with the numerous plates, are alone worth the money to any boiler-smith. Comparing the second edition with the first, we find that the work has grown by about fifty pages, although some portions have been omitted. The added matter, however, is of more value than the parts omitted, the new rules and the worked examples being admirably suited to the wants of those who will study the book. Formerly, managers or foremen were selected for their practical abilities alone, says Mr. Nicholls; now employers demand something more — they require men with technical knowledge, not mere rule-of-thumb workers, and that knowledge is what this book is intended to convey.

Art Instruction in England. By F. E. Hulme, F.L.S., F.S.A. London: Longmans.

This is not a treatise on art, nor in any sense a tutor; but is simply a manual in which an account of the position of art-teaching in this country is given. The various schools and the position given to drawing in their curriculum are noticed, while the art-requirements of candidates for posts in the public departments are indicated. Mr. Hulme points out what subjects are taught, and why they are taught, and endeavours to show that art-teaching is a necessity almost for all, whether rich or poor. In his first chapter, the author has some remarks on art-teaching now and 20 years ago, which leads him to discourse in a general way as to the method that should be pursued by the student; and, later on, to give an outline of the system adopted in the Government art-schools. Then follows an account of the position of art in the various public schools up to the Academy; and the author, by means of anecdote and excerpts from speeches, succeeds in making a readable book, which contains a great deal of dry but useful information.

We have also received *The Scientific Evidences of Organic Evolution*, by George J. Romanes (Macmillan), a reprint of a lecture published in the *Fortnightly*, which is so excellent an epitome of the Darwinian doctrine that the distinguished naturalist urged the author to issue it in its present handy form. ——*A Practical Treatise on Hand-railing*, by George Collings (Crosby Lockwood), is a handy little volume by a practical workman who gives plain instructions for working out hand-rails by new and simple methods, such as he has used himself in the pursuit of his trade.——*The Elements of Machine Design*, by W. Cawthorne Unwin (Longmans), is the fourth edition, revised and enlarged, of one of the best of the textbooks of science issued by the Messrs. Longmans. The work is extensively used in classes, and is carefully pored over by many amongst the more intelligent practical engineers, puzzled as they may be by the mathematical formulæ used in parts.——*A Treatise on Shoring and Underpinning*, by Cecil Haden Stock (Batsford), is a useful handbook for architects and students, as the author has carefully looked up authorities on the subject, and added additional notes and sketches from his own practice.——*Sydenham, Dulwich, and Norwood* (T. F. Unwin) is another of the half-holiday handbooks, the utility of which we have before mentioned. At present they all refer to districts south of the Thames; but, we presume, the north is to follow.——*Molesworth's Pocket-book* (E. and F. N. Spon) is the twenty-first edition of a work which has attained a well-deserved reputation. It has steadily grown in bulk until it now contains nearly 750 pages of "useful formulæ and memoranda for civil and mechanical engineers." Those who have previous editions will surely procure the new one, and those who are unacquainted with the work may be assured that it is an indispensable pocket-book for the engineer and mechanician. ——*The Photographic Studios of Europe*, by H. Baden Pritchard (Piper and Carter), is a gossipy account of a number of visits paid to the studios of well-known photographers, which is full of useful hints to the profession. The term "studios," perhaps, scarcely covers the contents, as amongst the articles are accounts of photographing prisoners at different establishments, and a description of Dr. Huggins's studio, in which he photographs the stars and their spectra.——*Micro-Fungi, When and Where to Find Them*, by Thos. Brittain, Pres. Manchester Microscopical Society (Simpkin Marshall), is a very handy and useful manual for the microscopist who wishes to study the minute fungi. The work is arranged to the months of the year, and an appendix gives a list of the fungi mostly to be found on the leaves of plants.——*The Open Fireplace in All Ages*, by J. P. Putnam (Trübner), is an American work, giving an historical sketch of the fireplace, and a large number of illustrations of fireplaces and over-mantels, ancient and modern.

THE ORGAN: A COMPREHENSIVE TREATISE ON ITS MANUFACTURE, PROCURAL, AND LODGMENT.*

By John Watson Warman,

Associate of the College of Organists, London.

It will be at once obvious that by this treatment the Driving-Wire will be rendered incapable of *turning* round while in its Cut, and that therefore the Regulation by the Button can always be performed with but one hand. The workmanship involved cannot fairly be considered greater than with the Threaded method, because the Clothing furnishes an *additional* advantage.

Defect No. 3 (stated at *n*, ante, 5th parag.). It will be equally manifest that this blemish likewise is got rid of by the preceding device,—all necessary to effect the disconnection of the Coupling Backfall being, first, the freeing of its rear end from the Sticker-top, and then the raising of the end containing the Cut, so that the Stirrup-bottom leaves the latter, and can so then be drawn forward and entirely freed from the Nose.

Defect No. 4 (stated at *n*, ante, 6th parag.). The removal of this also will be accomplished, so far as is ever practicable with the present Form of Man-to-Man Coupler, by the Nose-Stirrup Device. That is to say, all the while it is not found necessary to detach the Driving Wires from the *Great Organ* Backfalls, the position of the Regulating-Buttons on such Wires will obviously remain entirely undisturbed.

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Defect No. 5 (stated at *n*, ante, 7th parag.). This is remedied by keeping both the sets of Manual Keys perfectly straight on Plan, and obtaining the "Passing between" of the Great-Org. Sticker by the device of making such "Passing" portion to be of *Wire*, suitably Cranked: see now the Description, given at *z*, ante. Thus there is no Skewing whatever, either of Keys or of Action, in the entire Manual portion of the Instrument,—the especially unpleasant Anomalous Skew of the Coupling Backfall (see *m*, ante, 11th parag.) being of course got rid of along with the rest. Of more importance than the latter is the fact that there is *not* now the counter consideration of the *second* Skewing (see *m*, ante, 2nd parag.; and *qq*, next, 4th parag.) to militate against the adoption of one same Setting-out for both the Manual Roller-boards. [If the *Clear* Coupler should be here attempted (see at *m*, ante, 8th parag.), it will manifestly be necessary that the *Great-to-Ped.* Stickers also be Crank-wired (see again at *z*, ante) at and past the Square-Noses which lie upon the Swell-Org. Key-tails.]

At this stage see again (at *h* ante, 9th parag. and on) the method of *Front-Regulation* for the Swell Clavier,—remembering that such Regulation is here rendered slightly more practicable by the fact of the Wire-cranking of the Stickers affording less hindrance to the required access to the Regulating Buttons than do the ordinary—Wooden entirely—Stickers. Whenever such Front-Regulation is resolved upon, it will generally be best to plant the Great-Org. Stickers back at the extreme [rear] end of their Key-tails,—so of course causing the Noses of the Swell-Org. Squares to enter and lie between such Stickers: the latter, being of wire at such point, will accommodate these Noses in a sufficiently free manner (see *m*, ante, last part of 2nd parag.). The Notching of the Swell-Org. Key will thus, in such case, take the form of a simple removal of the corner portion of the extreme [rear] end of each side of such Key. The Sticker of the Coupler Great to Pedals must now obviously be set close inside of the regular Sticker of the Great-Organ.

By the forgoing arrangement the Swell-Org. Square-Noses—already lengthened by having to receive the Swell-to-Ped. Stickers—will be prevented from becoming still further extended, and the Regulating Wires carried by such Noses will be fairly accessible to a proper Tool. The contact of the Action Great-to-Pedals is not of course rendered so satisfactory as when made behind the said regular Sticker which is on the same Key; but still there will exist no real risk of fore-lifting the latter (see again *m*, ante, last part of 2nd parag.), provided only that such Great-to-Ped. Sticker is planted as close as is possible to such regular Sticker contact, and that the [Great-Org.] Key itself be of ample length (see here at *rr*, Bis, ante).

With regard to the abstract *advisability* of the preceding positing of the Great-Org. Stickers, and consequent entry of the Square-Noses between them, it may be considered that such a treatment is not usually to be adopted, unless either the Backfalls or the Keys of the Great Manual are already as long as is well admissible (see *n*, next), or else that the Front Regulation of the Swell Manual is a matter determined on. As to the first of these points, see what has been said (at *m*, ante, 16th parag.) as to the shortening by diminution of overlap: with respect to the second, go again over what has been given, with the *Faringdon* Arrangement, concerning such Front Regulation (at *h*, ante, 8th parag.), —the same *non*-necessity holding good in the present case. The alternative and preferable method has also previously been set forth (at *m*, ante, last part of 2nd parag.).

q. As a *Verdict* on this present (No. 4) *Treatment* we may confidently pronounce that it is, with the exception already implied in favour of some Treatment which comprehends a Clear Coupler (see fully at *r*, next, 2nd parag. and on), the best practicable for the General Lay-out indicated (see *m*, ante and on);—bearing in mind that the design will not suit a *Detached Buffet* (see *r*, next, 14th parag.), and that the Great-Organ Backfalls are prevented from ever being Fanned; but—on the other hand—that the work is quite simple, that Skewing is eliminated, and that friction is reduced to a minimum (see at *v*, ante). The Merits and Defects of *Treatment* No. 4, therefore, like those of No. 2, rise or fall along with those of the said General Lay-out itself. Concerning this the reader is to be again referred to *Department* Entire Organ,—in supplementation of what has already been given at *m*, ante, 4th parag. and on; and at *n*, ante, 9th parag. We may, however, here summarise, by saying that the General Arrangement and Design of the present Instrument are palpably superior to those of that at Faringdon; and that the only real Defect (the absence of Clavier Projection cannot fairly be called blameworthy) of Willis's general Design, is that the Swell Section still retains the Order of Smallest Pipe at Middle. It is necessary to add that such Order was here rendered advisable by the limited width allotted to the Organ (see *Dep.* Building Frame, 43, *q*),—obliging the Pedal Pipes' being kept close to the Wind-chest Sides (Ends), and so preventing that access to latter which is desirable with all Sections which have their *Largest* Pipe at Middle.

With regard to the advantage of this last-named Ordering, as applied to the Swell Section, the reader must be referred to *Department* Windchest, and also again partly to that of Entire Organ. It will suffice here to observe that a Swell-Organ which has its largest Pipes in the centre, and is also planted behind and on a level with a Great or other Un-Boxed Organ which has its *smallest* Pipes at centre, will derive real benefit from the tones of its Bass Half being then more unobstructed in reaching the Auditorium; and also that such an Order of the Swell-Org. Pipes is agreeable to the giving of a *Coved* and *Lofty* form to the Swell-Box,—such a form very palpably assisting the reverberation and consequent enrichment of the Swell-Organ Tone.

See at this point with reference to the Coupler Swell to Pedale's being made of the *Part* kind (descrip. at *qqqq*, next and on).

qq. *No.* 4½ *Treatment.*—This consists simply in the Correction of the Imperfection last named —viz., the Order of the Pipes of the Swell Section.

In the present Treatment, therefore, the Order of the Swell-Org. Pipes is understood and enforced to be with the largest of them at Middle. Of course, the necessary space for Tuning Access must exist at the sides (ends) of the Swell-Org. Windchest. In every other respect of *General* Arrangement—including the Pipe Order of the Great Organ—such present Treatment is assumed to be the same as that of the Hoddesdon Instrument.

In the Manuals, and in the Action connected with them, the only essential alteration from the preceding Treatment (No. 4) is that the Hoddesdon model is also resumed for the *Manuals*, in so far as that the Swell-Org. Keys are now Skewed as in Treatment No. 3,—the Great-Org. Stickers being therefore of course not Cranked. But this resumption does not extend to the Key *Action* of the Swell-Org., which Action now runs from such Key straight to its Roller-board,—the Setting-out of the latter being thus made to start at the Half Semi-tonal Key-tail distance "out" (aside): but this shifted nature of such start is manifestly of not the least consequence in the present Treatment, because, the Pipe-Order being here totally different in the two [Manual] Sections, the Setting-out of the Great-Org. Roller-board could not in *any* case be made to serve also for the Roller-board of the Swell-Org.; and the Setting-out of the latter will not be in the smallest degree more difficult than if its start were made in agreement with the Key-tails of the Great-Organ. Of course, the Backfalls of the Couplers Swell to Great and Swell to Pedale will require to be Skewed; but such two Skewings furnish the *only* departures from the square which occur in the entire Manual Action: and it will be noted that the *Anomalous* Skew (see *m*, ante, 11th parag.) is now got rid of altogether.

The only remaining Skewing, that of the Swell-Org. Keys, ceases here to have that objection against it which existed in the Hoddesdon Instrument (see *n*, ante, 7th parag.), because now, the altered Pipe-Order of the Swell-Org. not only renders unadvisable any second [return] Skewing in order to bring the two Manual Roller-boards into an agreement, but, in such rendering, also (as just stated) abolishes entirely the Anomalous angle of the Coupling-Backfall of Manual-to-Manual.

See now again (at *h*, ante, 9th parag. and on) with reference to the Front-Regulation of the Swell Manual.

For the exact posit of the regular Stickers of the Great Manual, and the connection which exists between such posit and the Front Regulation just spoken of, see as already given in *Treatment* No. 3 (at *m*, ante, last part of 2nd parag.), and *Treatment* No. 4 (at *p*, ante, 9th parag.),—where also will be found the necessary directions concerning the Coupler Great-to-Ped., and the exact design for the Key-Tails of both the Manuals,—in connection with all these points. The actual model adopted in these several items in the present Treatment will preferably be the same as that with Treatment No. 3.

qqq. As a *Summary* concerning the present *Treatment* No. 4½ we may say that the *General Arrangement* (see *qq*, ante, 1st parag: and on) for which it is suitable is the best possible under all ordinary or *Normal* circumstances (see again at *qq*, ante, 2nd parag.,—as to Tuning Access); and that the *Treatment* itself is, *for* such Arrangement, also the best possible under all conditions *excepting* when someone of the still preferable *Clear-Coupler* Designs is adopted;—remembering also, as before, about a Detached Buffet (see *r*, next, 14th parag.).

qqqq. We have now arrived at the proper Stage to point out that either of the preceding Five *Treatments* may be—in the absence of either a Clear Coupler or of a complete Pedal Organ—very much improved by making the Coupler Swell-to-Pedale to be of the *Part* kind. This Device (an idea of the present writer's) has been already partly described in connection with the Bellows (at 10, *l*); but a few words are advisable here also.

For a *Part* Coupler it is first necessary to provide with a Partition, such portion of the Soundboard as will be operated upon by such Coupler; and each of the two divisions so formed will then receive its own separate Pallett. In the present case the Coupler to be understood is the *Part Swell-to-Pedale*; therefore about the lower half—i.e., the portion correspondent with the Pedale Clavier—of the Swell-Org. Soundboard will receive such two Palletts to a note; and one of thesePalletts should supply the Reeds and Chorus of the Section, and the other Pallett serve the remainder of the Registers of latter. Each of these portions of the Swell-Organ must have its complete Action in *permanent* connection with its Swell-Org. Key, the two No. 1 Squares or Backfalls preferably having their Noses lying side by side on, or in the Fork of the Tail of, each single one of such Keys. Also it is of course obligatory that the Coupler Swell-to-Great do act upon both of the said Palletts, or it will not be possible to unite the *whole* of the Coupled Manual to the *Great* Organ *at all*. The simplest means of doing this will obviously be by placing such Coupling *between* the two Manuals (see *s*, ante); but such a Form may as manifestly be not always practicable (see next parag. but one), and in such event it remains (preferably) only to cause the *Backfalls* of the [Man.-to-Man.] Coupler to act upon both of the aforesaid No. 1 Squares or Backfalls. The Stickers of the Coupler Swell to Pedale are now to be so arranged as to be in contact with, and Wired into, *only* the one of each two of Squares or Backfalls which is connected with the Flue Foundation portion of the [Swell] Section. Such *Part-Coupler* is then complete. A moment's reflection will show that by such a treatment the Pedal Organ can be much better supplemented than by Coupling to it the *Full* Swell-Org.,—with some deep, powerful, and perhaps snarling Reeds almost inevitably present. If the Full Swell be at any time desired to be placed upon the Pedals, it can of course be so obtained by merely employing the coupler Swell-to-Great *conjointly* with that of Great-to-Pedale. [Should some form of the *Puppet Chest* be adopted instead of the regular Soundboard, the Coupler Swell-to-Pedale will be made to act only on those particular "Puppets" (Palletts) which belong to the Registers which it is desired to so place in connection with the Pedals. See hereafter in *Departments* Coupling Action and Windchest.]

It is hardly necessary to point out that the Coupler just described should never exist in any Instrument that has, or is to have, its Coupler Swell-to-Great made of the *Clear* kind (see *r*, next, 2nd parag.); for in such event the Reeds and Chorus of the Swell Section would be cut off from the *Pedal* Organ altogether.

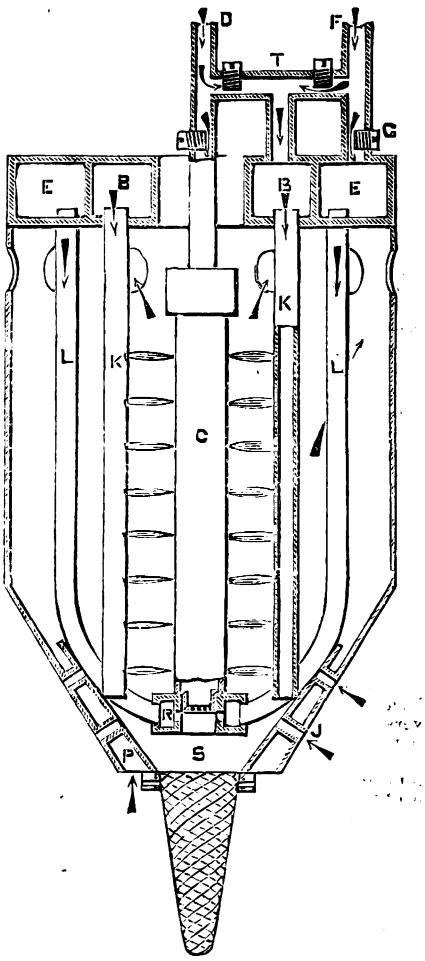
For a fuller description of the Mechanism of the Part Coupler see *Departments* Coupling-Action and Key-Action. It is here required only to add that any Coupler placed between the two Manuals will not, as a fact, be found well practicable in either of the preceding Five Treatments; because in every one of latter the lower portions of the Great Org. Stickers will be in the way of the Drumsticks Sliding forward, and in four of five there exists the additional obstacle that the hinder portions of the two Manuals are not set one vertically over the other.

(*To be continued.*)

CLAMOND'S INCANDESCENT GAS-LIGHT.

In No. 824, p. 419, we briefly announced that M. C. Clamond, of Paris, had patented a method of producing an intense white light by mixing hot air and hot gas, and directing the light upon a cylinder of lime. Since then experiment has led to modification, and another patent has been secured, the principal features of which are explained in the following description, with its accompanying illustration. The figure represents in vertical section one form of the improved apparatus, in which the heat of the products of combustion is partially recovered and considerable economy secured. The air current arriving by the pipe D descends the tube C, which is made hot by the small jets of gas playing on it, and becomes heated before reaching the jet S. A portion of the air regulated by the screw branches off by the pipe T and descends into the angular space B. The gas supplied by the pipe F enters the space E in quantity regulated by the adjusting screw G. From E four tubes L conduct the gas to the ring R which distributes it to the jet. A portion of the gas regulated by the screw shown passes by the pipe into B, which thus becomes charged with a mixture of gas and air in proportions which can be easily regulated by the screws. This mixture descends the four tubes K and issues from them in jets, which are ignited and serve to heat the tube C. The whole is inclosed in a casing which operates as a chimney, having at the top lateral apertures by which the products of combustion issue. At the bottom the casing terminates in two concentric cones connected by cross tubes J, and supports a basket of woven magnesia. Through this basket the jet flame passes producing the light, and by the draught caused by the casing the products of combustion ascend by the annular passage P whilst air entering by the cross tubes J becomes heated and aids in supporting the combustion of the small flames. It is obvious that the tubes K and L, as well as the spaces B and E, are heated by the products of combustion as they ascend within the casing M, a considerable portion of the heat being thus recovered.

The magnesian threads or baskets are thus made:—Magnesia calcined and pulverised is rendered highly plastic by thoroughly mixing it with a solution of a salt of magnesia that is readily decomposed by heat, particularly the acetate of magnesia. The plastic paste being put into a cylinder and subjected to moderate pressure by a piston, is caused to issue in continuous threads or tubes through a suitable die. These are then dried and thoroughly baked, during which operation the acetate becomes decomposed and, the acetic acid being driven off, there remains only compact and solid magnesia in the original form. The magnesian threads as they issue from the die are wound on a bobbin or mandril which turns first on an oblique axis and then on an axis at right angles to the former, so that the threads cross each other and adhere at their crossings, thus forming a net work which being dried and baked constitutes the basket of magnesia thread. The basket may be cased over with paper or other combustible material so as to strengthen it for transport and handling, this casing being burnt away when the jet is ignited. The magnesian basket is supported in a basket made of platinum wire or other refractory metal, with large meshes attached to a ring provided with a bayonet catch or its equivalent, so that it can readily be removed. The apparatus it will be seen admits of considerable modification; but has still the defect that gas is used in heating the air supply. The use of magnesian threads supported by baskets of platinum wire would, however, appear to be an improvement, as the magnesia becomes incandescent whilst the platinum remains sufficiently cool to escape fusion, or that state of semi-fusion in which it is impossible to keep it in shape. It is mainly because platinum, when raised to a white heat, tends to run together that coils used in electric incandescent lamps have failed, for the platinum glows with the most intense brilliancy only when it is just on the point of fusion. It remains to be seen how M. Clamond's burner will act when used with different qualities of gas.



MEASUREMENTS AND AMPLIFICATION OF TELEPHONIC VIBRATIONS.

"Everybody is aware," says M. Salet, in a recent paper to the Paris Academy, "that it is possible to hear through a thin door of pine, words spoken in an apartment that is otherwise quite closed. In this case the sonorous vibrations transmitted by the air agitate synchronously the wooden board, and this in turn transmits its movement to the outer air as a piston would. This familiar experience must have struck physicists, as giving proof of the exquisite sensibility of the ear. The vibrations of the board are indeed very small, hardly greater than those of the membrane of a telephone receiver in action; but these latter are so weak that their existence has sometimes been called in question. They exist, however, and I proceed to give an idea of their amplitude."

The method adopted by M. Salet was as follows: He fixed on the iron diaphragm of a Bell telephone a small glass disc weighing 0·45 gramme, and in front of this was supported a second, furnishing with it Newton's rings. The arrangement resembles that devised by M. Fizeau for study of dilatation. When one speaks at a distance of about six yards from the telephone, or sends into the instrument the telephonic current from a good transmitter (that of Buttcher, *e.g.*), the rings are observed to lose their distinctness, and disappear if the voice be a little forced. They vibrate, indeed, synchronously with the diaphragm, and nothing is simpler than to calculate, from the amplitude of their oscillations, that of the vibrations of the membrane.

It is certain, however, that the surcharge of the diaphragm with the discs must lessen the movements slightly; thus the results obtained err probably by defect rather than by excess.

To estimate the displacement of the rings, M. Salet arranges before the receiver telephone, which is caused to emit a continuous sound, a turning disc pierced with slits, like that of a phenakistiscope. One finds that, with a certain velocity of rotation, the rings reappear with distinctness. On blowing then through the disc, so as to make it act as a syren, it is found that the sound produced is in unison with that transmitted by the telephone. If it be slightly lowered or raised, immediately the rings oscillate, at first slowly, then with such rapidity that they become invisible again. While they oscillate one may easily estimate their displacement; in one experiment, the *la* of the diapason being emitted into the transmitter with the vowel *u* (*ou*), and with moderate intensity, the displacement was nearly equal to the distance of two consecutive rings, and the amplitude of vibrations of the receiving plate would thus be 2 to 3 ten-thousandths of a millimetre.

If there be sent into the telephone currents of different intensities, but very weak, and each of which, e.g., does not cause displacement of the rings beyond half the distance separating them, one may, by considering a point of the glass disc, infer from its brightness the intensity of the current. This singular galvanometric process, says M. Salet, might undoubtedly be utilised in the telectroscopic receiver.

In connection with the foregoing, we will here proceed to notice an interesting device for augmenting the dynamic effect of the vibrations of diaphragms, recently described by Mr. W. B. Cooper to the Franklin Institute.

When a cord is passed over a revolving pulley it is well known that there is a pull on one side proportioned to the character of the surfaces in contact and the pressure on them. This pull is due to the friction of the surfaces on each other, and increases in nearly, if not exactly, the same ratio as the pressure. Now, if the pulley is loose on the shaft, and we pull a cord passing over it, we have the same force exerted at the other end minus the friction of the shaft; if, however, the pulley is attached to the shaft and rotating towards the end pulled, then the result at the other end is the force applied *plus* the amount derived from friction on the surface of the pulley. This is the principle of the device, which, in its simple form, Mr. Cooper calls a phonodynamograph. To one end of a wire or band he attaches a diaphragm or other pulsating body, then he gives a half-turn or several turns round a drum or pulley, which is rotated in one direction. To the other end may be attached a lever, having a point adapted to indentations of sheet-metal passed under it at uniform speed by suitable mechanism. Mr. Cooper has thus embossed brass of the thickness of writing paper by the impact of the voice on a diaphragm of the size used in the phonograph.

The principle, he points out, is applicable to the telephone, both for the purpose of increasing the intensity of the electric impulses transmitted, and augmenting their effects at the receiving station. At the transmitting station, *e.g.*, the same, or by means of leverage a greater, amplitude of vibration may be given to a stouter diaphragm; or an armature, controlled by a spring, playing before the poles of a magnet. It is manifestly applicable, however, to any form of transmitter in which increased power is advantageous; and by it the telephone may be rendered available for greater distances. For increase of power in the receiver, Mr. Cooper has devised a plan in which he applies the principle somewhat differently. A number of horseshoe electro-magnets are set rapidly in a drum, and their draft upon an armature on the face of the drum is increased by the agency of friction of a wire or band passing round the drum, and connected with the armature and with a diaphragm. For details of the working we must refer to the original paper.

IMPROVEMENTS IN THE SODA PROCESSES.

SOME important improvements in the manufacture of soda and potash, introducing a method of combining the Leblanc and the ammonia processes, have been recently invented by Dr. Max Schaffner and W. Helbig, of Aussig, Austria. In the Leblanc process sulphur is used, which is thrown away in combination with calcium as "tank waste." In the ammonia process the residue is chloride of ammonium, from which ammonia is regenerated by distillation with lime. The present invention consists in combining the Leblanc process with the ammonia process, by employing for the regeneration of ammonia in the latter process hydrated magnesia, precipitated by the reaction upon chloride of magnesium of the calcium sulphide contained in the tank waste, which is the residue of the Leblanc process, and then employing the magnesium chloride resulting from the reaction of the magnesia upon the ammonium chloride for the decomposition of a further quantity of tank waste from the Leblanc process. The first-mentioned reaction takes place according to the equation:

$$2(NH_4\,Cl) + Mg\,H_2O_2 = 2\,NH_4O + Mg\,Cl_2 + H_2O,$$

and the second reaction takes place according to the equation:

$$Mg\,Cl_2 + Ca\,S + 2\,H_2\,O = Ca\,Cl_2 + Mg\,H_2\,O_2 + H_2\,S.$$

By combining these two reactions there is obtained a new industrial result of great importance. For the lime hitherto used in the ammonia process is substituted perpetually-regenerated hydrate of magnesia, obtained as a by-product of the operation of decomposing the tank-waste of the Leblanc process; and the whole of that part of the sulphur used in the Leblanc process which exists in the residue in the state of sulphide of calcium is liberated as sulphuretted hydrogen, which sulphuretted hydrogen can either be wholly burnt into sulphurous acid, which can be then converted into sulphuric acid, as will be well understood, or can be treated for the obtainment of its sulphur in the free state, or can be utilised in any other manner which may be preferred. It will be desirable, in order to diminish loss of chloride of magnesium, to divide the operation into two stages. The first stage should consist in heating the tank-waste with an excess of solution of chloride of magnesium, and then, when the calcium sulphide in the tank-waste has been completely decomposed, separating the resulting magnesia, either by subsidence and decantation, or by filtration. The magnesia so separated will then be ready for use for decomposing an equivalent of chloride of ammonium from the ammonia process. The liquor separated from the magnesia will be a mixed solution of calcium and magnesium chlorides, and this should now be heated with a quantity of tank-waste containing more calcium-sulphide than the quantity equivalent to the magnesium chloride in the mixed solution. When the whole of the magnesium chloride in the mixed solution has been decomposed by a portion of the calcium sulphide in the excess of tank-waste with which it has thus been heated, a second filtration, or a second operation of subsidence and decantation, should be performed. The solution separated by this second operation will contain only chloride of calcium, and may be thrown away, or otherwise disposed of. The solid matter separated from the solution of calcium chloride will consist partly of hydrate of magnesia and partly of excess of undecomposed tank-waste, and should now be treated, with or without more tank-waste, by an excess of solution of chloride of calcium.

The manner of employing the hydrated magnesia, obtained as aforesaid, for the decomposition of the chloride of ammonium of the ammonia process, may be the same as that which is at present followed. The present invention is so far applicable to the manufacture of potash that the tank-waste may be the residue of the manufacture of potash by the Leblanc process. Between the present invention and all preceding proposals for the use of magnesia for the decomposition of the chloride of ammonium of the ammonia process, there are essential differences, alike of object, of method, and of results. All former proposals to decompose by magnesia the chloride of ammonium of the ammonia process have had for their object the obtainment as hydrochloric acid of the chlorine of the chloride of sodium converted by that process into soda; but the object of the present inventors is to obtain, not hydrochloric acid, but sulphuretted hydrogen. All preceding proposals to use magnesia instead of lime for decomposing the chloride of ammonium of the ammonia process have been based on the idea (which has never yet proved capable of practical realisation) of evaporating to dryness the resulting solution of chloride of magnesium, and then heating the dry salt in a current of steam, so as to obtain on the one hand hydrochloric acid and on the other hand anhydrous oxide of magnesium; but by the present invention the chloride of magnesium is decomposed by treatment of the solution itself with the tank-waste of the Leblanc process, and the products obtained, instead of being anhydrous oxide of magnesium and vapour of hydrochloric acid, are sulphuretted hydrogen, hydrate of magnesia, and solution of chloride of calcium. Lastly, while to decompose the chloride of ammonium of the ammonia process by magnesia obtained by decomposing magnesium chloride by heating it in a current of steam would be to decompose it by anhydrous oxide of magnesium got by reacting upon solid chloride of magnesium by heat and a current of vapour, under the present invention the agent used for the decomposition of the chloride of ammonium is hydrate of magnesia, obtained by treating a solution of chloride of magnesium by solid sulphide of calcium.

STRAIGHTENING CROOKED CASTINGS.*

WHICH way will my casting go? is a question that the foreman of a foundry is often asked. To answer this question correctly every time would be a very hard task. The foreman may be well versed in the cooling and contraction of castings, but some time a complicated piece will come along that will puzzle him. In some castings the sooner some of the parts are cooled the less liability there is of the casting being crooked, while again there are others that require to be cooled from some certain temperature. There are two reasons for castings warping. The first is ill-proportioned thickness: the second, the allowing of some parts to cool before others. To these a third reason might be added, viz., the quality of the iron. Bad proportion is, perhaps, the chief cause for warped castings.

The two sketches illustrate the straightening of a crooked casting (Fig. 1), and also how gates and runners often make castings crooked (Fig. 2).

FIG. 1

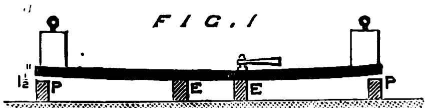
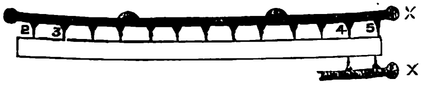


FIG. 2



Castings for house work give trouble from warping, as they are generally light and long. When the thickness of metal in a column is not equal, the thin side will cool first and draw the thicker side towards it, thereby making the thin side of the column concave and the thick side convex. A variation of 1-16in. in thickness is often enough to make a column crooked. When care is not taken to have the thickness equal and the core well anchored, crooked columns may be looked for. Cores that are made in half-core boxes, and then pasted together, should always be calipered before setting the bottom chaplets, to see if they are round. Should the core be found to be flat or out of round, the difference should be divided between the top and bottom chaplets.

Moulders will sometimes set a flat core by measuring the prints, and allowing for the variation there, but making no other allowance; and when the cope is set on there will be, perhaps, more thickness of iron on the cope than on the bottom side. If questioned about this by the foreman, they will answer that the core-maker should have made his core round instead of flat. This is all true enough; but as it is a well-known fact that very few cores are pasted together so as to be exactly round, like a core that is swept up with loam or green sand, the moulder should always caliper them and then the pattern, and set the chaplets accordingly.

There are also many house castings, such as lintels and ornamental work, that are troublesome from having flanges and ribs, for the purpose of strengthening them, and saving iron in the main casting. The flanges or ribs are usually either thinner or thicker than the main casting. It can only be told how a flange or rib will draw a casting in the case of a special pattern; that is, no general rule can be given. The same shaped flange or rib attached to different proportioned castings will not make the castings all draw in the same direction. Although it is mainly flanges and ribs that are the cause of many castings bending into all kinds of shapes, we must not lose sight of the fact that the main casting is just as much responsible. Either the flanges and ribs or the main casting could generally be cast separately and come straight. When the main casting is the thickest, then we must give our attention to the cooling of that; but when it is the reverse, the flanges or ribs will require especial attention in the cooling.

About all that can be said as regards the cooling of ill-proportioned castings to keep them straight is, *cool the thick part and keep the thin part hot.* Try to keep all parts of the same temperature so that their contraction will be equal. There are castings that it is almost impossible to cool so as to keep straight, on account of their ill-proportions, and should we by good management do so, we run the risk of having them crack sooner or later, as there is sure to be a strain somewhere, because a thin body of iron will contract in cooling more than a thick body.

With castings in which a strong artificial cooling treatment has to be resorted to to make them come straight, it is best when possible to have the pattern made crooked to compensate for the warping when cooling. This is very often done in the case of castings that always warp one way. But there are castings in which this would be impossible, because they twist into all kind of shapes, one day being one way and the next day some other shape, and so on. About the best thing that can be done with such castings is to make them of iron, of the least possible contraction. If iron could be had that had had no shrinkage qualities, we would not be troubled much with crooked castings.

Weighting down the ends or the middle of long, heavy, or light castings is very often done to keep them straight. Sometimes the weights are sufficient to hold the casting straight without having to resort to any cooling process, and again it is necessary to weight them down and to cool them as well. It is sometimes better, when possible, to weight a casting down than to try to straighten it by cooling. I have seen long awning castings go so crooked that it was necessary to take them out of the mould, lay each end on some pig iron and weight down the middle so as to bend it down more than an inch below a straight line, the bending being done the reverse of the way that it naturally crooked or warped. This should be done as soon as possible after the casting is poured, so as to bend it while red hot. When the castings had cooled and the weights were taken off they come up straight.

Often moulders will weight down the ends of a casting, and shovel the sand from the top in the middle in order to keep the ends of the casting from coming up. This is wrong, for by cooling the middle on the top side, this part is contracted quicker than the under side, which will naturally cause the ends to come up if the weights are not heavy enough to hold them down. If the moulder is trying to hold down the ends of his casting, it would look more as if he understood what he was doing to dig underneath the middle of the casting so as to cool it, which, by causing the casting to contract there, will help the weights instead of working against them.

If the under side cannot be got at, it would be better to put on more weights, and instead of coolin the middle on top, leave it well covered over with sand, so as to keep it hot. It should always be remembered that removing the sand or brick from any part of a hot casting cools it; that cooling any portion of a hot casting causes a contraction, and that the side that contracts the fastest becomes the shortest. Also that before one side can become shorter than another, there must be a crook or a bend in the casting, this bend being made while some part of the casting is hotter than another. The part that cools first will generally keep the casting in the shape it was bent when hot.

It is not always that a moulder will succeed in straightening a casting before it is cold. He may, when he gets it out of the sand, see that it is crooked, and while there is yet a little heat in it, by dampening the rounding side or surface with cold water, straighten it. This treatment requires care, especially if the casting is so hot that you cannot bear your hands on it. The action of the water is sometimes visible as soon as it is applied, and if care is not taken, the casting will be bent the other way, in which case, if there is heat enough left, it may be wet on the other side to bring it back.

After castings are entirely cold and are then found to be crooked, they may often be straightened by pening with a hammer, or by heating the middle with a wood and charcoal fire, and weighting down the ends. Fig. 1 shows how this is generally done. The crooked casting is rested on two iron bearings, E E, high enough to give a good chance to build a wood fire underneath. There are then wooden or iron guide-blocks, P P, set to allow the ends of the casting, when it is being straightened, to be bent down the proper distance, so that, after the weights are taken off, the ends will spring up, leaving the casting straight. It will generally be necessary, if the middle is made red-hot, to bend it down about twice as much as it is crooked; that is, if it is ¾in. crooked, it should be bent 1½in., and after it is cold and the weights are taken off it will be straight. This is done by adjusting the blocks, P P, so that the weights will bend the ends down just as far as required.

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* By Thos. D. West, in *American Machinist.*

In straightening castings in this way there is no cooling or contraction involved; the casting is simply bent, while red-hot in the centre, by the weights. The casting must be red-hot and be bent more than sufficient to straighten it, as explained. A wood fire is kept underneath, and a charcoal fire is made on top of the casting, so as to have it surrounded entirely by a strong fire. Often castings can be made straight by pening the hollow side with a hammer as shown. The hammering compresses and lengthens the part that is hammered, expanding the surface of the iron, which lowers the ends. A solid iron block should always be used to rest the portion of the casting under the hammer, and the hammer should have a good flat pene. The hammering should be done gradually over the surface. Steady hammering on one spot and then on another breaks the skin or surface of the iron, or perhaps worse, will break the casting in pieces. Fig. 2 shows how gates and runners sometimes draw casting crooked. This casting was a long toothed rack, the teeth being small. The casting was gated as shown, and when it was taken out of the sand it was bent sideways. This was caused by the gates and runner being lighter than the casting, and in cooling and contracting the quickest, they drew the casting crooked. To remedy this in the next casting, gates were made on both sides as at X X, instead of on one side only. This caused an equal pull on each side, thereby making a straight casting. The small gates 2, 3, 4 and 5, at the ends, would generally be broken from the castings by their rapid contraction. There is hardly a foundry that has not been at some time troubled by castings breaking or warping, and it is frequently troublesome to find the cause, and a remedy.

ANALYSIS OF JAPANESE BRONZES.

An examination of some specimens of Japanese bronze by Mr. J. Tadnari Matsdaira, B.Sc., a student of Rutgers College, N.J., gave the results recorded in the following short paper, contributed to the "Transactions" of the college. Bronze, as is well know, is an alloy of copper and tin. The relative amounts of its constituents vary according to the purpose for which it is intended; sometimes lead, zinc, gold, and silver are added, with the intention of giving it greater brilliancy or fusibility. Modern bronzes differ from the antique ones in composition and manner of manufacture. The bronze coin of Alexander the Great (335 B.C.) contained 86·72 per cent. of copper, and 13·14 per cent. of tin. A Roman bronze coin (500 B.C.) contained 66·04 per cent. of copper, 7·66 per cent. of tin, and 29·32 per cent. of lead. Many of the modern French bronzes are composed of—Copper, 91 parts; tin, 2 parts; zinc, 6 parts; lead, 1 part. The Japanese word corresponding to bronze is "karakane," meaning Chinese metal. Brass is called "shin-chu." The bronze industry in Japan is very ancient. Copper has been produced in Japan since the eighth century, but even before that period the manufacture of bronze had reached a certain stage of perfection, the copper or its alloys having been imported from China. Giyoka, a priest, and the introducer of the potter's wheel, planned the erection of monster statues to the god Buddha, and the plan was carried into execution by the Emperor Shomw, in 724-749 A.D. Three of these statues still exist. They are about fifty feet in height, and are said to contain a small percentage of gold. The modern bronze castings are employed for many ufeful and ornamental purposes, such as statues, bells, vases, knife-sheaths, candle-sticks, &c., and are generally made in the simple and curious style of the old and celebrated Chinese bronzes, or are embellished with the characteristically grotesque vagaries of Japanese art. The bronze objects are cast in clay moulds, formed upon models made of a mixture of wax and rosin, which is melted and poured out of the mould previous to running the metal in. The melting furnaces are generally of small dimensions, and consist of an iron pot lined with clay. The surface of the casting is then finished, and the design corrected by chiselling. Frequently gold and silver are inlaid to produce artistic effects. This work is known as "zogan," and is principally carried on in the provinces of Kagan and Techin. Frequently the surface of the bronze is deadened and darkened by the application of a solution of sulphate of iron and other chemicals. I have examined two of the best known kinds of bronze. One is called "shibuich." Its surface is of a light, brilliant gray colour, but a scratch reveals a red metal. The object from which I took the sample for analysis was a knife-sheath. The analysis gave—

Copper	74·11	per cent.
Silver	25·81	,,
	99·92	,,

The other sample was also from a knife-sheath, and was the metal known as "shakudo." The surface was a dark rich brown. It contained—

Copper	98·95	per cent.
Silver	·63	,,
Iron	·05	,,
	99·63	,,

THE METALLURGY OF NICKEL AND COBALT.

At the annual meeting of the Society of Chemical Industry, Prof. Huntington read a paper on the manufacture of nickel and cobalt. An important feature in the recent progress of this branch of metallurgy is the rendering of these metals malleable. In dealing with arsenical ores, Louyet's method is largely employed. For ores which do not contain arsenic the following method is said to be used. The ore is first fused with iron pyrites, by which means the nickel is separated in the form of a sulphide. The regulus of mixed sulphides is next treated for the separation of iron and sulphur, much in the same way as in the Swansea method of copper smelting—i.e., by a series of calcinations and smeltings, the "metal" in some cases being finally roasted in a fused state or treated with nitre to remove the last traces of iron. The remaining sulphur is then easily got rid of, and the more or less pure oxide of nickel thus obtained is reduced to the metallic state in the same way as in the wet process. The foregoing method is sometimes applied to the treatment of the New Caledonian ore, a silicate of nickel and magnesia, containing on the average 7 to 10 per cent. of nickel. This ore, which is very plentiful, is now, however, for the most part, smelted on the spot, much in the same way that iron is treated, and the metal exported to this and other countries in the form of pigs, containing about 5 per cent. of carbon and silicon, and occasionally a little antimony. The difference in cost for carriage between the ore and the pig amounts to about 20 per cent. The pig is refined without expense for arsenic by mixing with it a suitable proportion of arsenical ore. Hitherto nickel has only been used in alloy with other metals as a whitening agent. The reason of this is that it could not be obtained in a workable form. The metal resulting from the fusion of grain nickel is always wanting in malleability and ductility, behaving in a similar way to wrought iron which has undergone fusion, and probably for a similar reason.

Dr. Fleitmann, in the year 1879, succeeded in rendering nickel malleable by adding to it, whilst in a state of fusion, ⅛ per cent. of magnesium, introduced through a hole in the top of the crucible, a few lumps of charcoal having been previously added. In this way it is possible to produce malleable nickel which can be welded to iron or steel at a white heat, and rolled into thin sheets without separation. Fleitmann failed to get the same results by the use of manganese, aluminium, or calcium. Mr. Alfred Smeaton Johnstone, of the firm of Messrs. Wiggin and Co., who had previously been experimenting with manganese, has, however, succeeded perfectly in rendering both nickel and cobalt malleable by means of manganese. Commercial manganese (about 95 per cent.) or any ferro-manganese may be used for this purpose, the presence of iron not destroying the malleability of the nickel or cobalt. Thus the analogy between the treatment of nickel and cobalt and of iron which has undergone fusion is perfect. The manganese is added at a little a time to the fused nickel or cobalt, which is kept well stirred during the time, and finally poured out into moulds when tranquil. The metal is considerably agitated by the escape of gas during the addition of the manganese. For most purposes the addition of 2 per cent. of metallic manganese is sufficient, but when the maximum degree of malleability and ductility is required the quantity added may be increased to as much as 5 per cent., beyond which there is no gain under ordinary circumstances. The manganese left in the nickel need not exceed about ·2 per cent. Zinc can be successfully alloyed with nickel by reducing their oxides in a state of admixture. By rapidly fusing the alloy thus obtained a tough, malleable and ductile metal can be made. The melting point of nickel is too high to admit of zinc being introduced into it after the nickel is molten. The addition of ·1 per cent. of magnesium is said to improve the working properties of this alloy.

It is not likely that important applications will be long wanting for a metal possessing such valuable properties as malleable nickel, the price (about 4s. a pound) being comparatively low. Malleable nickel anodes are already being substituted for the old cast anodes. The former certainly have a great advantage in their uniformity of structure, which not only prevents to a great extent their being eaten away irregularly, but also avoids loss through secondary currents. The greater rarity and consequent higher price of cobalt precludes its general use in the metal state. It is, however, said to be used for electro-plating, the articles coated with it being sold as superior nickel plate.

COMETS' TAILS.

All who can should read Dr. William Huggins' interesting paper on "Comets" in the current number of the *Nineteenth Century*. He enters at length into the composition and nature of these bodies, points out what is to be learnt about them from the spectroscope, and from the information afforded by the observation of meteors and meteoric stones, and concludes with the following *résumé* of two or three of the most important of the many hypotheses which have been put forward to explain the formation and the phenomena of the tails of comets.

It is scarcely necessary to say that the enormous tails of bright comets, many millions of miles in length, cannot be considered as one and the same material object, brandished round like a great flaming sword, as the comet moves about the sun. It is but little less difficult to suppose that the cometary mass is of so large an extent as to include all the space successively occupied by the sweep of the tail at perihelion, the enormous stretch of tail maintaining a position always opposite to the sun, as the comet moves round the sun. Therefore, on the theory that material cometary matter is present throughout the entire extent of the tail, we seem shut up to the view that this appendage, often of stupendous magnitude, is constantly being renewed and reformed, either by matter streaming from the nucleus, or in some other way. But such a view involves velocities of transportation of matter far greater than the force of gravitation could account for, and indeed in the opposite direction, for we need a force of repulsion of some kind from the sun, and not of attraction towards it.

Consider a little closely the order of the apparent phenomena. As a comet approaches the sun, luminous jets issue from the matter of the nucleus on the side exposed to the sun's heat. These are seen to be almost immediately arrested in their motion sunwards, and to form themselves into a luminous cap; the matter of this cap then appears to stream out into the tail as if by a violent wind of some kind setting against it. Now one hypothesis supposes these appearances to correspond to the real state of things in the comet, and that there does exist a repulsive force of some kind acting between the sun and the gaseous matter which has been emitted from the nucleus. On this hypothesis the forms of the tails of comets, which are usually curved, and denser on the convex side, admit of the following explanation. Each separate particle of matter of the tail is moving in a curved course, under the influence of the motion it originally possessed, combined with that of this hypothetical repulsive force. But in the form which the tail assumes for spectators on the earth, we have to consider not only the effect of perspective, but also the circumstance that the comet itself is rapidly advancing in its course, so that the tail visible at any moment is due to the portion of space which at the time contains all the repelled matter, of which each particle describes its own independent orbit, and reflects to the eye the solar light, or gives out its own light as the case may be.

As a rule the tails of comets appear to be luminous by reflecting solar light, but at times the light-emitting stuff which gives a spectrum of bright lines or a continuous spectrum is carried into the tail, and retains this power of giving out light to a greater or less distance from the head. The value of the repulsive force which would be necessary on this theory has been investigated by Bessel, Peirce, Faye, and others. Recently Bredichin, of the Observatory of Moscow, by a series of investigations, has shown that the curvatures of a large number of comets fall into three distinct classes, each type of curve depending upon a different assumed value of the repulsive force. In this connection come in the secondary tails which are often present. On the hypothesis under consideration, these would appear to be darted off under an energy of repulsion so enormously great that the original motion of the nucleus tells for very little, and hence these secondary tails or rays are but slightly curved or even appear sensibly straight. It has been suggested that if this repulsive force, of whatever nature it may be, varies as the surface, and not like gravity as the mass, substances of different specific gravity would be very differently affected by it, and consequently separated from each other. On this view these secondary straight, or nearly straight, tails would consist of the lightest matter winnowed out from the other constituents of the cometary stuff. Of course, on this view a comet would suffer a waste of material at each return to perihelion, as the nucleus would not be able by the force of gravity to gather up again to itself the widely-scattered matter of the tail. It is certainly in accordance with this view that no comet of short period has a tail of any considerable magnitude.

A different view of the whole matter has been suggested by Professor Tait, which it is worth while to give as succinctly as possible, and in nearly his own words. He supposes not the nucleus only but the whole comet to consist of an enormous swarm of minute meteoroids, which becomes self-luminous at and about the nucleus in consequence of the impacts of the various meteoric masses against each other, giving rise to incandescence, melting, and the development of glowing gas, and the crushing and breaking up of the bodies into fragments of different sizes, and endowed with a great variety of velocities. The tail he conceives to be a portion of the less dense part of the train illuminated by sunlight, and visible or invisible to us according not only to circumstances of density, illumination, and nearness, but also of tactic arrangement, as of a flock of birds under different conditions of perspective, or the edge of a cloud of tobacco smoke. If on this hypothesis we are to suppose the glowing gas to arise from the decomposition of the meteoric matter, we should expect to have a more complicated spectrum from comets, and their spectra to differ from each other more than is the case, the comet of the present year standing alone in possessing a spectrum different from the type of spectrum common to all the other comets—about twenty—observed since 1864.

There seems to be a rapidly growing feeling amongst physicists that both the self-light of comets and the phenomena of their tails belong to the order of electrical phenomena. One of the most distinguished American astronomers recently wrote to the writer:—"As to American views of the self-light of comets, I cannot speak with authority for anyone but myself; still I think the prevailing impression amongst us is that the light is due to an electric, or, if I may coin the word, electric-oid action of some kind." The spectroscopic results fail to give conclusive evidence on this point; still, perhaps, upon the whole, especially if we consider the photographs of last year, the teachings of the spectroscope are in favour of the view that the self-light of comets is due to electric discharges. Those who are disposed to believe that the truth lies in this direction differ from each other in the precise modes in which they would apply the known laws of electric action to the phenomena of comets. Broadly the different applications of the principle of electricity which have been suggested group themselves about the common idea that great electrical disturbances are set up by the sun's action in connection with the vaporisation of some of the matter of the nucleus, and that the tail is probably matter carried away, possibly in connection with electric discharges, under an electrical influence of repulsion exerted by the sun. This view necessitates the supposition that the sun is strongly electrified, either negatively or positively, and, further, that in the processes taking place in the comet, either of vaporisation or of some other kind, the mattor thrown out by the nucleus has become strongly electrified in the same way as the sun, *i.e.*, negatively if the sun's electricity is negative, or positively if the sun's is positive. The enormous disturbances which the spectroscope shows to be always at work in the sun must be accompanied by electrical changes of equal magnitude; but we know nothing as to how far these are all, or the great majority of them, in one direction, so as to cause the sun to maintain permanently a high electrical state, whether positive or negative. Unless some such state of things exists, Sir John Herschel's statement, "that this force cannot be of the nature of electric or magnetic forces," must be accepted, for, as he points out, "the centre of gravity (of each particle) would not be affected. The attraction on one of its sides would precisely equal the repulsion on the other."* Repulsion of the cometary matter could only take place if this matter, after it has been driven off from the nucleus, and the sun have both high electric potentials of the same kind. Further, it is suggested that the luminous jets, streams, halos, and envelopes belong to the same order of phenomena as the aurora, the electrical brush, and the stratified discharges of exhausted tubes. Views resting more or less on this basis have been put forward by several physicists, and in particular by the late Professor Zöllner, who endeavoured to show that on certain assumed data, which appeared to him to be highly probable, the known laws of electricity are fully adequate to explain the phenomena of comets.*

RECENT ADVANCES IN PHOTOGRAPHY.—IV.†

By Capt. Abney, R.E., F.R.S.

In a collodion emulsion process, we have a process which is admirably adapted, at all events, for landscape work. The collodion emulsion was originated, I believe, in September, 1864, by Messrs. Bolton and Sayce, and a new era was opened out when they made their first emulsion. Now, an emulsion is very simply formed, particularly a silver bromide or chloride emulsion; but, as far to I know, it has been rather a crux amongst photographers to make an emulsion with silver iodide. However, this is a very easy thing to do, and I propose roughly to show those who are initiated in emulsion-making how an emulsion can be made, and further, how iodide of silver can be made amenable to treatment. The point in emulsion making seems to be, to get the precipitate in as fine particles as possible, and it is said that this can only be obtained, except at very great cost of time and trouble, by first adding the soluble bromide, or iodide, to the collodion. If you take the trouble to add the silver to the collodion, first of all the aspect of emulsion making is entirely changed, and you can get any amount of fineness by adding the iodide or bromide to the silver contained in the collodion so long as you keep the silver nitrate in excess. In this bottle is some ether, and some gun cotton which is not dissolved up. In this test tube I have some nitrate of silver dissolved in alcohol containing a very little water. I simply pour this solution into the mixture of ether and gun cotton, shake it, and I find an *emulsion* of nitrate of silver in collodion, since the alcohol and ether dissolve up the cotton. In the old days, emulsion makers would have said there is something wrong in having an emulsion of silver nitrate, but I think I shall soon demonstrate to you that in reality it is all right. Now I will add an iodide to this silvered collodion. I pour a solution of potassium iodide into it, not drop by drop, but somewhat carelessly, and shake it up in the bottle at intervals, and as a result, we get a very fine emulsion. You would find if you reversed the operation, and put the iodide into the collodion first, and then added silver nitrate, you would have precipitated the iodide of silver at the bottom of the bottle, and in a form which would not emulsify at all. My advise to those who wish to make collodion emulsion (not gelatine emulsion) is to add the silver to the collodion (or gelatine), and then add the haloid salts afterwards, and you will get as perfect an as you choose.

I have already shown you the colours of different haloid salts of silver under different conditions. I showed you two bromides, two iodides and two chlorides, one of each of which had been boiled in gelatine, and the other unmodified, and you saw the different colours they transmitted. To-night I wish to show you a new form of emulsion, which is adapted to certain purposes, and which is sensitive to the red and the ultra-red rays of the spectrum. If I had time I could show you that green is the most likely colour to absorb all above the red, and it was for this reason that I worked, till I obtained a green-blue colour for the purpose I had in view. I propose to try and take a photograph with the dark rays of the spectrum which lie below the red. These rays, which were discovered by Sir W. Herschel, and whose properties were examined by Tyndall, by means of the thermopile, we can analyse by means of photography. I will first, however, show you how very sensitive this form of bromide is to the ultra-red rays. There is what looks a very uninteresting picture on the screen, but still, it is sufficiently interesting for me to explain it to you. There are now, apparently, four black smudges, and these smudges were produced as follows:—A film of green bromide was prepared, and over it was put a card, punctured with holes of the same shape as the smudges, one-eight of an inch away from it. Above the card, and about half an inch away, was placed a kettle of hot water, having a blackened surface. After considerable exposure on development, I got the image of those holes in the card developed on the plate, and the result is the photograph on the screen. So you see that the dark rays of the kettle, or rather the energy of radiation from the kettle, was able to produce an image. This particular kind of bromide is very difficult to manipulate in a lecture, but I am going to be so bold as to make an experiment. I dare say some of you here who had the satisfaction of hearing Professor Graham Bell in his late visit, heard him discourse about the photophone; that is, as you know, an instrument which produces sound in a telephone connected to a selenium cell acted on by light. In one form of this instrument the light is intercepted by a revolving disc with alternate opaque and transparent sectors, which is traversed by a beam of light impinging on the selenium. He found, when he introduced between the source and the rotating disc a piece of ebonite, he still got the same effect, which was a matter of some interest. There were all kinds of explanations given about this remarkable fact. Some people supposed the ebonite took up the radiation, and gave it out on the other side, but I hope to show you that ebonite is transparent to the dark rays of the spectrum. I have some of this green bromide as a film on a plate. In front of that I have a piece of moderately thick ebonite. I propose to let the image of the carbon points forming the electric arc fall on the plate through the ebonite, by means of a lens. If the ebonite be permeable by the dark rays, we ought to get an image of the points on the bromide film when it is developed. As the rays have to penetrate through a mass of ebonite, I propose to give an exposure of about thirty seconds, and I dare say we shall then find we get the points fairly delineated.

For the sake of those who are uninitiated, I will show how very easy it is to develop an ordinary collodion emulsion plate. I am going to develop it with ferrous oxalate by means of a brush. Behind a negative is a plate coated with a collodio-bromide emulsion, and I will illuminate it by the magnesium wire. On taking it away from the negative, I place it in a little water, in order to make the developer flow, and then I brush the developer on the surface. It is rather a bold proceeding to manipulate a collodion film with a brush, but still I dare say it will answer. [The image was developed and shown.] The usual plan of developing these plates is to place them in a dish and pour the developer over them. They can also be developed in the hand in the same way as a wet plate. Now there is a great comfort in the collodio-bromide process, in that you are able to give local intensity to the image; and I hold that, for real artistic work, the great object is to be able to give local intensity to any part which the manipulator may judge expedient, so as to give that tone and that vigour which an artist may think necessary. In the next process which I shall describe you are at the mercy of your plate, and you must let come what will. The process which I refer to is the gelatine process, which may be described as silver bromide, held in suspension in gelatine, in the same way that it is in collodion.

What is the reason of the sensitiveness in the gelatine emulsion, for pictures can be taken in a tenth of the time necessary for a wet plate, and perhaps a thousandth that necessary for an ordinary dry plate? First of all we have seen on the screen in the last lecture that it has a blue form. But you must not run away with the idea that because anything is blue therefore the molecules composing that emulsion are blue. It may be an agglomeration of red molecules, agglomerated together in such a way that when light is scattered by it, it gives you the effect of blue light; and I believe I am right in stating that the most sensitive emulsion is that in which the agglomeration is in a red state, that is to say, the molecules themselves are red, and the agglomeration appears blue—the blue is there by accident, if I may say so. One reason why the gelatine emulsion appears so much more sensitive than the collodion emulsion is that you can use a more powerful developer. If you separate bromide of silver which has been emulsified in gelatine, and which gives very rapid plates from the gelatine—and there is an easy way of getting bromide of silver out of gelatine—and place it in collodion, the extreme rapidity will be found to be gone, simply because you cannot use as strong a developer as you can with the gelatine emulsion; in fact, the property that gelatine possesses of acting as a physical restrainer comes into play; each little particle, or aggregation of particles, is surrounded by gelatine, which prevents the developer acting rapidly on them.

Again, the fact that by boiling, or by the ammonia process, you get a coarser deposit of bromide of silver, also points to increased sensitiveness, for the reason that I tried to give point to in my first lecture. For when sub-bromide of silver is acted on by the developer, you have bromine, the last atom of bromine being taken away from the silver; and the moment you have freshly reduced silver in the presence of bromide of silver, and in contact with it, the bromide of silver can no longer exist, and therefore, you have fresh sub-bromide formed, thus:—$Ag_2 + Ag_2 Br_2 = 2 Ag_2 Br$, and this, in its turn, is reduced, and so on, until the whole of the bromide is reduced. The faintest action of light on one of these particles will therefore show itself, which it would not do were this aggregation not so marked as it is seen when looked at under the microscope. Another reason of the increased sensitiveness is this (and I have no doubt it aids it very materially), that if you boil or heat bromide of silver, or any haloid salt of silver, with an organic substance, it has a tendency to separate into the metallic state. So by boiling, for instance, a gelatine emulsion of silver bromide, the silver has a tendency to separate into a metallic state; in fact, the bromide of silver then is in the state of very tottering equilibrium; the bromine is ready to be given off at the very slightest disturbance of the molecule, much more so than before it is boiled. I think the fact that you so often get fogged emulsion when you over-boil, is proof of the statement that I am making. Now, if you were to ask me to illustrate the sensitiveness of a gelatine plate, I should take you down to the exhibition below, and I should point to you first, not some of those marvellously instantaneous photographs which you see, but I should just point out two, one by Mr. Henderson, which is a photograph by moonlight, and another by Mr. William Brooks, which is a photograph of some underground cellars at Reigate, taken by lamplight. I think, if anything can show what gelatine plates can do, it is the fact that candlelight and moonlight can be utilised for impressing the gelatine surface with an image. I have here another proof, perhaps, which will interest you as showing how rapidly a gelatine plate can act. I propose to take an image of a rotating disc, having alternate transparent and opaque sectors, when illuminated by the light of a single small spark. I have here an ordinary plate electric machine, and six small Leyden jars, together with a discharging machine, the knobs of which are placed five millimetres apart. If the Leyden jars are charged to a certain point, the spark will leap across between these two knobs. The light from that feeble spark will illuminate the rapidly rotating disc which I hold in my hand, behind which is placed a gelatine plate. The image, you see, of the rotating disc is perfectly sharp. I dare say it will interest you to know with what speed that photograph was taken. The duration of the electric spark, for a distance such as I have here, has been measured, and found to be 42-millionths of a second. You have now some idea of the immense velocity with which the spark travels, and the extreme sensitiveness of the plate which I employ. This recalls to my mind a very early experiment, made in the daguerreotype days, where a piece of newspaper was placed on a rotating wheel, and by the light of a spark obtained from a battery of fifty large Leyden jars, a photograph was taken of the rotating newspaper. I believe the words were tolerably well defined. The time of passage of the spark was greatly longer than that which I showed you first, and immensely thicker and more luminous. I should suppose the spark from the large battery at the Royal Institution would take not less than a thousandth part of a second to travel, so that you see they were labouring under better circumstances than we are here. I have taken a photograph of this rotating disc in the camera, with only a spark from one jar, but it was rather a ticklish thing, so I preferred to carry out the experiment in the way I have done, rather than to risk a failure. But you may take my word for it, that if you had fifty Leyden jars, you could take a portrait of our Chairman with the greatest ease, by a flash from the spark, in about a thousandth part of a second.

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* *Familiar Lectures on Scientific Subjects*, p. 140

* A theory based on chemical decomposition has been proposed by Professor Tyndall; and Professor A. W. Wright and Mr. Johnstone Stoney have suggested that the bright lines do not indicate heated matter, but are due to the opacity of the cometary gas to those particular kinds of light.

† Condensed from a series of Cantor Lectures delivered before the Society of Arts.

(*To be continued.*)

A Coloured Reaction of Atropine and Daturine.—If a specimen of either of these alkaloids or of their salts is covered with a little fuming nitric acid, let dry up on the water-bath, and when cold moistened with a drop of potassa dissolved in absolute alcohol, a violet colour is instantly produced, and soon passes into a fine red. Only the violet colour is characteristic, as strychnine also gives a beautiful red colour if similarly treated. According to the author, 0·000001grm. of atropine sulphate can thus be detected. None of the other important alkaloids give a similar reaction.—*D. Vitali.*

An Injector Worked by Exhaust Steam.—Referring to the article under the above head, p. 467, quoted from the *American Machinist*, the Patent Exhaust Steam Injector Company, St. Ann's-square, Manchester, inform us that the injector mentioned was made for them by Sharp, Stewart, and Co., under the Hamer-Metcalfe-Davies patent. The injector reported on by our Transatlantic contemporary was specially proportioned for taking feed at a higher temperature than is usual in this country, and the results are not quite equal to those obtained here—viz., temperature of delivery, 190° Fahr., against a boiler pressure of 70lb. The company inform us that they have these injectors fitted on all kinds of engines, and in every case they give satisfaction—as, in fact, they are bound to do, for if the feed can be forced into the boiler without using live steam, and without increasing the back pressure, there can be no question as to the economy to be obtained by the use of the invention.

SCIENTIFIC NEWS.

THE deaths are announced of two men well known in the world of mechanical science. Mr. Robert Wilson was the managing partner of the firm of Nasmyth, Wilson, and Co., was the constructor of the great combination hammer in Woolwich Arsenal, and a few years ago received a grant of £500 from the Government for his improvements in the fish torpedo. The deceased was seventy-nine. Mr. Robert Charles May, who died in the fifty-fourth year of his age, was well known at the Institution of Civil Engineers, and had a large practice as consulting engineer.

The *Science Observer* (No 37-38) contains a couple of diagrams showing the method of indicating the systematic work done in sweeping for comets. The diagram is divided into a number of squares which are occupied by nine types of peculiar form, the effect of which is to indicate by the depth of shade the work done. A closer inspection gives the actual number of sweepings. The horizontal lines represent parallels of declination, the spaces between being zones of 15° each. The vertical lines represent the hours of R A.; so that each square represents 1 hour R.A. and 15° Dec., and is further divided into nine squares which are empty or filled with types indicating the number of times that region has been swept over. Mr. Chandler has an interesting paper on Sawyer's Variable.

The autumn meeting of the Iron and Steel Institute will this year be held in Vienna, and the preliminary programme will doubtless attract a considerable number of members. The special train (Chatham and Dover) will leave on Sept. 16th, and the party will be conveyed viâ Flushing, Cologne, and Hanover to Dresden, where they will stop until the 18th, and arrive at Vienna on the 19th. The business of the meeting will then proceed with the usual excursions, the conversazione, and on the 21st the Institute will be entertained by the City of Vienna; the dinner will be followed by a concert and dance. Excursions will be made on the next and following days to Styria and Hungary, in the one case to visit the mines and large ironworks, in the other to inspect the mills and millwrights' shops.

We mentioned last week Mr. North's estimate of the coal in Natal We hear now that Prof. Green, of the Yorkshire College, has accepted the invitation of the Natal Government to go out and report.

In addition to the international expeditions to the Arctic regions mentioned last week, there is another which will attempt to winter either near Cape Chelyuskin or on the south coast of Franz Joseph Land. One of the principal objects of the expedition is to determine whether that land extends in a south-easterly direction towards Cape Chelyuskin, and whether a basis for further exploration can be reached without too great risk. Lieut. Hovgaard's vessel is an auxiliary steamship of 150 tons, and is provisioned for 27 months, but he hopes to return within 16 months. Observations will be made throughout the winter in accordance with the programme of the international congress.

The London and North Western have put on some new saloons for the fast service between Liverpool and London. The new type is 76ft. long, with a gangway throughout, the centre of the length being occupied by a luggage-box and an attendants' room, in which tea, coffee, &c. are prepared. This latter serves to separate the saloon into two compartments, one for ladies the other for gentlemen. The light is compressed gas, and the heating is accomplished by hot-water pipes arranged under the seats. The saloon is fitted with every convenience for comfortable travelling.

Electrical exhibitions are multiplying. Besides the combined international exhibition of gas and electrical appliances to be held at the Crystal Palace during the autumn and winter, a purely electrical show is to be held at the Westminster Aquarium from the beginning of November until the end of February, with the attraction of £1,000 in prizes. The Aquarium is in a central position, and the exhibition, of which Mr. W. D. Gooch is engineer, will doubtless attract both exhibitors and visitors. The exhibition at Munich is making progress, and the Bavarian Kunstgewerbe Verein has announced a prize for fittings suited for use with the electric light. Edison will again have a very prominent position; but the special feature will be the attempt to utilise the water-power of the Hirschau, and transmit the current over three miles to work a lift and a thrashing-machine during the day, and to light up the palace garden and the Königplatz in the evening.

A watchmaker in the Palais Royal, Paris, lights his shop with 24 Swan lamps, worked by as many Faure accumulators, each of which weighs 60 kilogrammes (say 132lb.) The accumulators work the lamps for eight consecutive hours, and the temperature of the shop is said to be 10 degrees less than when gas-lamps are used.

Mr. Henderson, an engineer employed by the Pennsylvania Steel Company at Steelton, has patented an improvement in converters which facilitates the work of lining them for the basic process. He converts the ordinary pillow blocks, in which the converter trunnions revolve, into wheels about 30in. in diameter, by means of which the converter may be run in and out of working position for use and for repairs, the track consisting of the girders usually provided. It is said that a 10-ton converter empty of metal, with the bottom removed, and weighing about 30 tons, can be wheeled away by two men, at the rate of about 25ft. per minute, for which purpose a power truck is provided, geared five to one, with winch handles. The invention has been secured by patent in the United States as well as in England, France, Belgium, and Germany. It dispenses with the necessity of having an intermediate ladle and crane between the converter and the ingot ladle to get the charge down to the working level. A special hydraulic lift for raising and lowering the shells is superfluous, and room is provided underneath the converters for the introduction of the gas main and pipes to rapidly dry the converters after re-lining.

The Mills Building, a collection of offices on Wall and Broad Streets, New York, has been wired for 5,588 Edison lamps. The conductors consist of 1,650ft. of patent electric tubes, 628ft. of lead pipe containing the taped leads, 23,658ft. of zinc tubes, 75,909 ft. of wire, and 24,162ft. of wooden troughs. The weight of the wire was 3,774lb., besides 48 vertical cut-outs and 213 division cut-outs. Full details of this installation would be useful, as there seems some difference of opinion in this country as to the precautions needed to avoid the fire-risks of electric lighting.

Mr. Edison's electromotograph drew attention to a new fact—viz., the variation of friction between two rubbing surfaces, produced by voltaic polarisation. Herr Koch found oxygen-polarisation to increase the friction of platinum or palladium; but he got no effect from the other kind. From recent experiments M. Krouchkoll infers that while polarisation by oxygen increases, polarisation by hydrogen diminishes friction. His apparatus consisted of a crystallising pan with polished glass bottom, rotated about a vertical axis. A series of small brushes of platinum, fixed in ebonite and connected with one battery pole, rubbed against the glass during rotation, and tended to affect the needle of a sensitive balance attached. The pan held a little water acidulated with sulphuric acid. The other electrode was a copper rod placed in sulphate of copper in a porous vessel, which stood in a second porous vessel holding water, and immersed in the liquid of the pan. By the movements of the balance, the effects above indicated were observed. Half a Daniell suffices to show them. The increase and diminution grow with the electromotive force.

A recent investigation by Professor Fischer, of Dresden, of the behaviour of phosphor-bronze wire with reference to tractive force, shows what a considerable influence the working of the wire has on its strength; and so, how uncertain experimental results are when this is not considered. On thinning the wire to about 0·4 of the original thickness, the force required for rupture was increased threefold, and it is thought certain that the same wire, by further condensation in the wire-drawing mill, and without annealing, could be made still stronger. In the case of telephone lines, less regard is generally had to flexibility and more to tenacity, as it is desired to span as great intervals with as thin wires as possible. Thus, with a view to strength and small sagging of the stretched wire, it is advisable to use as hard-drawn wire as possible, provided the conductivity is not hereby compromised. (For details of Professor Fischer's work see *Dingler's Journal*, July 12)

A safety buffer of simple construction has lately been devised by a German engineer, Herr Heydrich, and is being tried on several of the Government railways in Prussia. Its action is comparable to that of a brake, and takes place after full compression of the ordinary buffer-springs. On the buffer-rod, before the springs, there is a bush or socket (*Hülse*) with triple worm, and between the spring and the bush a shearing ring of hard steel. In the case of a collision, the latter is pushed forward, shearing the worm, and thereby so much mechanical work is absorbed, that the shock is greatly weakened. Thus, with four buffers per carriage (bush about 4in. long), a work of 7,200 kilogrammetres is consumed; and adding the work of the buffer-springs and that of the spring-frame, &c., transformed into heat before the carriage can be damaged, we have a total of 10,000kgm. per carriage. This corresponds to the kinetic energy of a carriage of 10,000kg. weight, at a velocity of about 16km. an hour, liberated by collision. This insures great safety, as in the case of shocks in or near stations, the velocity is mostly not over 10 to 15km. In new carriages, to avoid premature shearing of the screw, the cutting edge of the ring is applied not directly to the latter, but to a ring of certain width; and only after this has been sheared off does the continuous shearing of the screw begin.

Metals, it is known, can be volatilised at temperatures generally high, the use of the electric arc being often necessary. M. Demarçay has recently proved, however, that if the pressure be diminished, the volatilisation will go on at comparatively low temperatures. All the metals examined hitherto (the most volatile indeed), showed this effect. The metals were heated in a crystal tube by vapours of sulphur, mercury, &c., the tube being connected with a Sprengel pump, and having a U-tube, traversed by a current of cold water, inserted a little way in the metal. On this latter the metallic vapour was condensed. Cadmium was thus proved to have volatility at 160° C, zinc at 184°, antimony and bismuth at 292°, lead and tin at 360°. The deposits in 24 to 48 hours were sufficient to allow of weighing (5 to 15mgr.). M. Demarçay hopes soon to show that even metals like iron and platinum may thus be vaporised at temperatures much lower than commonly specified.

For ascertaining the water-level of steam boilers in the dark, Herren Schlag and Berend, of Berlin, place a small luminous float in the water gauge and make luminous marks near the glass. The float consists of a small cylindrical glass capsule, filled in the upper part with a mixture of Balmain's paint and phosphate of alkali salt. This mixture has the property of becoming luminous at temperatures of over 80°, without previous exposure to light. A grain of shot in the lower end of the float keeps it vertical.

During the first six months of 1882 the weather has greatly favoured Signor Tacchini's observations of sunspots and other solar phenomena. Thus there were 25 days of observations in January, 25 in February, 26 in March, &c. Spots were seen each day of observation. The solar activity has been increasing, and the maximum, it is thought, will probably be reached this year. There was a secondary minimum of spots in January; the size and number increased till April, then fell off again. There were most faculæ when there were fewest spots. With regard to latitude of spots last year, Signor Ricco has reported that there were 132 groups between + 7° and + 29°, with maximum at + 20°; and 120 groups between – 3° and – 33°, with maximum at — 18°. The northern spots seem to have more duration than the southern. Groups below 15° are displaced towards the equator, groups above 15° towards the poles.

In accordance with a recent State law of Massachusetts, special inspectors are now visiting the freight and passenger elevators used in Boston, to see whether they are provided with proper appliances for preventing a fall in case of breaking a rope. While all the safety catches tested on the first day checked the fall successfully, there were wide differences in their operation; thus, while in one case the platform was brought to a stand in about an inch, in another a weighted platform with cam catches fell 28¼in. before it was stopped. One platform was checked in a very smooth and gradual manner in 16½in. It is pointed out by the *American Architect* that the blow given to the guide posts by a platform weighted with one or two tons of goods, when brought up suddenly by a safety-catch after two or three feet of fall, would be terrific, and there are many buildings where the slender hard pine timbers would inevitably fail under such an impact, bringing down the whole structure in a heap. It would appear, further, that elevators depending for safety merely on the multiplication of the suspending ropes require thorough testing; for sometimes the parting of one involves that of the other.

Herr Noack, of Worms, has been making experiments on sounds from combined flames, with apparatus which allowed of moving the flames, either vertically or horizontally, towards each other. The burners were brass pipes 30mm. long and 6mm. wide, closed with a centrally perforated piece of platinum. The results were as follows: (1) When a horizontal flame burns against a vertical, the latter enters into vibrations; the pitch increases with diminishing aperture of burner. (2) The pitch is proportional to the distance of the horizontal flame from the mouth of the vertical burner, and inversely proportional to the distance of the vertical flame from the mouth of the horizontal burner. (3) The pitch increases with the pressure of gas in the horizontal burner, and falls in the same ratio with increased pressure in the vertical burner. With equal pressure in the two burners, the pitch is thus constant.

USEFUL AND SCIENTIFIC NOTES.

◆

Testing Wine with Catgut.—The determination of the astringent matters contained in wine is a most delicate operation. The principal astringent is a tannic compound called *œnotannin.* The ordinary methods of determination are rather uncertain, especially where there is little astringent matter. M. Girard has lately devised a method of very simple nature, which has proved to be superior in precision to the others. It depends on the tendency of the matters in question to combine with animal tissues. Long ago Pelouze used skin to separate tannin from gallic acid; others have analysed bark by a process based on absorption of tannin by skin. Some chemists seem to have even tried ordinary skin in the analysis of wines, but it is not well-suited for this. M. Girard finds in catgut a pure animal tissue, of definite chemical species, a much better means of determination. He takes some of the fine, white violin cords prepared by M. Thibouville-Lamy, the last process of polishing with oil having been omitted. Four or five of these are put together. A certain quantity is soaked in water for four or five hours (one grain having previously been detached to ascertain the water in it); then these swollen portions are put in a known quantity of the wine to be analysed. This is quickly altered in consequence; in 24 hours generally, or 48 at most, all colour has disappeared. The tanned and dyed portions of cord are then dried, first in a flat dish, then in a closed vessel at higher temperature. A comparison then made of the original cord (free from water) with the same cord tanned, coloured, and dried, affords a correct estimate of the *œnotannin* and colouring matters of the wine.

An American paper says the New York Custom House records furnish the following figures, which show the growth of arrivals of steam and sailing vessels at New York, during the years named:—1865, steamers, 455, sailing vessels, 4,291; 1866, 623 and 4,284; 1879, 1,591 and 6,486; 1880, 1,895 and 5,922; 1881,. 1,953 and 4,976. Although there has been a decrease of 1510 sailing vessels since 1879, and the number last year was only 683 more than in 1865, the increase in the arrival of steamers has been considerable. In commenting on these figures, an exchange says that the steamers, however, have not increased in number to this extent, as the majority of them arrive at short intervals.

An extensive deposit of bismuth in the form of metal and oxide has been discovered in the north-east of New South Wales. Hitherto the bismuth of commerce has chiefly been derived as a bye product in the treatment of zinc, cobalt, and silver ores, and has commanded a price quite out of proportion to the cost of production. From the new mine, the *Journal* of the Society of Chemical Industry says, the metal can be sent into the market at a cost which, if the present price—6s. 8d. per lb.—were maintained, would insure a profit of more than £500 per ton.

LETTERS TO THE EDITOR.

◆

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

◆

A CURIOUS WEATHER SUPERSTITION—AGE OF STONEHENGE—MEASURING THE HEIGHT OF LUNAR MOUNTAINS.

[20357.]—The rule with reference to the "Saturday Moon" and St. Swithin, given by Mr. Oliver in letter 20322 (p. 477) has broken down conspicuously, at the station whence I write, at all events. We had rain on St. Swithin itself, on the 16th, 17th, and 18th; fine weather on the 19th and 20th; rain on the 21st, 22nd, 23rd, 24th, and 25th, and then eleven consecutive days beautifully fine, hot, and sunny, without a drop. The solitary one of what I may call day rules in connection with the weather to which I attach the smallest importance is, "A wet Friday, a wet Sunday:" because it is a very common thing in this country for two days' rain to be separated by an interval of one, during which no rain falls. But then, of course, it would be equally correct to say, "A wet Tuesday, a wet Thursday"—and so on.

If "Neo" (letter 20323, p. 477) will consult Sir John Lubbock's most interesting book, "Prehistoric Times," he will find that its distinguished author attributes Stonehenge to the Bronze Age.

I very willingly accede to the request preferred by "A Ten Years' Subscriber" (in query 47538, p. 485), to give him the modus operandi of measuring mountains in the Moon. I can only, however, furnish some notions of the method of measurement, and of the principles on which it depends. For the reductions of such measures I must refer him to Neison's standard work, "The Moon," in which the mere formulæ (with their explanation)

FIG. 1.

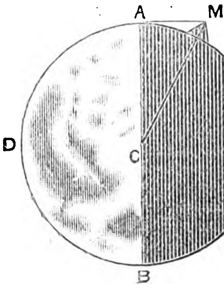
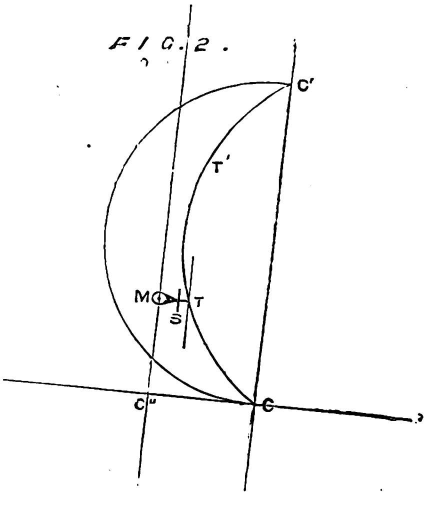


FIG. 2.



occupy pp. 554 to 560 inclusive. The older Selenographers proceeded on a principle which will be at once apprehensible from a study of Fig 1.

Suppose that A D B represents the Moon when half full, or accurately in her First Quarter, and let M be a mountain, the extreme tip of which only is illuminated, the Sun not yet having risen on the lower part of it; then, with a micrometer, measure the distance A M. Now, C A M is a right angle; C A (the Moon's semi-diameter) is known, and hence (Euclid I., 47) the hypothenuse C M is at once found. Take C A from this, and the remainder is obviously the height of the Mountain. As the Moon is a globe, a very little reflection will show that the point M may be anywhere to the right of the line A B, as long as such line is a straight one. Mädler adopted, and modern Astronomers generally use, a different mode of determining Lunar Altitude altogether—his method consisting in the measurement of the length of the shadow cast by the object whose height he was endeavouring to ascertain; then computing the altitude of the Sun above its Lunar horizon at a given instant, the remainder of the operation resolved itself into the solution of an ordinary right-angled triangle. It is the determination of the Sun's position with reference to the object at the instant of observation, which involves so much tedious calculation. The way in which the actual observations are made is indicated in Fig. 2. Here, C C′ are the horns or cusps of the Moon; C T T′ C′ the terminator, or boundary of light and darkness: M the Mountain to be measured, and M S its shadow. First, then, we measure the exact length of the shadow in a direction at right angles to the line joining the Cusps C C′; next, with all possible accuracy, in the same direction, the angle M T between the summit of the mountain and the terminator; and, lastly, turning the micrometer round 90°, we measure the distance M C″, or that between the Mountain and the Moon's Cusp. For the operose and most wearisome mass of calculation necessary to deduce the height of the given mountain from these data, I must, as I have previously said, refer my querist to Neison's great book. I may add that, having thus obtained the heights of certain standard objects, Mädler compared the lengths of the shadows cast by them with those of others in their immediate neighbourhood; thence deducing, very approximately indeed, the heights of the latter.

A Fellow of the Royal Astronomical Society.

δ EQUULEI—β LEPORIS—β DELPHINI.

[20358.]—The close pair (OΣ 535) of the triple star δ Equulei (Σ 2777) is probably the most rapid binary at present known. Whether a period of 6½ or 13 years (OΣ inclines to the shorter one) is the more probable is at present uncertain, owing to the small number of observations, and the almost perfect equality of the two compenents. It was discovered by OΣ, with the Pulkova refractor, on August 19th, 1852. The definition being extraordinarily fine, he saw the two stars just separated, with a power of 858; the next year he could only see an oblong disc, and in 1854 the star was absolutely single. It is a system resembling 42 Comæ, the elongations being from 0°–30° and 190°—220°. As far as I am aware, it has only been seen double at the observatories of Chicago, Lund, and Pulkova. The principal observations during the last twelve years are—

Du.	8°. Oblong, nearly certain ..	1870·73 (1ⁿ)
OΣ.	210·6°. Oblong, separated at intervals, distance 0·29″....	1874·71 (3ⁿ)
β.	[156·4°?]. 0·2″. A slight elongation (probably illusive)....	1877·76 (1ⁿ)
,,	No certain elongation	1878·65 (2ⁿ)
Hall.	Not certainly double, powers 888 and 1,300	1879·76 (2ⁿ)
β.	22·1°. 0·38″. (Unpublished)	1881·46 (4ⁿ)

Possibly Mr. Perry would be able to measure it this year; next year it will presumably be single again. The change in C is due to the proper motion of A-B. The distance was 19·5″ in 1781, it is 39″ now. The exceedingly pretty pair, β Leporis (β 320) has been supposed to be a binary in rapid motion, owing to large errors in the earlier measures. Hall's measures at Washington, and the Cincinnati observations, show that no change has really occurred. Hall's are as follows:—

281°·0	3″·12	1876·11	(3ⁿ)
284·9	3·16	7·12	(3ⁿ)
281·3	3·05	9·98	(2ⁿ)
282·4	2·70	82·10	(3ⁿ)

H. measured a 13ᵐ companion at the Cape (*h* 3761) 145·9° Δ A.R. 2·5s. 1835·9, but he missed the close star, though it is now easily seen with a 6½in. Calver; there is a much fainter star near H.'s comes. Smyth observed a very distant star in 67·5° 210″ 1832; β 75·0° 206·4 1879.

The wonderful binary β Delphini is opening out again. When Mr. Burnham discovered it, in 1873, it was a comparatively easy object with his 6in. refractor, and the next year I saw it with my 6½in. Calver. In 1879 it was absolutely single with a power of 925 on the 18½in. refractor at Chicago. The next year β. measured it 133·6° 0·2″ ± 1880·7, and the measures (unpublished) of last year give 149·2° 0·26″ 1881·50; this season it should be considerably easier. The arc described in seven years is not less than 135°.

August 4. **H. S.**

CATALOGUE OF SUSPECTED VARIABLE STARS.—VI.

(*Continued from page* 475.)

[20359.]—**Pegasus — Perseus — Piscis Australis — Pisces — Sagitta — Sagittarius—Scorpius—Scutum—Serpens—Sextans.**

		h.	m.		°	′		
	Pegasus.							
249.	1 Pegasi	21	17	+	19	17	4	Webb ?
250.	3..........................		32	+	6	5	Comes. Var. Col.	Smyth.
251.	ε..........................		38	+	9	18	2·3	Gould.
252.	κ..........................		39	+	25	6	Comes Var.	Dembowski.
253.	B. 600		58	+	27	46	6½ — 8	Birmingham.
254.	θ..........................	22	3	+	5	35	3·6	Gould.
255.	η..........................		37	+	29	36	3 Var. Col.	Schmidt.
256.	σ..........................		46	+	9	5		Gore.
257.	ρ..........................		48	+	8	3		Gore.
258.	51		51	+	20	0	5·6	Herschel.
259.	56		59	+	24	39	5½	Franks.
260.	55	23	0	+	8	45	5·2 Var. Col	Secchi.
261.	59		6	+	7	56		Gore.
262.	B. 637		14	+	22	26	5·0 — 0	Birmingham.
263.	80		44	+	8	37	5·8	Gould.
264.	P. xxiii. 216		47	+	11	15	8·5	Struve.
	Perseus.							
265.	17 Persei	2	44		34	29	4·9	Herschel.
266.	β..........................	3	0	+	40	30	Comes. Var.	Sadler.
267.	Heis 121	4	10	+	50	1		Pierce.
	Piscis Australis.							
268.	L. 9036....................	22	2	–	34	37	5·7	Gould.
269.	ζ..........................		23	–	26	44	6·0	Schmidt.
	Pisces.							
270.	Piscium	0	14	+	2	22		Pickering.
271.	B. A. C. 263		49	+	26	11	6	Franks.
272.	φ..........................	1	7	+	23	57	Comes. Var.	Piazzi.
273.	ζ..........................		8	+	6	56	4 — 6	Webb ?
274.	....		15	+	18	8	10	Peters.
275.	Σ 155......................		38	+	8	51	7½	Dembowski.
276.	V		47	+	8	8	6	Argelander.
277.	112........................		53	+	2	28	6·0	Schmidt.
278.	19	23	40	+	2	47	4·9·— 6½	Espin.
	Sagitta.							
279.	ζ Sagittæ..................	19	44	+	18	51	Comes. Var.	Flammarion.
280.	9 ,, ...		46	+	18	17	5·4	Herschel.
	Sagittarius.							
281.	γ Sagitt	17	57	–	30	25	2·8	Gould.
282.	B. 427	18	2	–	15	18	8 — 0	Birmingham.
283.	29		42	–	20	27	5·5	Gould.
284.	σ..........................		47	–	26	27	3·0	Herschel.
285.	....		59	–	18	55	6·7	Gould.
286.	χ³	19	17	–	24	12	5·6	Gould.
287.	....		17	–	21	32	6 5 — 9 0	(?).
288.	....	20	6	–	22	24		Peters.
	Scorpius.							
289.	Scorpii	16	21	–	19	11		Peters.
290.	α (Antares)		22	–	26	9	Var. Colour. Var. Magnitude.	Secchi. Baxendell.
	Scutum.							
291.	α Scuti	18	28	–	8	19	3·6	Gould.
	Serpens.							
292.	δ Serpentis	15	29	+	10	56		Webb ?
293.	τ¹ ,, ...		30	+	15	30	6·3 — 0	Birmingham.
294.	α ,, ...		38	+	6	48	Comes. Var.	Webb ?
295.	ρ ,, ...		44	+	21	25	6	Franks.
296.	B. 372	16	3	+	1	8	6·3 — 7½	Birmingham.
297.	B. 418	17	37	–	18	36	7½ — 0	Birmingham.
298.	θ Serpentis	18	50	+	4	2	4·2	Gould. Smyth.
	Sextans.							
299.	12 Serpentis	9	53	+	3	58	6·1 — 7.0	Gould.
300.	19 ,, ...		58	–	8	59	4·5 — 7	Gore.
301.	18 ,, ...	10	·4	–	7	4		Secchi.
302.	27 ,, ...		20	–	3	46		Gore.

T. E. Espin.
W. H. Gage.
T. Read.

MARKINGS ON JUPITER.

[20360.]—The red spot has been seen recently on Jupiter's central meridian at the following times:—

1882.	July	26, *p.* end	16h.	23m.
	,,	29, centre	14	22
	,,	29, *f.* end	14	53
	Aug.	5, *p.* end	14	50
	,,	5, centre	15	15
	,,	5, *f.* end	15	37

These times cannot be relied on as being very accurate, because of the extremely unfavourable conditions then prevailing, except those of Aug. 5, which are probably fairly accurate. The spot appears the same as it did last winter; but is perhaps a little paler.

The equatorial white spot was seen to be a little preceding the *f.* end of the red spot on Aug. 5, being estimated on the centre at 15h. 35m. It was bright, small, and very white. Closely following it was one of the dark spots seen by Mr. Denning (letter 20335, p. 498), to the east of the red and white spots, which has evidently gained not only on the red spot, but also on the white one.

The other features of the planet seem much the same as last winter, but the north equatorial dark belt is of very irregular breadth; in some places being scarcely visible, and in others nearly as broad and prominent as the conspicuous S. equatorial belt. Advantage might be taken of this to ascertain its rotation period. The colour of this belt is rather paler. The south equatorial belt now appears of a beautiful deep reddish brown, except in some places, where it approaches black.

On Aug. 2, at 16h. 0m., two singular larger nearly round white spots were observed between the north equatorial belt and the belt further to the north. Their appearance was rather striking, and bore much resemblance to some of those white spots seen in the equatorial zone for some years past. The whole of the interval between these two belts appeared unusually white.

A. Stanley Williams.

West Brighton, Aug. 7.

[20361.]—During the past three years the great red spot seen on the disc of Jupiter has been an object of unusual interest to astronomers. As the planet for the past three months has been too near the sun for observation, it was a matter of considerable interest to ascertain as early as possible whether the spot was still visible, because it was alleged last year by some observers that it was fading in colour and distinctness.

On the morning of the 14th inst. the great refractor was directed on this planet, and the spot was distinctly visible, and its approximate longitude ascertained by micrometer measurement.

The rotation of the planet, from observations on the red spot, made at the Dearborn Observatory in 1879, was found to be 9h. 55m. 34·2s. The observations made at the same place, in 1880 and 1881, showed that the rotation period was slowly increasing; or, in other words, the spot was retrograding with an accelerated velocity. The mean increase in the time of rotation amounts to about one five-hundredth of a second daily.

All our observations from September 25, 1879, up to the present time are fairly represented by the formula:—9h. 55m. 34sec. + t × 0·00209sec., in which t is the number of days after Sept. 25, 1879.

According to the formulæ, the "mean" period is now 9h. 55m. 35·9sec., and the actual period about two seconds more, so that the apparent rotation of the planet is four seconds slower than in 1879.

The observation of July 14th made the passage of the spot over the central meridian July 13d. 15h. 22·3m. M.T., and the formulæ gave 15h. 28·8m. M.T.

An approximate measure of its length gave 11·9″; the mean from last year's observations being 11·3″. The oval outline of the spot appeared as formerly, and the colour reddish. This remarkable object, which is 30,000 miles in length and 8,000 in breadth, has not perceptibly changed in shape, size, or latitude during three years. It has, however, apparently drifted in longitude about 40,000 miles, or one and one-third times its length. A number of astronomers have imagined it to be the solid portion of the planet; but the drift in longitude disproves this supposition. It appears to us that it is more probably an immense floating island of semi-cool matter resting in a liquid incandescent ocean surrounding the planet. Such a condition of the surface would give great permanency, and still allow slow and gradual changes in both the position and outlines of objects.

G. W. Hough,
Director of the Dearborn Observatory.
Chicago, U.S., July 25.

REFLECTED RAINBOWS.

[20362.]—Some time ago, I remember a discussion in your pages (see Index to Vol. XXVI.), as to the possibility of seeing reflected rainbows, and the Rev. T. W. Webb gave an account of one he had seen reflected in the Lake of Lucerne (p. 469, Vol. XXVII.)

In the *Field Naturalist* for August (a monthly, published by Abel Heywood, Manchester), is a paper by Prof. Stanley Jevons, the substance of which I beg leave to introduce to those of your readers who have not seen it:—"But though a reflected rainbow is to be seen, there are comparatively few people," says Prof. Jevons, "who have seen one. I have all my life looked out for any curious phenomenon of the sort, and have on several occasions seen beautiful lunar rainbows, which are considered rare appearances. Only two years ago did I for the first time notice a reflected solar rainbow. The rarity of the occurrence is no doubt due to the fact that it needs the combination of three independent conditions to allow of the observation. In the first place there must be a bright bow, which is not seen many times in the year; secondly, he who sees the bow must happen to be in the neighbourhood of a piece of water suitable in extent and position to reflect the bow; thirdly, the water must be tranquil enough to allow of reflection. The last condition will usually be wanting, because rain-clouds will in most cases be accompanied by wind.

"About two years ago, however, I saw a bright reflected rainbow, and what struck me much was that it assumed a form and character which I could not possibly have foreseen. I was on a steamboat, steaming up one of the lower and broader reaches of the lovely Hardanger Fyord. The water happened to be almost perfectly tranquil, and yet at the same time a brilliant bow appeared upon a heavy shower of rain, which was falling at the further side of the fyord. The brilliant colours of the bow were finely contrasted against the darkness of the cloud and of the surrounding fyelds; and as the boat advanced through the glassy water, it was easy, from the head of the vessel, to see a bright reflection. Instead, however, of the perfect segment of a circle, with all the seven colours clearly distinguished, I was surprised to see something entirely different—namely, a broad and nearly straight streak of confused whitish light, extending from the base of one side of the bow to within 10 or 20 yards of the steamer, where the light rather suddenly curved off in an awkward, sickle-form, and was soon abruptly lost. The fact is, that the water, although so placid and glassy, was affected by a ripple almost imperceptible except by its disfiguring effect upon the bow. Now, as we see in the case of the sun or moon settling over a placid sea, the effect of such a ripple is to spread out the reflection into a long streak, each wave, within certain limits of distance, having some part of its surface disposed at a suitable angle to produce reflection. A complete rainbow springs perpendicularly at the sides, and approaches the horizontal at the summit. If we imagine the bow cut up into nearly square segments, it follows that many of these segments in the legs of the bow will be reflected into streaks, and these streaks will be superimposed upon each other. Thus the full light of the bow will there be seen reflected undiminished by the scattering effect of the ripple, and as different coloured rays, derived from different parts of the bow, will be mixed together, they will, in accordance with the Newtonian theory of light, be fused together into white light. As regards the summit of the bow, however, there would be no superposition of reflected streaks, and the one thickness of the bow would give insufficient light to be perceptible.

Without in the least denying that a person may casually, and still more probably by intention, witness a rainbow reflected in all its beauty of form and colour, I have no hesitation in saying that nine times out of ten the reflected bow will be no bow at all, but only a whitish streak. Artists will doubtless continue to paint reflected rainbows as they are seldom or never seen, rather than as they are seen.

It should be added that since I began to write this little article, I have happened to see a rainbow almost perfectly reflected, both as regards form and colour, upon the flat wet sands of the sea-shore. The watery surface being unaffected by the moderate breeze which was blowing, acted as a nearly perfect mirror. Although persons walking upon flat wet sands see the clouds fully reflected therein, I cannot call to mind that I ever saw this effect represented in landscape paintings. I am, of course, far from denying that it may have been often so represented."

T. F. N.

ON THE CONSERVATION OF SOLAR ENERGY.

[20363.]—If Mr. C. H. Romanes (letter 20287, page 450) thinks the concluding paragraph in his letter so very sublime, his opinion on Dr. W. Siemens's theory cannot be worth much. Supposing the energy produced by the shrinking of the sun's body is required to assist its rotation, surely there must come an end of it. We would gain nothing by it excepting a few millions of years longer existence. It is against the laws of nature, and against logic, thinking that anything in nature should be constant, excepting change. That aqueous vapour and carbon compounds may be in the stellar and interplanetary space is most likely, but if the oxygen can be dissociated by radiant solar energy while in a state of extreme attenuation I cannot conceive how they can come back to the sun's photosphere without combining. This theory has been brought under my notice since the last four years by a Mr. Gether. He, however, differs, inasmuch as he thinks that the aqueous vapours and carbon compounds leave our solar system, and then are drawn into enormous forests where they are dissociated in the same way as on our globe. Then they are brought back by a stroke, similar to the blood in the lungs by the beat of the heart, every ten or eleven years, which he calls a sun year, and by that means accounts for the varying solar energy within that time. He was therefore in high glee when we had that severe winter three years ago, and the children in our house used to say "Mr. Gether has thrown coals on the sun, and before they burn properly we shall have a good deal more skating." Speaking from memory only, I think it best to make some inquiry to see whether I have made a correct statement, or whether Mr. Gether has improved his theory, and why he has not made it public.

J. H. Schucht.

GRINDING AND POLISHING GLASS SPECULA.

[20364.]—I think we can now rest satisfied that we have got at the true rule to find the ratio of the zonal foci for testing at the so-called centre of curvature. We all owe our thanks to "Orderic Vital," and all the other friends that have helped on the mathematical side of the question. The second paragraph of "O. V.'s" letter (20298) is very useful, and shows that the moving of the shutter an inch or so from the radiant point cannot make an appreciable difference in the ratio of the zones' foci. "Prismatique," as quoted by "O.V.," is quite right.

I have no doubt that our practical amateur friends who are waiting for information as to the actual grinding, polishing, and figuring of specula, have had their patience considerably put to the test by the time the investigation of the testing of specula has taken; but they must remember that perhaps we are writing on the subject for the help of the amateurs of the next 10 or 20 years, and, therefore, it is better that one subject be treated of at a time, and thus appear in one place in the future vols. of the "E. M." This will make reference much easier to those who have to refer to the vols. in the future, and this is my reason for thoroughly exhausting each subject as we go on.

I feel I should not be doing justice to our friends if I did not try to help them to understand the shadow test, at least as far as it can be depended upon; this shadow test is what may be properly called the Foucault test; it is the judging from the way the shadows come on the whole face of the speculum (*i.e.*, without stops), how far it is corrected, or, in other words, how near it is to the parabola. Now, I must warn the amateur that, unlike the zonal test, the shadow test is a matter of guess from the beginning to the end; that absolute certainty, even to the most experienced, is impossible, while the beginner may be fearfully mistaken; but still, as there is some benefit in understanding the shadow test in conjunction with the zonal test, and, above all, since the simple zone focus measuring apparatus that I have already described, enables the amateur to learn the shadow test in one-tenth the time he could without it, I will try to describe it. That moving the shutter by hand across the cone of rays is very trying to the beginner will be easily understood, when we consider that the image of the radiant point, or pinhole as it is sometimes called, is, perhaps, less than 1-200in. in diameter; this the beginner has to pass the edge of the shutter across by hand in the old way, and all the shadows from which he has to judge are produced in a moment, while he passes the edge of the shutter over this 1-200in.; then he must have the edge of the shutter exactly at a certain point along the cone of rays, at least to the 100th in., or else the shadows come on in a different way, and are, therefore, of no use; these difficulties have been too much for some (as well they might), who have made specula even up to 12in. diameter, while others, whose work I have had to test, who thought they understood the shadow test, and were masters of it, have been deceived, and specula that they thought correct were utterly wrong; and, to crown all, I know it as a fact that those who have had large experience in the shadow test, can at best only guess at what is the right amount of correction by it. Now this is not to be wondered at. If we understand the principle of the shadow test, it is a necessity of the case, and cannot be otherwise. The fact is this—The shadows from the ellipse approaching the parabola are exactly the same as the shadows from the parabola, and the shadows from the hyperbola just beyond the parabola are the same as from the parabola, the only difference being in their intensity, which intensity, to make matters more difficult for the beginner, varies with the proportion of the diameter to the focal length of each speculum. The shorter the focus in proportion to the diameter the more intense the shadows, so that not only has the amateur to get the right place to within the 100th inch along the cone of rays, and then by hand, while keeping the shutter in its right place pass it steadily across the 1-200in., but he has to judge, or rather guess, from the intensity of the shadows, whether the proper amount of correction has been reached, even when the proper kind of shadows are produced, the intensity he has to allow for, according to the proportionate focal length to the diameter. All I can say is—Poor amateur! Now, with the measuring apparatus a great deal of this difficulty is done away with, and the test becomes a pleasant one, though it can never (from the nature of the case) be a certain one; but as it is a help to the zonal test as to the judging of the regularity of the curve, I will attempt to describe it. But let me again warn the amateur not to depend upon it, for he can only (nor can the most experienced do more) tell from the shadow test that some correction has been obtained; whether it is just enough or too much or too little, no one can tell with certainty; the best can only guess from long experience better than the beginner.

I will now attempt to describe the shadows as produced by the shutter passing over the cone of rays from a parabola; of course I have had to greatly exaggerate the figure where the rays cross one another to make the indications perceptible to the eye. Of course, the amateur knows that the outside rays from the ellipse, parabola, and hyperbola are longer than the inside rays, the difference being that the parabola's outside rays are longer than the ellipse's, and the hyperbola's are still longer than the parabola's; the rule of dividing the square of the semidiameter by the radius of curvature (double the focal length for parallel rays) gives us the true amount of lengthening for the parabola; therefore, it is, that the zonal test is the only certain way of testing at the centre of curvature. Now, let S P in Fig. 1 be the speculum divided into 6 zones, and the rays 1 to 6 proceeding from the middle of these zones to their respective foci. I have drawn the rays alternately plain and dotted lines, so that their course can be more readily traced where they cross one another about their foci. The positions of the shutter opposite the focus of each zone are seen at 1 to 6 B. The circle, F C, with the markings on it, represents the face of the speculum as the shadows pass over it. Now, to commence, let the amateur put stop No. 1 on—i.e., leaving only the outside zone exposed (of course, I suppose the amateur has made himself master of my previous letters describing the measuring apparatus and zonal testing, &c.); he now puts the index to the number of hundredths of an inch that the focus of the outside zone is longer than the focus of the centre zone No. 6, as shown by the rule; he now passes the shutter across the cone of rays, and alters the position of the shutter along the cone of rays by the adjusting screw, till the shadow comes on alike on both sides of the zone and at the same time. He has now the shutter at the focus of the zone No. 1; he can now commence to test with the shadow test; but, before he does this, he had better see that his centre rays are shorter than his outside; for, if they are not, it is no use testing with the shadow test, for the proper shadows will not be produced; so he had better put on No. 5 stop and carefully find its focus by the measuring screw; if it is shorter than No. 1 zone (as our supposed parabola would be), then he can commence the shadow testing by placing the shutter back to the focus of the zone No. 1, by putting on stop No. 1 and testing for its focus by the measuring-screw; then, if the index points to the same number of hundredths as before, he will be doubly sure that he has got the right place to test at by the shadow test. Now, he has got the shutter at No. 1, B, position—*i.e.*, at the focus of zone No. 1. He must now remove the stop and pass the shutter across the cone of rays by the shutter-screw. This will be from left to right, in the order of the figures, 1 to 7 A. Now, let him observe on the figure that the first ray intercepted is No. 4 P; then No. 3, so that when the shutter has advanced as far as 1 A, it will have shut off or darkened the spot between 4 and 3 P on the speculum S P, which is represented on F C by the dark spot 1; thus it will be observed that the first dark spot on the face of the speculum will be exactly midway between the outside and centre of the speculum. Here the shadows commence from in the ellipse, the parabola, and the hyperbola, so that this test does not tell the amateur which figure he has got; but we will proceed to suppose the shutter to be made to advance to 2 A, and oh, the ease and pleasure this can be done with by the shutter-screw, as compared with the hand, the distance being only perhaps 1-500in. or less; well, now it will be observed that the rays 5 and 2 P are cut off; in other words, the shadow 1 C has enlarged so as to be represented by the shaded part 2 2 C; now this enlargement has been gradual as the shutter was passed from 1 to 2 A. The shutter is still further passed over the cone of rays to 3 A, and now it will be seen that the left-hand ray 1 S is intercepted, and so the space frem S to 1 is darkened, and thus the shadow 3 F will be produced while the shaded part 2 2 C will be enlarged till when the shutter has reached 4 A it has increased so as to include the shaded part 4 4 C, but having the right-hand edge 5 C still light, while the 3 F has got fully darkened; with the shutter's advance to 5 A, the bright part 5 F will be darkened, and now the whole of the right-hand half of the speculum will be in darkness, with the darkened edge 3 F increasing in darkness and size; now advance the shutter to 6 A, and the shade on the right has crept out to the left-hand half, and the shade 3 F has crept to the right till the part 6 6 F is now covered with shade, and we have only the space 7 7 and 8 F left light; pass the shutter still further to the right to 7 A, and the part 7 7 F is cut off, and it becomes shaded, leaving now only 8 F light, and now a little more advance of the shutter, and all is darkness. It will be observed that the numbers at A and F C correspond to the order in which the shadows come on, so that by tracing the advance of the shutter from 1 to 7 A, and as it meets with a number looking for that number on F C, the part shaded by the shutter in that position is at once seen. Let it be remembered that a part once shaded never becomes light again, so that if we want to see what parts are shaded when the shutter gets, say, to 5 A position, we have only to look for 5 on F C, and that part and all parts numbered with figures under 5 will be likewise darkened with the shutter at 5 A. And, further, let it be remembered that the shadings gradually creep from one part to the next: thus the shade 1 C gradually enlarges till it covers the whole of 2 2 C by the time the shutter has reached 2 A. This, then, is the Foucault, or shadow test proper, and all that it tells is that the centre rays are shorter than the outside, but this we proved with the zonal test before we commenced the shadow test, so we have gained nothing so far. Of course, I suppose the speculum is pretty free from rings, regular in curve, and not turned down at the edge.

FIG. 1.

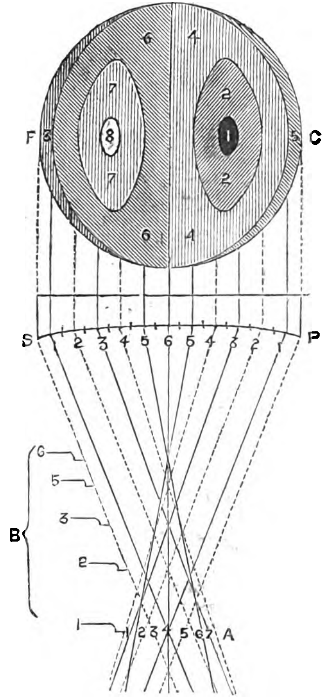


FIG. 2

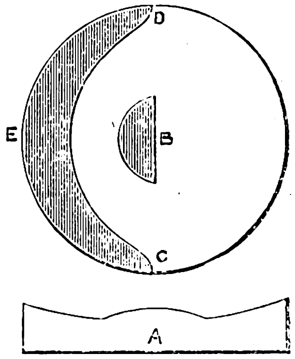
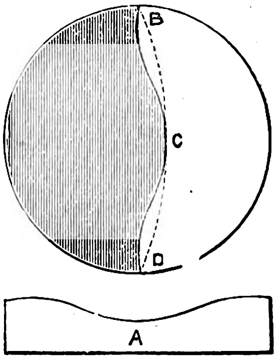


FIG. 3.



But now we will proceed a step forward to a really useful application of the shadow test, and that is, to see by its aid, if the curve is absolutely regular or not. To do this we must put the shutter in another part of the cone of rays, and this must be at the focus of the centre rays. To do this put stop No. 5 on, and find the focus for this zone. See whether it is the same number of hundredths that it was found to be when we at first tested to see if the centre rays were shorter than the outside, to see if it was any use to go on with the shadow test; if the reading is the same we can be doubly sure that we have the right place; this will be No. 5 or 6 B. Now let the amateur pass the shutter across the cone of rays, from left to right with the shutter screw, and he will observe that the shadow will gradually pass from left to right to the centre of F C, and will in succession cut off the rays from S to 6, so that when the shutter gets to the ray 6, just half of the face of the spec. F C will be in the darkness. This is the way the shadow comes on in the ellipse, parabola, and hyperbola; but now, suppose the curve is not regular, although the centre rays are shorter than the outside, such a speculum with a surface as seen in section at Fig. 2 A will present the appearance as at B E, when the shutter is halfway across, which is always known by the shadow at the top and bottom—D, C being half-way across the face of the speculum; then the centre part, B, will be shaded as shown, and a half zone of light will be between it and the outside shading E; the face of the speculum is really formed of two curves. Now suppose, in another speculum, when the shadow formed by the passing of the shutter across the cone of rays, at the focus of the centre rays and a little beyond the centre, as at C, Fig, 3, the curve of the outline of the shadow is not a regular curve, as marked by the dotted line, B, C, D, but as represented by the shaded portion, then the curve of the speculum is as seen in section at A, the opposite of Fig. 2. Thus the passing of the shutter across the cone of rays, at the focus of the centre rays, shows whether the curve is regular or not; thus, if in turning the shutter-screw at a regular rate, while the shadow is passing across the face of the speculum, the shadow does not move at a regular rate, but jumps forward every now and then, and its right-hand edge does not keep a regular curve, first concave, gradually decreasing in concavity till it reaches the centre, when it ought to be straight from top to bottom; then convex with a regular increase of its convexity, till it reaches the right-hand edge of the speculum. If all this is not seen, then the curve of the speculum is not regular. In all I have now said I have supposed the absence of rings, and the turning down of the edge. These ought to be seen, if present, at once by any one who has had the slightest experience with the shadow test, especially with the aid of the perfect control the measuring apparatus gives over the motions of the shutter, and its place along the cone of rays. The following experiment I should advise the amateur to perform, as practice in the shadow test. First ascertain the position of the foci of the various zones by the index, as before described for the zonal testing; now put the index to the number of hundredths that corresponds to the shutter being at the focus of zone No. 1, pass the shutter across the cone of rays, and carefully study how the shadings come on, by repeatedly passing the shutter from left to right with the shutter-screw; he may stop the shutter at any point, and draw the shadings on paper. All this is possible with the measuring apparatus, but next to impossible by hand in the old way. Now put the index to the focus of zone No. 2, and pass the shutter across the cone of rays as before, studying the shadings where they differ from the former position of the shutter; then put the shutter to the focus of No. 3 zone, and proceed as before, studying the difference of the shadings, and how the difference is gradually progressing; thus proceed through all the zone foci. When at the last zone, or with the index a little in front, which may be easily guessed from the ratio of the other foci, so as to pass the shutter over the focus of No. 6 zone, the regularity of the surface may be studied. All this will be to the earnest amateur a pleasant task; the certainty and ease with which it can be done, and the time allowed for study, which the control the apparatus has over the motion gives, will be the means of learning more in one day than possibly could be learned in twelve months in the old way of moving the shutter by hand. And further, if the amateur has time, and will for it, he cannot do better than make a drawing like Fig. 1, and make the distance between the foci 1 to 6 B 1in., as I have done, and putting the other foci in between at their respective positions and drawing the rays from the zones on S P to their respective foci, he can then, by watching the order in which the rays are intercepted, explain the shadows produced by the shutter, when it passes over the cone of rays at the corresponding zone focus of the actual speculum; no more interesting experiment I know than thus to master the principles and laws we are at work under in our testings. It will perhaps take a little time to get thoroughly master of all this; but once accomplished it is worth all the time, and will make the amateur discontented with anything short of perfection in his speculum.

H. A. Wassell.

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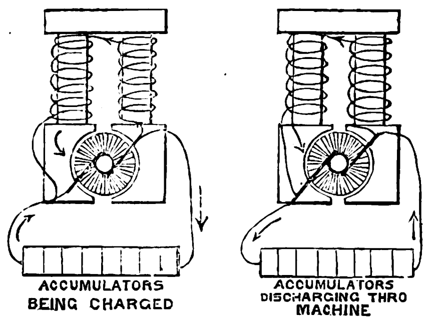
NOTES ON DYNAMO-MACHINES—VII.

[20365.]—54. In all dynamo-machines the current generated tends to cause rotation in a direction opposed to that in which the machine is being driven. Consequently, if a current is sent through an ordinary dynamo-machine in the same direction as the current flows when worked as a generator, the machine will go as a motor *backwards*. Changing the direction of the current will not alter the direction of rotation, since the polarity of the field-magnets is changed at the same time as the direction of the current in the armature.

55. To reverse an electro-motor the direction of the current through the armature must be changed by a switch in connection with the brushes and field-magnets; the current always flows in the same direction as regards the terminals of the motor.

56. It is impossible to say in which direction the current will flow in a new dynamo-machine, and it is easy to change the direction of the current in a dynamo by an accidental discharge through it in a direction opposite to that in which the current has hitherto flowed. This is a serious consideration in charging accumulators, for should the engine be stopped or the belt slip off when charging, the accumulators will at once discharge themselves through the machine, sending a current in the opposite direction. On starting again the current will continue to flow in this direction, and so discharge the accumulators; moreover, the combined strength of current from accumulators and machine will very probably burn the latter up.

57. To avoid this, accumulators are always charged by a dynamo arranged as a shunt, or by a dynamo excited by another machine. It will be understood from Fig. 16 that although the current may be reversed in the main circuit and armature by an accidental discharge, the current round the field-magnets flows in the same direction as when charging; consequently the polarity is not reversed. On starting the machine after an interruption the current will become reversed in the main circuit, when the E.M.F. of the machine is sufficient to overcome the E.M.F. of the accumulators, and the charging will continue.



58. Since a current in an opposite direction through the shunt-dynamo alters the direction of current in the armature without altering that of field-magnets, it follows that the shunt-dynamo, when driven as a motor, always runs *forwards*, and not backwards, like the ordinary dynamo. This fact is sometimes taken advantage of when employing a gas-engine as the motive power in charging accumulators, by making the accumulators start the gas-engine.

It is a matter of inconvenience to drag the flywheel of the engine round two or three times by hand, so the accumulators are discharged through the machine; and since the machine runs forward it starts the gas-engine without any trouble. It is very easy to arrange any ordinary dynamo-machine as a shunt, by putting a convenient resistance in the field-magnet circuit.

59. The E.M.F. of a Faure accumulator is two volts. The mean resistance in charging (large size, about 28 to a ton) is ·04 ohm, and the resistance in discharging ·01 ohm each. The charging takes about twelve hours with a current of 30 ampères, and a fairly constant current of about this magnitude will be given off continuously for ten hours. Since the E.M.F. required for a Swan incandescent lamp is 45 volts, about two dozen accumulators are required to light one lamp. The minimum number for an Edison incandescent lamp is 50. Incandescent lamps of two-candle power are now being manufactured, requiring an E.M.F. of six volts.

E.

SMALL DYNAMO-MACHINES.

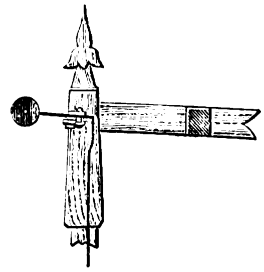
[20366.]—Notwithstanding all that has been said of the impracticability of small dynamo-machines, there has not, in my opinion, been a single scientifically valid reason shown why successful current generators of this class cannot be constructed. In many cases, no doubt, failures result from ill-proportion of the various parts, owing to the designer's ignorance of the physical laws involved. But the chief cause of failure appears to be the absence of a sufficient quantity of residual magnetism in the field-magnets to originate current in the armature when it is revolved. tl to remedy this, I should propose that one or alothin steel magnets be placed longitudinally son e-a cores of the field-magnets. Let no perpends o. too much from his machine. If he ex- n power upon it, he cannot reasonably hope that it will give out in electricity the full equivalent of that power, because some of it will be absorbed by friction, some in heating the coils, and some will be wasted through the mechanical imperfection of the apparatus. The most successful of the large dynamos driven by power do not, on an average, give out in electricity more than three-fourths of the power expended on them. Their efficiency will therefore be represented by this fraction. In all calculations regarding the capabilities of dynamo machines, large and small, the work is much facilitated by expressing the current produced in mechanical equivalents, such as foot-pounds, horse-powers, &c. To find the horse-power of a current, multiply the square of the current in ampères by the resistance of the circuit in ohms, and divide the product by 746; or, which is the same thing, multiply the current in ampères by its electro-motive force in volts, and divide the product by 746. Thus, if we desire to know the maximum current and electro-motive force that can be produced by a hand-driven dynamo, we proceed as follows: Assuming the efficiency of the machine to be represented by the fraction two-thirds, and that one man-power is equivalent to one-twelfth one horse-power, then $746 \times 1\text{-}12 \times \frac{2}{3} = 41$. Therefore the number of ampères of electricity that can be produced, multiplied by its electro-motive force in volts, cannot exceed 41; consequently when the number of ampères is 4, the electro-motive force will be 10·2, and when the number of ampères is 3, the number of volts will be 13·6, and so on. Let us now see what candle-power we might expect in an incandescent lamp from a hand-driven dynamo. The maximum candle-power in an incandescent lamp has been found to be 300 per horse-power of current. One horse-power of current is equivalent to 746 volt-ampères, and; our hand-dynamo gives 41 volt-ampères, therefore we obtain the following proportion: 746 : 41 : : 300 : 16, from which we find we can expect only a 16 candle light from the energy of one man-power.

Hosein Ibrahim.

RAILWAY SIGNALS.

[20367.]—Thanks are due to those correspondents who have so rapidly responded to my letter in your issue of July 14th (20267), and I will now, with your condescension, reply to the several suggestions which have been made.

I do not see any practical utility in weighting the back of the arm (letter 20295), so that if the connecting-rod between the arm and the weighted lever at the bottom gave way it would fall back to danger, for so few of these accidents have occurred that the extra expense (slight as it is) would not be warranted. We might, perhaps, shift the weight from the bottom of the post to a point level with the arm, but this necessitates putting the lamp lower down, unless we perch it up behind the arm, but that would not very much matter. The weight in the position shown (see figure) would, however, look rather unsightly, and, should it require regulating, it is not so easily got at as below, seeing that they are sometimes of considerable size. and the man would have to stand on the ladder. A compensation for strained backs might frequently have to be paid. The specs are usually affixed to the arm itself on bridge signals and all places where they are suspended from the roof, but sometimes the specs are inserted in the arms of other signals. Of course the hole necessary for the insertion of the latter materially weakens the arm, and, for this reason alone I think it desirable to have the spec separate. When the arms and spec were fixed on an axle, which was round throughout, they frequently used to slip after a little wear, but this is avoided by making the portion of the axle which bears them square. The wear under the latter condition must be very great, for them to slip out of position. I do not see that there is a greater impetus to fly to danger at 85° than at 45°, because the nearer to the perpendicular the weight is, the greater the weight sustained by the axle itself, and the less the said impetus to go to danger. Of course, as long as the weight does not reach the perpendicular, and is heavier than the arm, it is bound to fall to danger when the lever is taken off, when the wire breaks. I have not heard of connecting-rods breaking by ordinary wear, as used in our present locking arrangements; but they are liable to decay, like all other worldly matter. The "home" and "starting" signals should not throw different angles; it was this very discrepancy between the various signals which caused me to start this correspondence. "G." makes a good suggestion when he asks, "Would it be any practical use to coat the arms with luminous paint?" But the question arises as to how far this luminosity would be visible.



The reason for allowing the 5° above zero—condemned by Mr. Manock—is this—viz., axles wear, as do also axle bearings; but they may not be so far worn as to require renewing, although they may allow the arm to go a little above the horizontal position. However, a limit must be fixed to this upward inclination, and when the axle has gone so far as to let the arm go up to 5°, it must be renewed; or perhaps the hole through the arm may have given way a little; then that must be seen to. Thin pieces of board are liable to split; so are, consequently, signal-arms; and one or two bands of iron, or other metal, have to be put round to prevent this defect, as, should such an accident occur, it is more than probable that it will be near the axle, and allow the arm to shift. The bands prevent this. There is not likely to be any confusion, or misunderstanding of any kind whatever, if a rule of strict uniformity is established, never mind what the angles determined on may be. Mr. Manock's angles I cannot agree to, and in confuting them, it would be well for me to state the reasons why the angles given in letter 20267 were fixed on. A true "danger"-signal is the horizontal position, in which the weight should rigidly keep it; but owing to the decay and other causes previously enumerated, an allowance of 5° on either side of zero is made, and more than this on either side opens up a "doubtful" signal, and is to be, and must be, emphatically condemned. As all our readers are aware, iron is capable of expanding 1-820th to 1-888th of its length when subjected to heat, and stranded iron wire is soon penetrated by the heat, and expansion ensues. Now, let a wire be 500 yards long, and let temperature be 53°; this is one-fourth of heat required to give expansion of 1-820th, and let us see what the result is. We shall find that the expansion is about 5¼in. for 500 yards at 53°, and this is no mean figure.

The point at which no expansion would occur is 32°, or freezing-point, and as our temperature is not always so low as that, we must make a little allowance for it; and even then we see that the lineal extension of the wire must be great. As the heat varies, so varies the degree of expansion, and the signal arm is affected accordingly. Hence, we see the difficulty of defining to a nicety the "clear" signal; and from 45° to 85° is allowed for that signal, so that the error caused by expansion will not affect what the driver has to comprehend. If the signal fall from 85° to 90°, the driver *has* instructions to treat the condition as a "danger" signal. Between 5° and 45° is treated as a "doubtful signal," and acted on accordingly. These are the reasons for proposing what I have done; and this controversy can but lead to a good result in the end.

I congratulate Mr. Harrison on his invention. It is a good one, provided its action is as good as its purpose. May I ask if the signal is returned to "danger" mechanically or electrically?

"A Fellow of the R.A.S." seems rather inclined to hypercriticism in his remarks concerning angles, and I may say that other correspondents have described things apart from my direct question, instead of endeavouring to assist me. I do not for one moment assume, or for one moment expect, that an engine-driver would be able to detect *to a nicety* how a signal stood. What I wished to arrive at was a "hard and fast" rule whereby all signals might be made uniform, or as nearly so as possible, in the *fixing*.

"Danger" and "clear" are of course the only two *true* signals; but suppose the specs to be in such a position as to show *half green and half red*, what is the engine-driver to make of that? Must he not treat it as "wrong," and act on it as danger? Again, when the curve is entirely hidden from view through having fallen within the post, must not he see something is "wrong"? And if he has a *doubt*, is he not bound to treat that "doubt" as "danger"? Virtually there are only two signals: but provision must be made to insure decisive action when the arm does not fall far enough, or, through a disconnection, falls too far.

H. Stooke.

[20368.]—I have read the remarks of "Nun Dor.," p. 501, letter 20344, but I really cannot see that any advantages would accrue from making the changes suggested by him. It is quite true that the G.W.R. Co. did, and may still, use a form of disc signal, but in my opinion a semaphore is much the best. If there were not great advantages one may be sure that the M.R. Co. would not at the present moment be going to the enormous expense of cutting down every disc signal upon their enormous system and replacing them by semaphore signals with "swallow-tail" arms. "A Driver" is quite right in stating that the arms should not go lower than 45°, and that every post should be placed upon the left-hand side of the line; in my opinion this is a most important point. I would even go a step further, and insist that as all signals and platforms are on the left-hand side, that the driver's situation on the foot-plate should be on the left-hand side. Before I conclude I should like to express one opinion which I hold most strongly with regard to signals at night. As far as signals go, white lights should be abolished. "Green" should be the "all right," "white" being "no signal," or "signal out of order," to be treated as "danger." What say my brother-drivers to the suggestion?

A. S. H.

THE WERRINGTON JUNCTION AND ELY ACCIDENTS. — AUTOMATIC v. NON-AUTOMATIC BRAKES.

[20369.]—The recent accidents upon the Great Northern and Great Eastern railways furnish most conclusive evidence in favour of efficient continuous brakes, and against those which are inefficient.

Upon the 26th of June, an express train, consisting of an engine, tender, and eight vehicles, fitted throughout with Smith's vacuum brake, was running near Werrington Junction, upon the Great Northern Railway, at a speed of about 45 miles an hour, when one of the side-rods broke and tore down the adjusting-rod of the vacuum brake upon the engine; this latter rod falling on the rails caused the tender and train to leave the line. The driver at once shut off steam, and opened the valve to apply the vacuum brake; this brake being non-automatic was, of course, rendered useless at the very moment when it was required. The engine broke loose from the tender and ran forward for about a mile before it could be stopped. The tender and train ran no fewer than 470 yards off the line, and finally came to rest with two of the carriages turned over on their sides. Considerable damage was done to rolling-stock, permanent-way, and signal materials, details of which occupy a page and a quarter of the official report, and from this it will be seen that the vacuum brake gear was more or less damaged on the vehicles throughout the train, and was of no use whatever.

On Friday, the 28th July, the Great Eastern Company's 5.15 p.m. express from London was thrown off the line near Ely in consequence of the balance weight of the engine of an up train falling off and getting under the down express.

The accident is very remarkable from the fact that the weight, which weighed about 3cwt., escaped between the wheels of its own train when running at a speed of 50 miles an hour.

Fortunately, the express was fitted with the Westinghouse automatic brake, and although the distance from the engine striking the obstruction to the point where it came to rest in the ditch was only 114 yards, the train was, by means of the brake, safely stopped, without any loss of life, or "telescoping" of the carriages.

The contrast between a train running 470 yards all off the rails, and another being pulled up in about 100 yards on the rails is, as the *Engineer* remarks, "sufficiently striking." Had the circumstances been reversed, and the Great Northern engine, instead of running away for a mile, been turned into a ditch at the end of 100 yards, the consequences must have been of the most fatal character.

Clement E. Stretton.

Glen Magna, Aug. 5.

HOW TO MAKE A FLAT FOR A NEWTONIAN REFLECTOR.

(*Continued from page* 430.)

[20370.]—The two discs should now be rounded on the "jigger," or bevelled to a circle on the faces; this will prevent chips from being detached from the edges, which would endanger the surfaces. Great care must be used in cleaning all grit from the surfaces before putting them together. I find the best way is to hold the plates vertically, and blow between them just as they are on the point of contact; if there is the slightest sensation of grit they must be recleaned. This method gives us the lesser of the two possible evils, for if the discs are slipped together there is no chance of scratching. In the former way a few pits or bruises may be got, which are not so unsightly as scratches, and do not interfere with the performance. It is well to place the discs horizontally together on a table, and let them stand an hour or so before looking for results. A sky reflection from between the surfaces must reach the eye in this test. Those who have seen Newton's rings produced in the usual way, will be prepared for the results. Now, if the surfaces are convex and spherical, Newton's rings, pure and simple, will be produced—broad in the centre, and narrowing as they reach the edges of the discs; the reverse of this if concave. If the rings are fairly uniform, a very near approach to flat has been produced; if a single colour covers the surfaces (I find green or red usually, and both colours, in testing the same plates by altering the position of the eye a very little), it is proof that a mechanically true flat, or, I should say, two flats, have been got —a result which I hope none of "ours" will get is absence of colour. This would prove that the surfaces are so hollow or concave as to be perfectly useless for our purpose. Of course, there is nothing for it but to start on another disc, and try again, carefully fitting tools, &c., as at first. Hoping that our operator has achieved a success with the surface, I will now describe how to finish the edges. The "shanks" come again into use to chip off the sides of the discs to form the minor axis of the flat. It is best for the amateur to leave plenty to grind off to insure neatness, so I would say leave the minor axis 1 3-16in., and do not shorten the major axis at all with the shanks. When chipped near enough heat both discs enough to melt a little fine sealing-wax on the polished surfaces; place them together, but do not press them too close. Leave the major axis standing out as shown Fig. 1, and let them cool down in that position. A wooden chuck is now wanted with the end cut off to 45° (Fig. 2), also a "jigger" with a plate for grinding 2½in. wide; the two flats are cemented on the wooden chuck with pitch, adjusted while warm, and when set, ground into shape on the jigger, screwing up very gently, until all lumps are ground off. It will be seen that the required shape must be got by these means; 90-hole emery should be used at first and a little No. 2 to finish with, when all chip marks are ground out. It then only remains to separate the flats by heating, and to soak off the wax with naphtha or methylated spirits. The sharp edges may be taken off with a very fine file or a strip of No. 1 emery paper glued on a stick. The method I have endeavoured to explain in these letters may be used for any size of flat by simple increase of proportion all through.

Prismatique.

STRING VIBRATIONS.

[20371.]—Page 197 contains my letter on this subject with what I thought some original conceptions based on simple analysis of a tuning-fork, represented by a hairpin. This seems to have stirred up the ire of Mr. Stocks, p. 238, who pins his faith on experiments with the tuning-fork proper, by Prof. Guthrie (an expensive and tedious process), but who, however, still believes in Chladni's theory, that a vibrating string is made up of ventroids instead of oscillating from side to side, the greatest impulse being in the middle of the string. I have stood alone for 10 years in this primary law, everyone contradicting me until they have taken the trouble to look for themselves, instead of believing the classbooks. And, moreover, professional men do not like to be disturbed, and will not listen till obliged; but their day will soon be past in the popular eagerness for knowledge. This month's *Musical Opinion* has a letter from Mr. Hermann Smith, which is worth perusal, showing Chladni's mistake. It is a pity this has only now been found out; but it infers a radical change in our ideas of the value of nodes, and, without offence let it be said, that if one part of a theory is wrong, the whole falls to the ground.

Mr. Smith writes: "As in all musical instruments, the communication of transversal vibrations from one solid to another is invariably through the nodes," &c.

Now this I do not agree with, although it is precisely on these ideas that the violin has been called the most perfect of all musical instruments—*vide* Mr. Schucht's letter on the Berliner violin, and his node formed between the leg of bridge and the soundpost, an interval of half an inch or so. I am very bold in saying that if the soundboard is moved or vibrated the right way, that no soundpost is required at all, and it will sound louder—consequently without a node. What does a node infer? Simply an harmonic formation, which by itself weakens the sound because it is only a part of the whole fundamental tone; hence one harmonic is scarcely heard, while the total harmonics joined in one diameter in the centre of the string sounds the loudest of all. Therefore, it must be the joint action of all parts of the string acting from the middle, that communication is made between bridge and soundboard. I don't expect old theories to be done away directly. Didn't our grandfathers make a living out of them, and can't I see the dealers in Houndsditch handling the precious relics and selling them for their weight in gold! This need not go on, for a useful instrument need not be expensive; it has only to be made the *right* way to vie with the finest expositions of the old masters. Time will show! The bass of our new violin is now perfected. But to return to this old idea of sound being imparted through a node or soundpost, or any other obstruction, would a drum sound better or at all with a soundpost? Here we have plenty of pressure, elasticity, and free motion to and from the centre to the edges round the head. I won't wait for an answer. Try it on with a harp, piano, or banjo. No; it won't do. None of these can be called the most scientific instrument. Then why have a post added to the violin? I answer because it is *not* a scientific instrument as usually constructed, requiring a post to return the vibrations, so that the soundboard may move the right way, and so unfortunately robbing the vibrations of their direct action. This is something like the Irishman's crooked gun, made to shoot round the corner. Now then jumps up my little critic, and says: Ah! I should like to see any violin come up to mine, my dear old Amati, Klotz, &c. Now, I never can but admire other people's babies, because they are so grateful for a little praise; but, in return, let them remember that I am a family man, and fully expect my fledgling to come up to and finally surpass all. It is reduced to 22in. in length and 8in. wide in the major width. A small ordinary violin is 23¼in. long. Some going over 2ft. having strings 14in. long, which is very bad form indeed. To end this letter, Why not put a series of soundposts and so make a number of nodes; but this might be like to the man who said, If one feather so hard to lie on, what must a large number be.

Fiddler.

COLOUR.

[20372.]—The reason for advising that the "blue glass" to be used in the experiment on mixing blue and yellow light should not be cobalt glass is not (as Mr. Calton suggests) that if cobalt glass were used —"in fact, something approximating pure blue—the unfortunate result may be green"; but that I wished to put in as marked contrast as possible the very different result of mixing blue and yellow *light*, and of superposing blue and yellow glass, or of mixing blue and yellow pigments. I, therefore, chose a blue glass, which, when placed together with the yellow glass, allowed green-coloured light to pass through, which was not the case when cobalt glass was used. The light transmitted by cobalt glass, though very far indeed from pure blue, does not contain sufficient green for our experiment; but the glass I used, the common blue glass, coloured with oxide of copper, does transmit light containing a considerable quantity of green. The yellow glass also transmits a considerable quantity of green, and when the two are superposed, green light alone passes through. But when the two coloured lights are added together, the resulting light is white, with perhaps a yellow tinge; and this light is of greater intensity than its yellow constituent, and not of less, as Mr. Calton supposes. Of course, the blue and yellow glasses are not pure blue and pure yellow; if they were, they would, when superposed, produce a black or opaque combination. Each contains green, and the same is the case with any blue and yellow pigments which, when mixed, give a green pigment. If Mr. Calton can find a blue pigment which, when tested by the prism, is found to contain no green, and a yellow pigment also containing no green, then I venture to predict that on mixing them he will obtain a black colour. So in Mr. Calton's "much simpler and certain test" experiment of throwing light, coloured by passing through blue glass on to yellow paper, or that which has passed through yellow glass on to blue paper; the yellow light contains green, and the blue paper is able to reflect green (does not absorb green in fact), though it absorbs yellow and red; therefore the light reflected from the paper is green. If, instead of using yellow light containing green, Mr. Calton will illuminate his blue paper by monochromatic yellow light, obtained from a (really) non-luminous flame—e.g., of a good Bunsen lamp—in a dark room, by sprinkling sodium carbonate into the flame, he will find the paper does not appear green at all.

Mr. Calton objects to the method I suggested (as the easiest) of mixing blue light and yellow light, as "dodgery"—I really do not know why; but there are several other methods of experimenting which all lead to the same conclusion.

If we want to use pure colours we must employ a spectrum, and if we combine (for example, by reflection from strips of looking-glass upon a white card, or by allowing the required colours to pass through holes in a screen, and then combining them by means of mirrors, or lenses, or prisms) blue and yellow light so obtained, we do not obtain green, as I can testify; probably Mr. Calton has never seen the experiment. There is another way of combining blue and yellow light, which does not require a dark room, and which ought to satisfy Mr. Calton, but that, as I suspect, no amount of evidence would satisfy him. I mean the experime
in which two discs of blue and yellow (if requi
light are caused to overlap, and it is seen th are
overlapping portion is colourless. The ough
obtained by viewing a small round apertu

a doubly refracting prism of Iceland spar, the aperture being illuminated by polarised light which has passed through a film of selenite. The overlapping portions of the discs are as colourless as if the selenite and prism were simply colourless glass. On turning round the prism a large number of pairs of colours are obtained, each pair giving white light. Amongst these pairs might be obtained blue and a particular shade of yellow.

X. N. X.

[20373.]—Before categorically replying to the letters on this subject in the "E.M." of 28th July, 1882, I wish to state that both my business and my inclinations have induced me to study the doctrine of light. I write occasionally for the photographic journals on photographic and lantern optics, and have, therefore, a reputation to make or lose. I have devoted all the time I could spare to the study of the phenomena of light, with the view of satisfying myself step by step, and it is only after long and careful thought and research that I have come to the conclusion that the modern theory is still incomplete and unsatisfactory. I therefore claim a patient hearing, and while allowing that I may err, will not allow anything else except it is self-evident or mathematically proven.

It were presumptuous on my part to propound a theory of colour. The one propounded by Brewster was generally accepted until Helmholtz succeeded in causing it to be rejected. I do not affirm that Brewster is right or that Helmholtz is wrong; but I do say that the proofs produced by Helmholtz, and now currently adopted, are fallacious, and that the phenomena which he pointed out in connection with the commingling of blue and yellow light do not amount to proof that the theory of Brewster is wrong. I say this with the fervent hope that others, more capable than myself, will re-investigate the subject and clear away all error wherever it may lie. Indeed, I have no theory to propound. I incline towards that of Brewster because I find that some of the phenomena relied upon to upset his hypothesis can be intelligibly explained in accordance with them, and because I believe that painters, whose whole lifetime is devoted to the study of colour, fail to reconcile the modern theory with their experience. It is but a short time since that a lecturer on Modern Chromatics—reported in these pages—announced that he had never been able to make a painter agree with him on the theory of colour. Can this be right? It is the pride of modern science that it is true religion, the immutable laws of God as learnt from established facts. Science, therefore, is ever progressing; conditions previously overlooked are carefully examined, till, by degrees, hypothesis is strengthened into theory, and theory, when found to agree with all observed facts, is accepted as a law. No philosopher, however, is justified in saying that any law is absolutely settled, but he is justified in holding to it until it is proved to be based, either on incorrect premises or erroneous deductions. Such a case, I believe, we have here—erroneous deductions from causes overlooked in the premises.

In reply to "Sigma's" courteous letter, I quite agree with all the main points of the theory of the production of colour. The doctrine is so clearly laid down in Tyndall's "Notes on Light" that I repeat them here. The italics in all quotations are Tyndall's.

"255. Natural bodies possess the power of extinguishing, or, as it is called, *absorbing* the light that enters them. This power of absorption is selective, and hence, for the most part, arise the phenomena of colour.

"256. When the light which enters a body is *wholly* absorbed, the body is black; a body which absorbs all the waves equally, but not totally, is grey; while a body which absorbs the various waves unequally is *coloured*. Colour is due to the extinction of certain constituents of the white light within the body, the remaining constituents which return to the eye imparting to the body its colour.

"257. It is to be borne in mind that bodies of all colours, illuminated by white light, reflect white light *from their exterior surfaces*. It is the light which has plunged to a certain depth within the body, which has been *sifted* there by elective absorption, and then discharged from the body by interior reflexion that, in general, gives the body its colour."

"258. A pure red glass interposed in the path of a beam decomposed by a prism, either before or after the act of decomposition, cuts off all the colours of the spectrum except the red. A glass of any other pure colour similarly interposed would cut off all the spectrum except that particular portion which gives the glass its colour."

So far, by substituting the word "rays" for "waves," which in no way alters the real meaning, this definition might have been written by Sir Isaac Newton himself? and, as far as I know, is absolutely correct. Tyndall, however, continues:—

"It is, however, extremely difficult, if not impossible, to obtain pure pigments of any kind. Thus, a yellow glass not only allows the yellow light of the spectrum to pass, but also a portion of the adjacent green and orange; while a blue glass not only allows the blue to pass, but a portion of the adjacent green and indigo."

Here, I would ask, what is the yellow which cuts off all rays except yellow and a portion of the adjacent green and orange? But to continue:—

"259. Hence, if a beam of white light be caused to pass through a yellow glass and a blue glass at the same time, the only transmissible colour common to both is green. This explains why blue and yellow powders, when mixed together, produce green. The white light plunges into the powder to a certain depth, and is discharged by external reflection *minus* its yellow and its blue. The green alone remains.

"260. The effect is quite different when, instead of mixing blue and yellow *pigments*, we mix blue and yellow *lights* together. Here the mixture is a pure *white*. Blue and yellow are complementary colours.

"261. Any two colours whose mixture produces white are called *complementary colours*. In the spectrum we have the following pairs of such colours:

Red and greenish blue,
Orange and cyanogen blue,
Yellow and indigo blue,
Greenish yellow and violet."

It is with No. 260 that we have to deal. I do not think I at all misunderstand the bearing of Tyndall's experiments in considering that they are intended to prove the position he there lays down. To my mind, they fail to prove it, and if so, it still remains an open question whether the law is true or not, unless there are other proofs to be brought forward.

To *prove* anything we must have clear definitions, axioms, and postulates from which we can argue step by step. It will be best to avoid such terms as "wave-length," "rate of vibration," &c., —in fact, to treat the question as if the theory were yet to be established.

For definitions let us represent *pure* colours as red, blue, &c., and natural colours, all of which are impure, as red, blue, &c. Our axioms shall be the production of colour by absorption from white light, and my only postulate that the eye alone is not infallible in the matter of colour. This is easily demonstrated, but will at once be allowed on reference to "Notes on Light," 278.

In Tyndall's experiment, No. 1, he professes to produce white by the overlapping of blue and yellow discs. At the best it can be but white, for even allowing that blue and yellow produce white, it is clear that as the blue and yellow pigments employed are *each* capable of allowing green to pass—besides other colours—although the impression on the eye is that of white, it is not really so. This experiment, then, does not prove the position laid down in 260, while, as I showed in my last letter, it is quite easily explained in accordance with the Brewsterian theory.

As to Tyndall's experiment No. 2, Mr. Holmes asks: Where does Tyndall show that "what he (Tyndall) here calls the blue and yellow contain between them all the colours of the spectrum?"

I reply, In his "Lectures on Light," pp. 29, 30, 31, and subjoin the full quotation:—

"The synthesis of white light may be effected in three ways, which are now worthy of attention. Here, in the first instance, we have a rich spectrum produced from the decomposition of the beam. One face of the prism is protected by a diaphragm, with a longitudinal slit, through which the beam passes into the prism. It emerges decomposed at the other side. I permit the colours to pass through a cylindrical lens, which so squeezes them together as to produce upon the screen a sharply-defined rectangular image of the longitudinal slit (now upright). In that image the colours are reblended, and you see it perfectly white. Between the prism and the cylindrical lens may be seen the colours tracking themselves through the dust of the room. Cutting off the more refrangible fringe by a card, the rectangle is seen red; cutting off the less refrangible fringe, the rectangle is seen blue. By means of a thin glass prism, I deflect one portion of the colours, and leave the residual portion. On the screen are now 10 coloured rectangles, produced in this way. These are *complementary* colours—colours which, by their union, produce white. Note that, by judicious management, one of these colours is rendered *yellow*, and the other *blue*. I withdraw the thin prism; yellow and blue immediately commingle, and we have *white* as the result of their union. On our way, then, we remove the fallacy, first exposed by Helmholtz, that the mixture of blue and yellow light produces green."

If Mr. Holmes will read this carefully, he will see that no stopping-off screens are employed. The words are clear: "I deflect one portion of the colours, and leave the residual portion." The card is used as a stopping-off screen in a preliminary experiment. I, therefore, repeat that in this experiment, what Tyndall calls "blue and yellow," are the whole of the colours of the spectrum, so divided that they appear to the eye blue and yellow, but, as a matter of fact, contain red.

Mr. Holmes proposes a test experiment: that I should "cut off from the solar spectrum all but the pure blue and yellow, and then recombine these." Precisely. If Mr. Holmes will tell me how this is to be done, how I can get blue and yellow, he will solve the great problem.

Next, if Mr. Holmes will advertise his address, I will send him an apparatus, which I have had constructed for the purpose of rapidly revolving coloured discs in the lantern, and trust to his honour to report to the readers of the English Mechanic whether he was justified in asserting that I have said "the thing which is not." I repeat, that if an aperture of one-tenth the circumference be cut in a coloured disc, and that disc be made to revolve rapidly in the lantern, the effect, *to the eye*, will be a white ring on a coloured ground, the nine-tenths colour actually present being apparently destroyed by the one-tenth of white light.

"Sigma" allows that in the overlapping experiment there is an excess of green on the screen, which is apparently destroyed by the white light present. My postulate, therefore, is proved.

I do not affirm that blue and yellow make green, though I incline to that belief. I simply deny that it is proved that they make white. I deny that they are complementary colours, though blue and yellow may be.

Take a blue film—a solution of ammonio-sulphate of copper is a very good one—and look at the fire through it. The flames, which are tolerably white, are clearly visible while the live coals are invisible. This is exactly what should be expected. The blue cannot allow yellow, red, or orange rays to pass. Now take a purple film, one which confessedly allows the red and blue rays to pass. The coals glow with a gorgeous crimson. As I write I have before me in the garden bright yellow calceolarias, and scarlet geraniums almost side by side: through the purple film both are a brilliant red—almost indistinguishable in hue. I turn to the gravel path, to a stray piece of orange peel to every place where the eye sees yellow, and find red. We have agreed that the light coming from these objects is sifted by the film. The red, therefore, is not produced by the purple film: it *must* be existent in the yellow. Yet, if I look at the spectrum through this same film, the yellow is entirely cut off.

Clearly, then, every natural yellow contains also red, and, therefore, the phenomenon of blue and yellow producing white is quite consistent with the Brewsterian theory.

Of course, I admit the theory of complementary colours. Imagine a disc on which the colours are arranged round the centre in segments — first broadly with three segments of 60° each, red, yellow, blue, the intermediate spaces with orange, green, and purple, or still more elaborately with the colours blending by slower degrees. Each opposite pair will be complementary colours and agree with either theory, as well as every-day experience.

Geo. Smith.

FORECAST OF STORMS.

[20374.]—"The atmosphere travels with us at an enormous velocity, through a void and airless region; yet no particle of it leaves us. Why is this? The earth exerts upon the atmosphere the attraction of gravitation. As we travel it travels with us. As we revolve it revolves with us. Could the globe for the space of one hour continue its revolution on its own axis while the air stood still, the resistance offered by the air to the passage of the earth would be such as to produce to all appearance such a tremendous blast as would not only level trees and houses, but would lift men and animals and every movable thing into the air, hurling them in common destruction against the first mountain range that might present itself." ("Chemistry of Creation," by Robert Ellis, F.L.S., M.R.C.S., &c., Edition 1870 A.D.) "There are tides in the air as in the sea. The hourly observations of the barometer made for some years past at the Meteorological and Magnetical Observatory at St. Helena have now placed beyond a doubt the existence of a lunar atmospheric tide. On each day the barometer at St. Helena stands on an average four-thousandth of an inch higher at the two periods when the moon is on the meridian above or below the pole than when she is six hours' distant from the meridian on either side, the progress being continuous and uninterrupted between this maximum and minimum" (Sir R. H. Ingliss, at the meeting of the British Association, 1847). "A vast air-wave has for several years been observed about the middle of the month of November. It begins, rises higher, reaches its highest point, then subsides again to its usual condition in the space of a fortnight or sixteen days. Sometimes it has been observed to set in with a gale of wind, and end with one also." ("Chemistry of Creation," page 181.) Now, it is highly probable that closer investigation would have shown that this so-called atmospheric wave in November was only one of an ever-recurring series. Let us take another period of the year, and see how the matter stands. Thanks to Mr. Westwood Oliver for information, of which I was deficient. (See letter 20322, ENGLISH MECHANIC, p. 477), in which he asserts that "a gentleman examined records covering a period of about 80 years, and as the result asserted that 19 times out of 20 a Saturday moon was followed by 20 days of wind and rain. He announced his discovery to the Royal Astronomical Society in 1848.")

One gentleman finds out a periodical storm-wave in November for years past, another gentleman finds out periodicity at St. Swithin, and the records extend over years past. And I have already pointed out that the normal period of time from one set of atmospheric depressions to another set is 20 days. Is not this tolerably conclusive evidence of the operation of a natural law, and as the 20-days period of storms is not an exceptional phenomenon, may we not expect this periodicity to continue?

The balance of atmospheric pressure is restored by periodical storms, which come over us when the moon has lost its hold on the atmosphere and the sea. It is for those who have the means of information to follow out the inquiry here indicated, not by theorising, but by the examination of barometrical and magnetical records of the past. There seems to be a paucity of information on this question of storm periods. One gentleman says you must continue your observations for twelve months, another says observations must extend over several years, yet another says I have long been aware of this periodicity; but the period is not perfect, and therefore of little practical use. Now, one would have thought that a scientist would not have spoken thus, but would have endeavoured to trace the cause of this imperfection. Must it not be sought for in the maximum and minimum sunspot periods, and in the ever-shifting orbit of the moon?

I beg to thank "F.R.A.S." for his kind reply to my query.

The books containing the above quotations were not known to me when I wrote letter 20305, p. 453, ENGLISH MECHANIC, No. 904.

W. M. Gardner.

OPEN-FRONTED MACHINES—TRICYCLE BRAKES.

[20375.]—To have a good brake and know how to use it is of great importance to tricyclists. In my experiments I find the hindwheel-brake very defective, as it not only allows the machine to slip and tumble, but causes it to swerve out of the path by affecting the steering; often makes the machine run across the road, and before you know what is the matter the rider and machine are wrestling together; but the machine generally throws the rider.

I have fitted a double-spoon brake to my machine, which is a decided improvement, which allows the spoons to grip the wheels instantaneously, and has great power over the machine without stopping it too suddenly. **Ex.**

LEGAL REPLIES.

[20376.]—(47568.)—WITHOUT seeing this agreement, I cannot advise with certainty. It is necessary that a lease for more than three years from the making thereof, should be under seal, which, I understand, this is not. But it may be that the document amounts to an agreement to grant a lease for longer than three years, at the tenant's option, and this the Chancery Division would compel the landlord to do, presuming the agreement is clear. Whether or not the writing is for three years or more does not affect the stamp required; and either as a lease or as an agreement, it must be stamped according to a scale which is fixed by the yearly rent payable. If, as seems likely, there is only a sixpenny stamp, this is useless. Additional stamps cannot be added after the two months allowed, except on the payment of the penalty. I may add, that in answering this question I am much hampered by the want of a fuller statement of the case.

(47596).—I cannot understand how any office insured a life without asking the usual questions as to health. But even though no questions were asked, if the insurer knew that the insured suffered from an illness and said nothing about it, this is a suppression of a material fact which would certainly void the policy. It is true that the agent's conduct in making no examination is strange and remarkable: but still, presuming the office to have acted *bonâ fide* in taking the life, and to have had no reason to suspect such an illness as is mentioned, they would undoubtedly succeed in their defence to an action for the amount insured if they could prove that the insurer concealed this fact of disease, which was within his knowledge.

(47618).—It is quite certain that any documents, such as a lease and policy, deposited with the holder of a bill of sale, as collateral security, must be handed over to the grantor when the sum secured is paid off. With regard to the bill of sale itself, I believe the same rule would apply; because I am unable to see what good ground the grantee can have for its detention. The way to proceed is, after having made a demand, which might as well be in writing, for the delivery up of the bill of sale, to bring an action in the County Court for its wrongful detention. This would, I think, prove successful, unless, indeed, there is anything in the bill of sale itself, or perhaps the rule of the society, to the contrary.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall.

MEDICAL REPLIES.

[20377.]—VEGETARIANISM.—This subject, on which I am asked by several correspondents to say something, is one which needs defining. Persons there are who object to wearing leather shoes; others who object to milk, eggs, &c.; while the majority go only so far as to eliminate from their use the flesh and other parts of animals which involve their slaughter. Some adopt vegetarianism because they object to the slaying of animals; others take purely economical grounds, and point out that one acre of ground will support five vegetarians, but only one flesh-eater. Others again say that men are healthier, longer-lived, and happier as vegetarians, than as eaters of a diet containing flesh meat. It is difficult to set a practical limit to the consequences of a purely humanitarian basis—much as one denounces anything like cruelty to animals. Admitting, for the sake of argument, that a man has no more right to murder a horse or an elephant than to murder another man; yet, upon the balance of the greatest happiness to the greatest number (say of oxen or sheep), I think it could easily be shown that flesh-eaters provide more happiness to these animals than vegetarians would; and that the quick and painless death by which their lives may be terminated constitutes but a small set-off against the pleasant and untroubled life which is conferred upon animals reared for the purposes of food. I speak now not necessarily of our present methods of killing animals, which includes the bleeding to death of calves, &c., but of a refined and sensible system of slaughter. The economists would arrive at a somewhat modified vegetarianism. They would still slaughter the beautiful salmon which multiplies in our rivers, where no other food could be grown, and which, descending to the sea as large as one's finger, browses around the coast upon materials still less accessible to us, and comes back as large as one's lower limb. Thus, in various ways, the practical outcome of the economist vegetarian differs from that of the humanitarian. Now, if the mere multiplication of human beings be the end of civilisation, it is clear that the economists have the argument. It can be shown abundantly that several times as many people who take their vegetables—say, as oatmeal porridge and fruit—can live upon the land as those who like their "vegetables, after they have been converted into beef and mutton," as is suggested by an anti-vegetarian, which simply comes to the substitution of animal life for that of man. Here, again, the question rises, Is the object of civilisation to multiply human beings? Or is it, rather, to develop a comfortable number of human beings of the highest possible type? For myself, I confess that the mere multiplication of human units would have no more interest for me than the multiplication of rabbits. I go for *quality*, at the sacrifice, if necessary, of quantity. Just as I would prefer a few small paintings that I could name to acres of vulgar canvases, so I would rather see a community of 500 of the grander types of men than of 5,000,000 of mere animals in human form. It follows, therefore, that I see nothing in mere humanitarian vegetarianism, nor in mere economical vegetarianism; and that, in my eyes, the question turns solely upon what food is most likely to develop the grandest type of men. There is, however, in the economy argument another aspect than that of an increased multiplication of human units. The life of an individual man is mortgaged, first, for that amount of labour which will provide the man with the means of existence; and only after these are provided does the man begin to have leisure for enjoyment and personal culture. Now, the simpler the food upon which he can exist, the larger the margin will he have, and the more profitable and perfect will he be as a mere machine for all purposes beyond those of mere animal existence, and the man eats to live, instead of merely living to eat.

In attempting to say how one would shape one's own life, if one could unroll half a century, and, with one's present knowledge, begin again as a plastic and developable infant, what one first sees is that one would like to select one's own parents. Almost the entire value of any eminent horse that is now before the public depends upon his *pedigree*, upon his *stock*. Most of our present eminent horses trace their pedigree back to one great horse of the last generation, i.e., Eclipse. Often in the shafts of a London cab one sees a horse with a Bay Middleton head on his shoulders—a head that once seen, even in engravings, is never forgotten. But here the body of the cabhorse tells of some fine progenitor having been mated, but not matched, and the horse is no more the Bay Middleton than a common stock upon which a beautiful rose has been grafted will reproduce the rose which it bears upon its trunk.

If we take eminent greyhounds, eminent cattle, in all cases we find their value to depend upon their pedigree again, and no amount of feeding or of training will produce a racehorse out of a cart-colt. We cannot choose our own pedigree; but if when marrying we marry wisely, we shall do for those who come after them as much as a single generation of wise selection of one parent can do. Taking the physical make of the man's mouth and digestive apparatus, the indication is that he was constructed to live upon grain and fruit rather than flesh. But the mere structure, notwithstanding the habits of progenitors for many generations, must be taken into account in considering what is fittest as food for the individual. Assuming that 100 men, accustomed always to live upon grain and fruit, were suddenly transferred to flesh food, what would happen is this. Some of these men would perish from their inability to live upon a purely flesh diet. Some would do indifferently well; some would take rapidly to flesh, and would flourish admirably upon it. Confine these people to an island, and in each generation the same result would take place; and thus, after many generations, we should have, in the survivors, a race of pure flesh-eating men, just as, in the Amazon, there are races of fruit-eating fish, and, in Norway, the cows live upon fish and offal. Now, were these carnivorous men suddenly moved to another island, where, instead of living entirely upon flesh, they had to live entirely upon fruit and grain, the result would be a gradual reversion of the previous modifications. Those who had flourished most perfectly upon flesh would probably do worst upon grain and fruit, and would perish from dyspepsia and various consequential diseases. Those who did worst upon flesh would probably take most readily to grain and fruit, and such reversion and natural selection going on, the tribe would have become pure vegetarians again after many generations. Therefore the adaptability or elasticity of the digestive organs would in each case be a measure of capacity to survive, and the law of the "survival of the fittest" would govern the result. It must be noted that the "survival of the fittest" is one thing, and depends upon the conditions of existence. The "survival of the best" is another, and depends upon abstract ideas of the ultimate object for which the men or animals are designed, and upon the extent to which the conditions of existence can be varied so as to subserve these ideas. If, for instance, we want horses to ride we aim at one ideal, horses to draw brewers' drays another, horses to run one-mile races another, horses to run four-mile races quite another, and so on. I shall not attempt to define an ideal man. In an ideal community we should need as many types of ideal men as we now have of horses and of dogs, and differing, perhaps, as widely as the King Charles spaniel from the bloodhound. Considering also that Byron had a club foot, that Pope was a hunchback, that Milton and Homer were blind, that Napoleon had epileptic fits, and that the Shakesperian strain of blood is dissipated, the subject is one upon which it would be very difficult to lay down any general principles. But, to multiply people who are blind, or deaf, or otherwise physically defective, would be bad policy, unless such defective persons have other qualities which clearly outweigh these defects. One querist (47615), for instance, asks:—"I am engaged to a young lady, aged 33 years. I have recently been told that 13 or 14 years ago she lost her reason through a bereavement, but soon regained it, and has ailed nothing since. I desire to know is it wise to marry her or to break off the engagement?" Here is a most important question, most intelligently put; and there is no doubt that if querist discovers that there is marked insanity in the family, he would be wise to break off the engagement, and especially so if he himself also has insane relatives. But there are few families in which some mental or physical defects would not be discovered by a careful investigation of two or three generations. And in this case, if the parents are healthy, moral, well-conducted people, without eccentricity; if the lady is in good health, and of an equable mind and good temper; if her brothers and sisters are all right, the incident may be looked upon as a mere temporary attack of mental illness, like an attack of bronchitis or of pneumonia not at all dependent upon a consumptive tendency. In the latter case it would be wrong to disturb an important engagement such as this, and to do so would be to inflict a great cruelty upon the lady, inasmuch as the cause of the rupture would be sure to break out, and give lasting pain to herself and all her family. But in such a case as this, the personal judgment of a skilled physician is what should be relied upon.

The causes of death of parents and of brothers and sisters may always be obtained by searching at Somerset House and getting copies of the certificates of death, and these facts would be important as materials for judging in such a case.

Returning to the question of vegetarianism, it will be seen that while fruit and grain are the food for which man's mouth and digestive system are constructed, man yet has a most elastic digestive system, and that those whose parents for many generations did well on a mixed diet will probably continue to do well on a diet largely consisting of flesh. As to the nutritive properties of a sound practical vegetarian diet, there can be no question that among Englishmen of my own acquaintance, some of the very finest specimens of physical and mental developments have been vegetarians, and some of them also the children of vegetarians. Pythagoras, probably the greatest of the Greek sages, was a vegetarian. I believe that we poison ourselves with nitrogen in the large proportion of flesh food that we now take. The one difficulty that I have been consulted about by vegetarians of very active turn of mind is *sleeplessness*, and in more than one instance vegetarianism has had to be abandoned on that account. But some persons, undoubtedly, derive vast benefit from vegetarianism. Those who desire to consider this subject more fully, and in detail—and the subject is one of great interest and importance—should get the "Dietetic Reformer" (post-free 2½d. Pitman, Paternoster-row), of which this present number now lying upon my table is a most able and scholarly one. Pitman also publishes some little pamphlets and cookery-books on vegetarianism which are sound and useful. My own conviction is, that I should do my own work better, and live longer, as a vegetarian; or, at any rate, with almost no flesh food. For years I have taken no alcohol, and have rather limited the amount of flesh I eat. Fortunately, also, I never could persuade myself to use tobacco; and I am of opinion that the use of tobacco lessens one's freshness of memory and one's mental endurance. The only reason why I have never tried vegetarianism is because I never yet have had indigestion, or, indeed, any other illness, and being apparently in excellent health, I drift along on the principle of leaving well alone. In dining out, also, it is a great infliction upon friends to have to eat up all their vegetables.

NIGHTMARE (47580). — If stout, the patient should starve down at the rate of one pound a week, till at the fair weight for his height and make. Heavy suppers should never be taken. Less flesh-meat should be used, if that be now freely used. Lying upon the left side, and upon a horsehair mattress, and not covered up with an impermeable coverlid, is good.

James Edmunds, M.D., &c.

Grafton-street, Bond-street.

P.S.—Being about to go to Norway for my annual holiday, I shall see no more papers till the middle of September.

SCIENCE AT SOUTH KENSINGTON AND THE CITY AND GUILDS INSTITUTE.

[20378.]—WHEN the "gentlemen who live at home at ease" at South Kensington read the letter of Mr. E. Jackson, p. 498, they no doubt exclaimed "Save us from our would-be friends!" for, unlike Balaam, he came to praise, and has passed a scathing condemnation, obviously an honest one, for he does not see the effect of his statements. The pith of Mr. Jackson's letter is stated in the following sentences:—"While at South Kensington, I received instruction and gained information which has enabled me to take such a position as would have been impossible from private study only. And this was not peculiar to me. I know a number of men now holding important (*sic*) positions in both pure and applied science who could not have hoped to have attained such positions had they not have been fortunate enough to get to South Kensington." From these sentences it seems clear that the persons referred to were students at South Kensington, not merely members of science classes and candidates for science certificates. Now we follow on. "One is a teacher of science under a school-board, another is in a corporation surveyor's office, a third chemist in a large chemical works, a fourth science master in a grammar-school," and so on. Mr. Jackson does not say what he is himself, but he shows that one-half of the instances he quotes have actually gone astray from the very objects of the Science Department, especially if, as I assume, they were students of South Kensington itself; for no sooner did these men get a little scientific training than they departed from their trades, and never acted as leaven at all—although Mr. Jackson assures us that the majority would still have been earning their living in a workshop but for the Department at South Kensington. Permit me to ask, is there any lack of science teachers of the usual type—any lack of chemists, or of suitable persons for the duties of a corporation surveyor's office? for if not, it seems to me that the public is being taxed for the benefit of individuals. Had these gentlemen remained in their workshops, without the benefit of South Kensington, they would, no doubt, by their native nous have made intelligent workmen; had they remained there, with the knowledge gained at South Kensington, they might, or they ought to, have been of great benefit to their particular workshop. I do not mean that of necessity they ought to have stuck to the bench; but you may depend upon it that if South Kensington is to be utilised for educating or fitting persons for occupations which are supposed to be higher in the social scale or better paid, the British taxpayer will begin to howl loudly. By all means spread a knowledge of science—if you can reach them, down even to the lowest ranks of the labourers; but don't inculcate the notion that it is worth studying merely with a view of bettering oneself. It should be distinctly understood that science students selected for the special course at South Kensington are not educated for their own especial benefit, but for the good of the country at large. Mr. Jackson's letter deals, however, only with the fringe of the subject; for the question really is, what amount of good is done amongst the many candidates for the examinations? Undoubtedly many of the teachers who have graduated at South Kensington are up to their work; but it is incontestable that many more are only schoolmasters tempted by the extra grant to qualify in certain subjects—such subjects, moreover, being those of but little value to their pupils, even supposing the masters were competent to teach them thoroughly, which they are not. I speak from experience. Mr. Jackson says that "not even the teachers themselves, much less the Department, can be held responsible for these answers" (that is, those quoted on p. 463). If the teachers are not responsible, permit me to ask who is? Candidates do not attend examinations unless they have been prepared somewhere, and with all deference to Mr. Jackson's opinion, I think he will find that the majority of people will say that the teachers (save the mark) are responsible for sending such crammed birds to the plucking, and the department is responsible for such "teachers."

In your "Scientific News" (p. 496) you quote the energetic denunciation of Prof. Graham referring to the examinations of the City and Guilds Institute, but if you look at the figures given in Table III., you will see that the case is as bad as bad can be. There were 41 candidates in "breadmaking," and only one passed! Of these 38 were taught in classes the teachers of which receive payment by results, and three were from other institutions or were private students. The solitary candidate who passed belonged to the latter category, so that for candidates trained in classes under the rules of the Institute, or connected to it, Prof. Graham returns the percentage of failures as 100! In brewing there were five candidates from the science classes, and 80 per cent. failed; 21 from other sources, and only 9·5 per cent. failed. To take larger numbers—in mechanical engineering, there were 397 candidates from science classes, and 51·3 per cent. failed; 126 from other sources, and 31·7 per cent. failed In mine surveying, of 87 science class students 55·1 per cent. failed; of 12 candidates from other sources all passed. It is worthy of note that the solitary pass in breadmaking was a pass in honours, and yet one would think that that is an industry of which, at least, something ought to be known by the candidates sent up by so-called teachers.

If your readers will refer to *Whitaker's Almanac* they can see the large sums paid as salaries to the officials at South Kensington, and it will not be surprising if, with a falling revenue and increased taxation, the British public shortly demands to know what they do for their money. A careful digest of the Tables shows that what I may call private students are by a long chalk far in advance of the students of science classes. The summary does not show that fact, because in many subjects there were no candidates from science classes at all. I recommend a perusal of the Report to those interested in the subject—especially the Pass List.

Nun. Dor.

PRESSURE OF WIND.

[20379.]—As I did not read the paragraph on page 143, but only the version of it given in the query on page 461, this accounts for my remark that "the figure in the 'E.M.' is evidently a misstatement." I did not therefore deny that with an hourly velocity of 50 miles the pressure was 49½lb., but that with a velocity of 50 miles an hour the pressure on the square foot was 49½lb. This "F.M.S." might have seen had he read my letter carefully.

It is quite true that mere contradiction or statement is of little value unless supported by confirmatory evidence, and when I said that such a velocity as 53lb. on the square foot, was unknown in this country, and spoke of the erroneousness in the registration of such high pressures, I did not do so without the support of such evidence.

Are we to believe that every structure that is now errected, including even those which are "jerry-built," is calculated to resist such a pressure as even 40lb. per square foot? If we are to trust our anemometers, such must be the case; otherwise, far more damage would be caused, than what we now observe, which does not often exceed broken windows and loss of slates. That buildings are not subjected to such a high pressure as this, we conclude from the fact, that tall factory chimneys, and other structures of a more or less fragile nature, which are certainly not calculated to resist a pressure of 40lb. on the square foot, have remained intact, notwithstanding many a storm and in spite of the anemometers. Again, railway carriages, it has been ascertained, are overthrown by a pressure of from 30 to 40lb. per square foot. [Vide Report of Committee appointed to consider the Question of Wind Pressure on Railway Structures, on July 29th, 1880] Now if such pressures as these were as common as the anemometers would lead us to suppose, the upsetting of a railway carriage would be no unusual occurrence, and it would not be necessary to have a pressure of 93lb. per square foot to overthrow a locomotive.

These remarks on the force of the wind do not apply to air-currents above a certain height from the earth, for it is known that as we ascend the wind can blow with much greater violence, owing to the absence of friction which terrestrial currents experience. Thus Mr. Simmons may easily have reached a velocity of 130 miles an hour in his recent balloon voyage. But I would venture to assert, from the considerations before mentioned, that we never have such a storm as that on the surface of the earth.

I do not consider that "F.M.S." proves in at all a conclusive way, that Mr. Hawksley's formula and table are "worse than useless," and the only apparent ground upon which that conclusion is founded, is, that the connection between velocity and pressure as illustrated in the formula does not coincide with what the anemometers give, and it does not seem to strike him that the latter might be at fault, for he remarks that "the only trustworthy data are the actual pressures registered." Now as there must be some connection between the velocity and pressure, perhaps "F.M.S." can suggest a better formula than that given by Daubuisson ($P = \frac{wv^2}{g}$, which applies not only to atmospheric air, but to any liquid) or point out where the error lies. With regard to the pressure of wind on a structure, I think the opinion of such an eminent engineer as Mr. Hawksley should have some weight, as he speaks, not with the voice of a mere theorist, but as a practical man, and he considers, "that for structural calculations a pressure of 40lb. on the square foot may be safely adopted, notwithstanding some common anemometrical observations to the contrary." I quite agree with "F.M.S." when he remarks that "velocity per hour" is misleading when pressure applied for one second will destroy, still in a table it is of course useful to have the velocity in miles per hour, as well as in "feet per second."

Worthing, Aug. 7th. **C. H. Romanes.**

Errata.—Amateur Surgical Appliances, p. 499.—In letter on above subject, in line 2, first col., p. 499, for "cut" read "at;" and in next line for "½in." read "1in."—N. S. HEINEKEN.

Tracing on Cloth.—A correspondent of the *Moniteur Industriel* refers to the difficulties encountered in tracing upon cloth or calico, especially the difficulty of making it take the ink. In the first place, the tracing should be made in a warm room, or the cloth will expand and become flabby. The excess of glaze may be removed by rubbing the surface with a chamois leather, on which a little powdered chalk has been strewn; but this practice possesses the disadvantage of thickening the ink, besides, it might be added, of making scratches which detract from the effect of the tracing. The use of ox-gall, which makes the ink "take," has also the disadvantage of frequently making it "run," while it also changes the tint of the colours. The following is the process recommended:—Ox-gall is filtered through a filter paper arranged over a funnel, boiled and strained through fine linen, which arrests the scum and other impurities. It is then placed again on the fire, and powdered chalk is added. When the effervescence ceases the mixture is again filtered, affording a bright, colourless liquid, if the operation has been carefully performed. A drop or two must be mixed with the Indian ink; and it also has the property of effacing lead-pencil marks. When the cloth tracings have to be heliographed raw sienna is also added to the ink, as this colour unites with it the most intimately of any, besides intercepting the greatest amount of light.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[45964.]—**Glass Transparencies (U.Q.)**—Many thanks to "M.I.C.E.," p. 64, but the transparencies he speaks of are an entirely different thing to those to which I refer. The latter are often as large as 20 by 24in., and have no film of any kind upon their surfaces. They are glazed into window sashes, and not acted upon by the weather. They have the appearance of roughly-ground glass.—An Old Fellow, Melbourne.

[46748.]—**Sharpening Carpenters' Saws.**—Will "Jack of All Trades" kindly say if he means that each of the teeth 5, 6, 7 in Fig. 3 should be sharpened on both sides when in the position so represented, or that the fronts of those set from you and the backs of those set to you should be sharpened when in the position so represented?—Tiro Tironum.

[46841.]—**Vacuum Pump.**—I expect, ere this reaches England, J. R. Edginton will have discovered or had his error pointed out by some readers of the "E.M." However, in the event of such not being the case, I supply the required information. "J.R.E.," in not constructing his pump particularly according to my description (p. 34), has completely nullified its action. For the pump to act with a reservoir of mercury raised above bulb A, it would require that the top of tube F should be full 30in. above the surface level of mercury in the reservoir when at its highest point. This was, in fact, the original design of my pump, but in order to make it more compact and prevent the necessity of raising a reservoir of mercury (a somewhat laborious matter), I designed the force pump at the base of the stand, the length of tube B being such that on production of vacuum in A the height between surface of mercury in cylinder C and junction of F with B is over 30in. This being the case, it is only necessary that the top of tube F be about 2in. or 2½in. above the bend between A and J. The length of vertical portion of F in mine is 11in, the upper angle being 3in. above the bend between A and J. The cylinder C must be made of iron, and by having plenty of leverage in handle E, the work is comparatively light. I notice one reader has failed to obtain a current from my secondary battery, although the sulphate of copper solution was all decomposed. This is evidently owing to his having deposited the copper on the amalgamated lead plate.—Henry Sutton.

[46859.]—**Indigo-Blue Dyeing.**—I am very sorry indeed that "Blackwater" should think that his friend, Mr. Simpson, was treated rather ungenerously. "Blackwater" says that a woad vat will dye 700 yards of serge navy blue with 12lb. of indigo, at 6s. per lb., and wishes to know what quantity Read-Holliday's process will produce. Of course, it is important to know the weight of the cloth, for navy blue serge, like other cloths, differs in weight. I have calculated it, however, at 12oz. per yard, which would give over 520lb. weight. Now, to dye that all indigo to the depth of colour that the writer of this is in the habit of doing daily, is simply an impossibility. I can assure him that if he can dye 700 yards of cloth, the weight that has been calculated at, with that amount of indigo, he need not trouble himself about any other process. Read-Holliday's process of indigo-blue dyeing is as expensive, perhaps more so; but the time to dye 700 yards of cloth in a woad vat, Read-Holliday's process will dye 1,200 yards a much better colour, less cost in the cleaning; so that, time being money, the new process is preferable to the old. I trust "Blackwater" will kindly state the weight of his 700 yards of serge, and give some idea of the depth of colour, and perhaps I shall be able to give him some practical information. Indigo-blue dyeing, in the manufacturing of woollen goods, is a large item, and it is important to manufacturers to ascertain the cheapest and most durable method.—J. Ormiston.

[46859.]—**Indigo-Blue Dyeing.**—I do trust J. Ormiston will not suppose I am answering his note—but to "Blackwater" I wish to explain that the mysterious preparation of indigo sent out by R. Holliday and Sons is merely that drug in a reduced state, so that the dyer has only to use zinc-powder, bisulphite, and lime in small quantities to get the vat into condition. (I do not know what term the dyer would use for this.) You are not obliged to buy indigo in this state, but can reduce your own by making an arrangement with the firm. You will, no doubt, understand that, manufacturing this bisulphite of soda, and being very large buyers of zinc-powder and indigo, and by the employment of special plant, they can supply small consumers at a lower rate than they could reduce the drug for themselves; another point which may be of advantage to the consumer is that they send the indigo out of uniform strength, which everyone knows cannot be obtained in the drug as imported. They do not use anything beside the chemical substances I have enumerated. A very fair idea of the manner in which reduction is accomplished is given in the little book on "Dyeing and Tissue Printing," by Crookes, lately published. There, however, it states, that scrap-zinc is employed, which is an error; zinc-dust is used in its stead. I am sorry I cannot tell the cost as against that of woad vats; but I believe the majority of users of the new process say it costs more than the old method; the extra cost, however, is more than counterbalanced by its being so much more expeditious, &c.; all this, however, you can find out for yourself by using it against the woad process. I wish to say, in conclusion, that the statement I make as to the reduction is not from hearsay nor book knowledge, but from personal knowledge. I am much obliged to "Blackwater" for his thanks.—S. J. Simpkin.

[47029.]—**Difficulty with Coil.**—To Mr. Lancaster.—Now satisfy yourself that the wire you have removed is good throughout its entire length, then commence re-winding, and leave out two coils from each end in every successive layer, carrying on the insulation from end to end as before. The middle will, of course, be even then thicker than the two ends. You ought to have a coil as nearly perfect as possible.—W. J. Lancaster.

[47219.]—**Textbook of Physiography.**—Thanks to "S. R.," I am acquainted with both Huxley's and Geikie's manuals, but neither goes over all the ground required for the advanced stage of the Science and Art Department.—A. J. Smith.

[47223.]—**Bird-Cage Making.**—"Querist" would require a pair of good wire nippers about 7in. long, two pair pliers (round and flat nosed), awls size of wire and brads used, and a true square is indispensable. He had better buy a common cage and work upon its principle as to posts, &c.; but if he will advertise his address, and communicate with me, saying what he requires, I will with pleasure assist him either with advice or drawings. —Handy Man.

[47228.]—**Telephone.**—I should advise you to put 1oz. of No. 36 silk-covered wire on each bobbin, the size of which should be ¾in. diameter (of ends), and 1¼in. long, made of cardboard, with wood ends.—Beetle Crushers.

[47239.]—**Biliousness—Bile.**—I think Mr. Nolan will find the following correct:—The bile is mixed with the blood in the process of digestion and blood manufacture. It is the duty of the liver to extract the bile from the blood and pour it into the bowel. If this duty is neglected the bile is carried with the blood through the system, reaching the delicate veins of the head, and producing severe bilious headaches. From which arrangement I think we may gather the following: certain materials require bile to pass them through the bowels, which bile they contain in the quantities required. If the liver does not perform its duties in secreting and excreting the bile, we not only have bilious headaches, &c., but also stoppages in the bowels, &c. Moral.—If the liver is out of order, don't take material containing too much bile.—John Alex. Ollard, F.R.M.S., Enfield.

[47261.]—**Arsenic in Wall-paper.**—When powdered arsenic is dropped into chlorine it immediately takes fire, producing arsenic trichloride $AsCl_3$. I should advise you to scrape the wall-paper and drop some of the powder into a jar of chlorine gas. I suppose, from your query, you understand something about chemistry. Another way is to mix with it some ammonium sulphide, NH_4HS, which gives a yellow precipitate.—Beetle Crushers.

[47267.]—**To Chemists.**—Thanks to "Video" for his reply, but quicklime slaked with water would not answer my purpose. I want a mixture of chemicals that in small quantities will produce considerable heat gradually. Would a mixture of iron-filings and sulphur answer, and if so, in what proportion? Surely any practical chemist could answer this query. "Video" says I appear to think, by asking twice, that I am entitled as of right to a reply. I think that all replies to queries in the "E. M." are obtained by courtesy. I have answered many on subjects I understand, and have felt a pleasure in doing so.—Caloric.

[47274.]—**Illuminating Clock.**—Why not dispense with reflectors, &c., and paint the hands and figures of the clock with Balmain's luminous paint? Then the time would be plainly seen in the dark, and the expense is trivial. If your clock has its hands and the figures gilded, probably you would not care to spoil the look of them in the daylight; therefore you could paint the face with the luminous colour, leaving the hands and figures gilded; then in the dark the figures and hands would appear black on a luminous ground.—Beetle Crushers.

[47277.]—**Engine.**—This is one of those queries which no one can possibly feel inclined to answer, except by referring the querist to previous replies. What does the querist mean by "the piston is cut off for a crosshead"? Undoubtedly such an engine might be made to work a sewing-machine, and probably a flywheel weighing 14lb. would suit it as well as anything else. Really, "T. B.," you should read up back volumes, or, at all events, learn sufficient to state explicitly what information it is you do want.—Essar.

[47281.]—**Tricycles.**—"Cherophus," whoever he may be, should, before he writes, be sure that he knows what he is about to write, and not make any erroneous statements. He may be—and most likely is—unconscious of having misrepresented me; but, at the same time, he ought to have been more careful before he deliberately puts one in the category of—well, people not to be believed. Now, anyone can refer to my answer on page 433, and they will find that I never once said I could ride 12 miles an hour all day, neither did I say that anyone could go 12 miles an hour all day; but what I did say was, "With such a machine you can go 12 miles an hour." Perhaps "can" should have been in italics to have made my meaning more distinct. I have on the road ridden a mile in five minutes, measured; only last evening I rode a mile and a half in seven and a half minutes, and could do it any time; but this is on a back-steerer, and I have never seen or used a machine that has given me greater pleasure. There are many reasons why I don't like a front-steerer, and although they may be coming to the front now, they will, I feel sure, soon go to the back again. With a back-steerer I can climb hills that I cannot possibly climb either on a front-steerer, rotary, or any of the other forms of machine now made. I have plans for a new machine that possesses advantages not in any machine now made, and I shall have a machine made up and then will describe it. Its great feature is throwing the continuous strain off one set of muscles and putting it alternately on to others. Of this machine, when I have tested its powers, I will write more.—W. J. Lancaster.

[47283.]—**Launch Tubular Boiler.**—The spec. grav. should never exceed 1,087, and, for a launch, better be kept down to 1,060. The quantity of water used as steam is an indication of the quantity that must be blown off, and as it is required to keep the water down to 2-33, and the normal contents is 1-33, the water to be blown off is to the water evaporated as 1 is to 1. Blow off in any usual way, and supply by feed, at any time that suits you.—Essar.

[47284.]—**Modelling in Plaster.**—Presumably you mean modelling in modeller's clay, for "plaster" is used for casting, not modelling. It is an art that cannot be taught by writing, beyond such simple directions as to how to keep the clay moist, and the special manipulation of the tools—mostly strips of box, or other hard wood. There are some handbooks on the subject—one by Vago, published by Simpkin and Co.; but if the whole of that were reproduced here, you would be very little the wiser. If you wish to go in for the art, you can obtain lessons at many of the science and art schools at a very cheap rate, and with just a few hints, you want no more than an artist in any branch can suggest. Perhaps some of your readers who may have gone through the elementary class will give an outline; but it is much like asking for directions to drive a locomotive: there is precious little that can be put into words, but a tremendous lot to learn by actual practice.—Nun. Dor.

[47286.]—**Chromograph.**—I have made very good "graphs" with the following "compo": ½lb. gelatine glue, 6d.; ¾lb. of glycerine, 1s. 6d.; ½lb. water, and a little prepared chalk in order to give an opaque surface. The ink I used to write with was Judson's aniline violet dye, 6d. per bottle, and I got, as near as I can remember, 40 distinct copies. I cannot say anything about HCl being useful for removing the old copy. I have always found hot water to answer as well as I could desire.—Beetle Crushers.

[47289.]—**Sulphur Casts.**—Are you sure the vermilion was good? The only method is to stir it in just before pouring, and to work at the lowest possible heat, because vermilion, being a sulphide of mercury, is liable to be decomposed in melted sulphur. I should try some other pigment, preferably one of the red earths.—E. G. M.

[47290.]—**Calculating Machine.**—For details of calculating machines, see p. 109, No. 811 (Babbage's); p. 611, No. 649; p. 563, No. 568; and p. 642, No. 571 (Thos. de Colmar's instrument illustrated). If the querist will look still further back in your volumes I have no doubt he will find much other information about them; but if he consults the pages mentioned he will obtain a good idea. De Colmar's machine is in use in several offices in London (the Railway Clearing House, for one, I believe), and querist should endeavour to see it, though the illustration in No. 571 makes everything clear.—F. I. A.

[47292.]—**Bunsen Battery Connections.**—The description I gave in No. 901 "E. M." will, I think, give all the necessary information you require.—BEETLE CRUSHERS.

[47293.]—**Pump Query.**—The clearance may be ¼in. for such a pump; but it may be practically very small. The speed should not be more than 500ft. per minute.—NOSCO.

[47307.]—**Mildew on Vines.**—I am sorry to find "Amateur Gardener" and others are troubled with the mildew; but I was once troubled in the same way, but found a most certain and effectual cure for it, as well as the insects which sometimes abound on the vine. I fear, by what "Amateur Gardener" says, that this year the grapes are too forward to do any good, because the remedy I used will make them taste; but in future it will be a sure cure if made and used as directed. Boil a small quantity of sulphur with some quicklime, quite fresh, in a glass flask, with some water. It will require to be boiled for, say, 10 minutes. Great care must be taken that it don't boil over, and the mouth of the flask should be slightly stopped with paper so as to form an obstruction to air entering. When the boiling ceases the sulphur and lime quickly settle, when the clear yellow liquor should be poured into a bottle tightly corked, and fresh water added, and the boiling again begun. This should go on till sufficient solution is obtained—say, nearly a pint. The sulphuret of lime solution should be kept well corked, as the air decomposes it very quickly. To use it add a wineglassful to a quart of water, and then brush the stem of the vine with it, doing it quickly, as it decomposes almost directly. When the stem has been well brushed don't be sparing with the solution; the whole of the leaves should be syringed, and the greenhouse shut up for a short time. This should be repeated three times, the last just when the grapes begin to form. If well done, it is a sure preventive for scale, mildew, &c. I don't say anything about the management of the vine, as I suppose that is properly understood. If the trouble is thought too great to make the sulphuret of lime, perhaps it may be bought; but I cannot say. A Florence flask is the best to use.—EDWD. THOS. SCOTT.

[47310.]—**Naturalisation.**—This question depends entirely on the laws of France. If a Frenchman has been naturalised here, he acquires all the rights and privileges of a Britisher. But I do not see how that can affect his status in his native country; and if it is the law that the property of those who run away to escape their duties as Frenchmen shall have their property confiscated, the mere fact that they have been naturalised here or elsewhere will avail them nothing.—PATRIOT.

[47311.] — **Cannon.** — Make it 3in. thick at breech end, and "prove" it, before you sell it.—E. G. M.

[47322.]—**Injured Thigh.**—To DR. EDMUNDS.—I have looked back all the numbers I have (34), and cannot see any of your former replies I would think suitable as you direct for treatment. I may say some days before I received your reply the abscess came to a suppuration of its own accord without pain. I then kept it poulticed with linseed-meal (now about five weeks). I kept it well pressed to assist the emptying of it, and there came at times about the size of a nut of pus, and occasionally twice the quantity, but no apparent lessening in size. For the last ten days I have discontinued pressing it, but nothing has come away since. The opening is about the size of a point of a lead-pencil, and the gathering has rather a solid or hard feeling. Will Dr. E. kindly say what would be the best treatment to continue? Should I follow poulticing, or when should I give it off, and if correct to put it on as warm as I can really bear it; or should I take any medicine or tonic at the present time or after? Since I received your reply I rested, but kept moving a little about. The warm poultices have made the flesh tender on the surface, and in a few places there is a slight oozing of serum. Any remarks as to mode of treatment will be thankfully and gratefully received by—S. J.

[47351.] — **Mathematical.** — I am much surprised to find, after the very lucid explanations by J. H. M. Jacoby and "Hemisus" of the illegitimate assumption made by "An Engineer's Son," that the latter still considers his solution satisfactory. "Hemisus" very truly points out that the fallacy lies in the fact that $(1 - x)^{-n}$ is not independent of x; and, to take the very instance proposed by "An Engineer's Son" in his last letter, the reason why the coefficients of x in $(1 + x + x^2)^3$ increase up to 7, and then decrease, is not at all because when written:—$(1 - x^3)^3 (1 - x)^{-3}$ (i.e., $1 (1 - x)^{-3} - 3x^3 (1 - x)^{-3} + 3x^6 (1 - x)^{-3} - {}^9 (1 - x)^{-3}$). The coefficients 1, 3, 3, 1, obey the rule and $(1 - x)^{-3}$ is then multiplied into each, which is the reason set forth in "An Engineer's Son's" first letter.—CANTAB.

[47423.]—**Diabetes.**—There is a work entitled, "The Skim-Milk Treatment of Diabetes and Bright's Disease, &c.," published by Longmans and Co., price 10s. 6d., in which, I should think, "E. F. C." may obtain the information he requires. There is, also, an American work, published in Philadelphia, under the title of, "How a Person afflicted with Bright's Disease ought to Live," by J. F. Edwards, price 4s. It is numbered 677 in the list of American publications in the *Publishers' Circular* of 15th February, 1881, and may be obtained through Sampson Low and Co., or any respectable bookseller.—G. TOMMY, Bristol.

[47434.]—**Lathes.**—In answer to Mr. J. H. Evans, what I wished to know is how to Babbitt the mandrel, and as it is a bar-lathe, I also wish to know how to Babbitt the two iron bars that form the shears or bed. How are the holes chambered in the standards to receive the metal? If J. H. Evans would inform me how to make and use Babbitt metal I shall be obliged. Does he think ordinary white metal would answer?—MINER.

[47441.]—**Minute Photography.**—You can have a lens of any focus made to photograph either the whole of the front of a newspaper or parts; then these can be read either with the table or the oxyhydrogen microscope. You cannot use ordinary collodion, as the film is more or less reticulated under a high power. The albumen process is one of the best for obtaining a structureless film.—W. J. LANCASTER.

[47450.]—**Measuring Flow of Water.**—Multiply the depth, breadth, and speed, in inches, together, and you will have the total amount in cubic inches passing over in any given time. It is then only a matter of simple calculation to bring it into gallons, pounds avoirdupois, or whatever you may require.—W. CLARKSON.

[47451.]—**Improving Definition of Telescope.**—I am sorry I cannot help you much in getting rid of haze. The only way to remove the difficulty, even in a slight degree, is by using an eyepiece of very large field and lower power than the one you have. I should have an eyepiece with its field-lens at least 1½in. to 1¾in. diameter, and mounted with the erector in the pancratic form, to give a power of 10 to 20 diameters. You might use a comet eyepiece, and a diagonal to reinvert the image. This would perhaps be the best thing you could do.—W. J. LANCASTER.

[47463.]—**Change-Wheels for Screw-Cutting.**—I am obliged to Mr. T. J. O'Connor for his attention, but he hardly answers my query. Let me put it this way. The change-wheels are the usual set, 20 to 25, and from 25 to 125 by fives; the leading-screw is four to the inch. Suppose, now, I require a screw 31 threads to the inch—you will say, perhaps, that with these wheels it is impossible to cut 31 to the inch exactly. But out of the thousands of screws which can be cut with these wheels and this leading-screw, I should expect to find one or more differing from 31 to the inch by so small an amount that in practice the error could be neglected. Now, what I want is a method of calculating this as directly as possible. What is the method in actual use? I don't want to be shown how to calculate for 31 specially, but for any number, and to find the screw with the least error.—TRY AGAIN.

[47465.] — **Faded Daguerreotype.** — The answers in last week's issue are good, with one exception, and that is, the pouring on to the plate. Don't pour at all, unless you wish to spoil the daguerreotype; but put the plate into a dish. I have restored many so-called faded daguerreotypes with cyanide of potassium solution. It, of course, requires a little care; and when the solution is done with, don't leave it for the youngsters to drink, but at once throw it away.—W. J. LANCASTER.

[47468.]—**Transit of Venus.**—I send the following, hoping it will be of service to "Jamaica:—

LATITUDE, 18° 5′ N. LONGITUDE, 77° 30′ W.

	Local meantime.				Sun's altitude.	
Dec. 6.	h.	m.	s.		°	′
First external contact	8	52	37	a.m.	30	15
,, internal ,,	9	13	23	a.m.	33	54
Last internal ,,	2	39	5	p.m.	32	17
,, external ,,	3	0	22	p.m.	28	29

The point of which lat. and long. is given above would be in the vicinity of the "Blue Mountains," Jamaica.—S. G.

[47468.]—**Transit of Venus.**—A three years' residence in the Southern Port Royal Mountains of Jamaica makes me think the atmosphere there for telescopic work is simply superb. In and about Kingston, however, which is situated on a plain, I think the radiation of heat during the day-time is so great that good definition would be out of the question; but in those mountains which surround this plain, and which rise very abruptly to elevations varying from 1ft. to nearly 4,000ft., the case is very different. I will give an experience or two out of many similar. Many times I have seen the horizon as a fine delicate line drawn between sea and sky, from the tops of the Flamsteed and Bloxburgh Mountains, whose elevations are over 3,000ft., and from the former with a 3in. telescope (not, by the way, a five-pounder), I have seen, with ease, the time by the town clock (Kingston) at 9 a.m. with the sun shining in its full strength, a distance of not less than 14 miles; and from the top of the latter mountain with a 1½in. or 1⅝in. telescope, I have seen the various splashes in the water from a cannon-shot (in target practice) off Port Royal, 20 miles away, at least. I have also seen one of the R. W. I. mail steamers with the same telescope, when five hours' sail off the port, the white foam from the paddles being plainly seen, and not until two hours after could a trace of the ship be seen with the unaided eye. I think these facts will give an idea of the rare excellence of the atmosphere for telescopic work. The finest time in this country cannot be in any way compared to it. My reasons for selecting the Southern Port Royal Mountain can be given if required, and December a good time.—S. B.

[47478.]—**Induction Coil.**—To MR. LANCASTER.—The core should be ⅜in. diameter for such a coil as you intend making, and should not be more than 6in. long for ½lb. secondary. If you are careful in winding and insulating you will be able to get a good ⅜in. spark or under very favourable conditions, ½in.—W. J. LANCASTER.

[47486.] — **Euclid's Axioms.** — What Euclid asserts in axiom (2) is: that if A and B are equal, then A + C = B + D; from this we can deduce that A − D = B − C, which is obviously the same as A − C = B − D, which is axiom (3). Axiom (4) can be demonstrated indirectly from (2). Suppose that when A and B are unequal, and C and D equal, that A + C = B + D. But this is clearly impossible, since it has been shown to be the case when A and B are equal; therefore, the sum of A and C is unequal to the sum of B and D. Axiom (5) may be deduced by a similar consideration. Axioms (6) and (7) are obviously merely cases of Axiom (1).—C. H. ROMANES.

[47490.]—**Loco. Engine with Broken Crank Shaft.**—W. Bradshaw, Derby, on p. 506, answers "Young Mechanic" re broken crank-shaft, but gives no information as to the modus operandi. Driving-wheels are often lifted clear of the rails by putting a couple of nuts or fish-plates on the rails, and drawing the driving-wheels on to them, the extra pressure forcing the axle-box up so as to allow packing to be placed on the keeps or bottom-stays, the pressure of springs tending to keep such packing firm. If the engine has outside axle-boxes, a screw-jack will answer if applied under them. "Young Mechanic" should ask some old driver, and not be ashamed of his ignorance, when he would get all the information he requires.—TAKAPUNA.

[47491.]—**Magic-lantern Slides.**—You cannot learn how to paint lantern slides from any description. You will have to work hard until you succeed. I have a lot of men who colour slides, and but few of them know how to put the colours on as they should be, and yet I often pay 10s. to 15s. for one slide. There are several handbooks, most of them written by men who never painted a slide in their whole lives. I once attempted to paint a few slides, and I put the colours on as the best books told me; but the success was indifferent, and I found it would take years to obtain the knowledge how to paint properly.—W. J. LANCASTER.

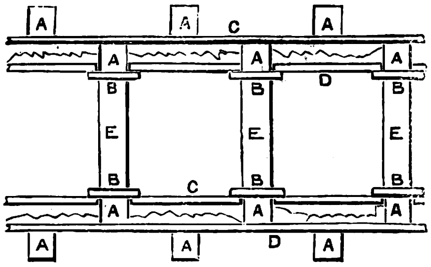
[47496.]—**Power of Batteries and Coils.**—There is no rule, but a safe plan is to use not more than four quart Bunsens to each 1in., and, to be absolutely safe, not more than three to each 1in. for coils giving 2in. and longer sparks.—W. J. LANCASTER.

[47498.]—**Indigestion.**—Having recommended cocoa from the nibs as a most valuable tonic for the stomach, the best receipt for making it is, I believe, to put 4oz. of the nibs into a kettle or large tea or coffee-pot, add 4 pints of water, and let it boil for about 4 hours; it is then reduced one-third (not more) if boiled slowly. A good drink of cold water, repeated if necessary, often removes uneasiness, and is excellent before meals. I find alcohol an injury instead of a benefit to stomach or nerves.—C. M. Y.

[47500.]—**Bichromate Battery.**—To "BEETLE CRUSHERS."—The number of plates in the battery depends upon what amount of power you wish to obtain from it; the more plates you have the stronger will be the battery. Supposing you used the battery four hours a day, on completion of the work remove all the solution, and allow a flow of water from a tap to pass through the battery, thus thoroughly cleansing the sawdust, plates, &c. This may be done for a week, when it is best to take the battery to pieces and reamalgamate the zincs, see to connections, &c. To attach the battery to an electric lamp, it is only necessary to connect the binding-screw that has the zinc wires to one wire of the lamp, and the binding-screw connected to the carbons to the other wire of the lamp. Any information further required I shall be most happy to supply.—Beetle Crushers.

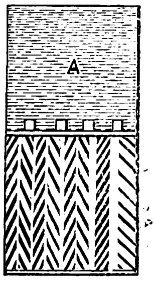
[47510.]—**Cistern.**—A cistern 6ft. diameter and 8ft. deep, clear dimensions, would be suitable for a house of the size given—i.e., 70ft. by 23ft., capacity 226 cubic feet = 1,380 gallons.—Ditton.

[47511.]—**Coffer-Dam.**—Get the shell of an old Cornish boiler, if for sinking well; or if for putting foundation in for wall, proceed as follows: Put piles in as Vandyke fashion shown in sketch;



main piles, A A, 5in. by 3in., and plank at back of B, 8in. by 1½in. Boards put down between, as A, and B, C, and D; puddle between with clay, and stay or strut from one point to the other, E E. Perhaps waleing A, B, C, and D put down, break joints with felt, will do without puddling.—Jack of All Trades.

[47513.]—**Water Filter.**—Make a cistern under ground, rectangular, 8ft. long, 5ft. wide, with a partition wall across the centre, one end 10ft. deep, the other for filter 7ft., and in the latter put bricks on edge, as shown in sketch, one course;



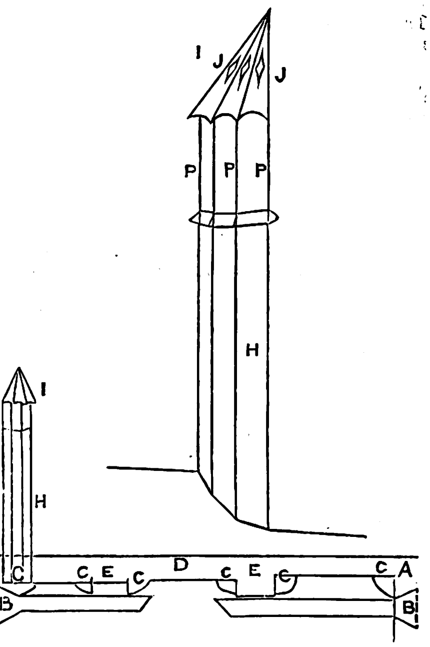
reverse the order, and lay another course; upon these lay another course of flat; upon this some washed shingle sifted through a ¾-mesh, about 8in.; upon this some finer, about 4in.; and upon this some (about 3in.) river sand washed; upon this 2in. of charcoal dust, and 2in. more sand. The bed or bottom of this should be inclined towards the receiver, A, and an opening, or four or five, about 4in. square, left in the parting-wall into it. When foul the top sand can be removed and the filter supplied with a fresh lot; thus the filter is renewed when choked, and, if thoroughly out of order, the whole can be taken out, washed, and replaced with little trouble.—Jack of All Trades.

[47515.]—**Dry Collodion.**—Presuming you have some acquaintance with the wet process, proceed as follows:—Coffee process: coat the plate with a substratum of sheet gelatine 15 grains to 12oz. of distilled water, with the addition of 24 minims of ammonia. When dry, coat with ordinary collodion, to which has been added 2 grains of cadmium bromide to each ounce; sensitise with a 40-grain bath, wash for about one minute under a stream of water from the tap, and flow over with a preservative as follows:—Solution of coffee ½oz., boiling distilled water 5½oz, and white sugar 90 grains; when cool, filter and mix with solution of gum-arabic (picked) 90 grains sugar-candy, 20 grains, and distilled water 5½oz. filtered. Flow this preservative over the plate in two applications of about a minute each, using the liquid from the first flowing as the first application to the succeeding plate. Drain the plate, and dry in a drying-box. The plates are very transparent, and so require a backing to prevent blurring; for this a non-actinic paper coated with gum may be used. The exposure required is from three to six times that for a wet plate. Before development, soak the plate in water for three minutes, and remove the backing. For developer make solutions of (1) pyro, 6 grains to the oz.; (2) Bromide potass, 20 grains to the oz.; and (3) ammonia (·880), 15 minims to the oz. Take two parts each of (1) and (2), and flow over plate and return into developing-cup, in which is one part of (3). If the plate shows over-exposure, return developer into cup and wash the plate; continue with more of No. (2) added. If under-exposed, add more of No. (3). The image may now be intensified by the ordinary pyro intensifier, first flowing over with solution of ammonio sulphate of iron 10 grains, sulphate of copper 10 grains, and citric acid 10 grains to an oz. of water; fix with hypo. The above process is that of M. de Constant.—Ditton.

[47518.]—**Balance-Wheel Cutting.**—I am sorry I cannot oblige this correspondent. I have not got a balance-wheel cutting-tool, and am not provided with drawings of one. It is an expensive and complicated tool, and by ordinary jobbers very little used, or even known. To give a drawing from memory would end in failure, so I will not attempt it. Small files, called balance-wheel files, may readily be bought, with which, by careful working, the teeth may be correctly recut if they are incorrect. The tips of the teeth may be trued up in the turns with slightly oiled Arkansas-stone. The ends of the teeth should be cut in a line with the pivot centre, and should be of equal thickness, and good clearance should be left in them for the swing of the pallets.—Alfojoe.

[47531.]—**Ventilation.**—Fix on roof two of Boyd's patent ventilators for outlets, and for inlets, tubes 7ft. high of any convenient size with grating to open air at bottom. These outlets should have a total area of about twice the total area of outlets to prevent draughts.—Ditton.

[47531.]—**Ventilation.**—If your floor-line lies above the general ground-line, remove bricks at each end, 12in.sq., and cover over with a perforated, ornamental, cast-iron panel. If the interior of walls are panelled, put an ornamental zinc piece across the angles, with perforated ornamental top. These should be 5ft. 6in. high; and at the bottom the angle of flooring should be removed, and these put over them. The air, if taken through the holes under the floor and up these shafts, will be somewhat noisome, and a zinc trunk, for the conveyance of the air to these shafts, would be better—say, opening at each end 18in.sq., tapering up to 12in. by 8in.; distance from end, 2ft. (See sketch.)



A, outer wall; B, ventilation trunk; C, angle; D, wall line; E, piers; F, floor line; G, joist; H, ventilating shafts; I, caps; J, perforations; P, perforated panels). The material need not be heavy.—Jack of All Trades.

[47548.]—**Industrial Company's Account.**—It is impracticable to answer this query, even in outline, within a reasonable space. The general principles are those of double entry, which can be found explained in books costing eighteenpence and upwards. The problem is solved by the best application of those principles to any one particular business. The practice, therefore, depends much on the detail and extent of the business—more on the number of items than the money amount of them—and other like considerations. The results which "Boss" wishes to see displayed are sometimes arrived at by dividing the business into departments, so far as the cost of production is concerned; but this course need not necessarily be followed. In a large concern, an exhaustive analysis of the wages, raw materials, and manufactured articles bought; of such costs as horses, stabling, and cartage hired or carriage both inward and outwards, of stocks or goods previously bought, when subsequently issued for use; wear and tear of plant; sub-contracts, &c., &c.; and the redistribution of such results when obtained among works contracted for, extras on the same, day-work, piece-work, jobbing, and many other heads—all this is often costly—to establish a good system as well as to carry it on. The most lucid accounts are those which show the financial facts of the business, in its earliest stages, in the most ample detail, and in its latest stages in the most complete condensation—so that a man may carry his balance-sheet written on the back of his calling-card. Such accounts are analogous to the "quantities" of the architect or engineer, and have quite as much or more work in them; the one, however, is based on estimate, and the other on accomplished financial facts; and any difference between parallel lines should be easily discernible on comparing the one with the other.—J. D.

[47540.]—**Measuring Flow of Water.**—To ascertain cubic feet of discharge per second, use the following formula:—$5{\cdot}35\, b\,.\, h^{3/2} = Q$. Where b = breadth of weir in feet, and h = height of water above weir in feet. To get the cube of the square root of height ($h^{3/2}$), look in a table of squares and cubes: in the column of squares for the nearest approach to h, and opposite, in the column of cubes, will be the approximate value of $h^{3/2}$. Example: Weir 6in. wide; depth of water over same, 3in. Here $Q = 5{\cdot}35\ ({\cdot}5 \times {\cdot}25^{3/2}) = {\cdot}33$ cubic feet per second = 2 gallons. This is supposing the discharge is from a still pond. See Rankine's Rules and Tables.—Ditton.

[47553.]—**Problem in Dynamics.**—The ball will acquire a velocity = ½v. The following consideration will make this clear, I think. Suppose the monkey to ascend to a height v above E, the point at which they are in equilibrium. The action of gravity will cause it to descend, drawing the rope over the pulley, and consequently raising the ball through v. Both will now be half v above the original point of equilibrium I. But the monkey will have ½v rope hanging below E. Thus, while the monkey has gone over a distance = v, the ball has only risen ½v in the same time.—C. H. Romanes.

[47556.]—**Calculating Sizes and Powers of Boilers.**—In reply to "Learner," 474 is the vol. of steam compared to 1 of water, and it means that 1 cub. ft. of water may be converted into 474 cub. ft. of steam at a pressure of 55lb.; so that having ascertained the quantity of steam required per hour, we can thus find the quantity of water required to produce it; and the boiler must be able to evaporate that quantity. The number corresponding to any pressure may be found in Molesworth, or any similar work, under the head of "Table of the Properties of Saturated Steam."—J. H.

[47562.]—**'Xtraordinary Challenge.**—I have ridden this make now over twelve months, previously having ridden "Timberlake," "Ariel," "D. H. F. Challenge." For safety and ease in mounting and dismounting, it is far beyond the old style, or, rather, the ordinary style. Speed is the same. There are some things you can do on ordinary make but not on 'Xtra., such as riding with hands in your pockets. With 'Xtra. you must keep hold with one hand or over you go. I do not find it any easier to mount hills, nor do I find it easier over rough roads. I may add I am 52 years old. I like the 'Xtra. My son does not, but likes his D. H. F. better.—B. N.

[47563.]—**'Xtraordinary Challenge.**—As one of the oldest riders of the bicycle—being just 80 years of age—and also a frequent user of both the ordinary and 'Xtraordinary machines, I may offer "Undergraduate" an opinion of the merits of the 'Xtraordinary. I began with a 50in. ordinary, but a smashing cropper over the handle warned me to look for something 'xtraordinary to avoid such an occurrence for the future, and I obtained a 52 'Xtraordinary. This I rode for some time with great confidence—alas! somewhat misplaced. Having been from early youth, and, in fact, being still, a first-flight rider with the foxhounds, I early learned the advantage of speed down-hill, and the swift rush through the air is a most enjoyable sensation. Now, this the bicycle affords you in perfection, and I fancied myself secure when on my 'Xtraordinary. There is, however, this disadvantage, when the speed becomes too fast for the feet to be kept on the pedals, the only method of keeping them out of the way of the pedals and levers of the 'Xtraordinary is to lift them above them; but this is a fearful risk, as I found to my cost about a month ago. Being out with a young companion, whose youth and strength enabled him to outride me going uphill, I rejoiced in the nerve and confidence in my machine which enabled me to overtake him ere he reached the bottom on the other side. This went on pleasantly for some time; but on coming to the bottom of a long and steep hill, I allowed my right foot to drop too low, owing to fatigue. The pedal struck it, knocking it into the wires of the wheel, and jamming it against the fork. Away we went—over on the left side first, and then bounding over to the right, the machine clinging to me like a rat-trap, and lying on me at last, of course a perfect smash, and with my foot so fixed in the wires that my companion appeared to me an hour in releasing me (I believe he was five minutes). I was badly knocked about, but no bones broken—the bicycle a perfect smash, and a cart brought it home for me; and I am now careful not to let my machine run away beyond the control of my feet, as unless the rider can hang his feet over the handle, he runs a fearful risk in doing otherwise. Now for the merits of the Xtraordinary—and they are: great safety from croppers, when used with care, as a brick may be ridden over with safety. Great ease in mounting, from the saddle being so much farther back and lower than on a common machine of equal size of wheel. Less jolting experienced in riding over rough roads, as the jolt is shared by both wheels. Any size wheel may be ridden without reference to the length of the rider's leg, as the pedals are made adjustable. Also, I think, an increase of power, from the feet being over the pedals. The disadvantages are: increase of weight, also more friction from the joints of the lever, and more of the weight also being put on the small wheel. But I consider the advantages are greater than the objection, if the machine is to be used for common road-riding. I can get ten miles an hour out of my machine, without any great fatigue, and I do not find much difference in mounting hills with one or other machine, for with either I walk up if at all steep, as the change of motion is pleasant and the fatigue much less. The steering is a little different at first; but this is soon overcome. On a smooth flat road, the common bicycle would have the advantage; but not on roads as they are commonly found to be. I will call the attention of my fellow bicyclists to a little addition I have to the Challenge wrench, as also to the four-holed spanner, neither of which are long enough to enable one to unscrew the nuts of the pedals, after they have been some time in use. This is, to the Challenge wrench, a piece of stout wire ⅜in. diameter, having a twist at the top to hook round the lower end of the wrench, and fall into the square nick at the end, and 6in. long, which will add 5in. to the length of the wrench, and give power enough to unscrew the nuts of pedals. In the four-holed spanner I have another and similar piece of sheet iron, with two bolts at one end, the heads of which fitting into the two smaller holes of the spanner, make that proportionally more powerful, and these pieces being only 6in. long, will go into the tool bag of the bicycle, and be often of great use. Such has been my experience. — PHILIP VALLANCE.

[47570.]—**Bronzing of Cardboard.**—The cards are, I believe, specially prepared with gum or isinglass, to prevent the absorption of the varnish or gold size; when covered with the varnish, they are passed through the powder, just tapped upon the edge to remove surplus until set; afterwards brush over with a hare or rabbit's tail, or foot.—JACK OF ALL TRADES.

[47571.]—**Polishing Bobbin Ends.**—This will be best done with a flat disc of wood in a lathe, covered with felt or stout cloth. Furnish yourself with some thin polishing cake, made of 2 parts of beeswax and 1 of gum sandrac melted together; pour out upon a glazed tile, plate, or marble slab, for use; when your chuck is running, touch the face with a piece of this; then apply your bobbins with both hands as fast as you like. You do not require much of it. If you have convenience, you can run your chuck, or polishing-wheel, horizontal. The least used the better they will polish. Put the compo. in centre, and finish outside.—JACK OF ALL TRADES.

[47572.]—**M.R. Tank Engines.**—The latest class of M.R. tank engines have cylinders 17in. by 24in., and leading and driving-wheels 5ft. 3in. diam. They are similar to the former class of tank-engines numbered 1252-1281, and built by Nelson & Co., 1876, with a few differences. The older class have leading and driving-wheels 5ft. 6in. diam., but the tanks and coal-bunkers of the new class are somewhat larger. Fifteen of the new class, numbered 1532-1546, were built for the local traffic at Manchester and Bradford. These were built at Derby in 1881. Nos. 1547-1561 are for the London traffic, and are now in the course of construction.—METEOR.

[47577.]—**Watch-Cleaning.**—Get a sixpenny bottle of refined benzine, or benzine collas, and pour a portion of it into a saucer or other shallow vessel. Put all the dirty parts of the watch into the benzine, and stir them gently about. Allow them to remain therein for a few minutes, then remove, and allow the spirit to evaporate. That which remains in the saucer may be thrown away or returned to the bottle. Do not mind the disagreeable smell; it will soon pass away. This will cleanse all the parts perfectly from oil, and no fear of rust need be entertained as regards the steel work. The most delicate hairspring may be laid in it without injury. I won't answer for common benzine, though, as it leaves a film upon the bright parts, which may or may not be detrimental. I habitually use the refined, so can speak of it from experience. On no account approach a naked light with it, as it gives off a highly inflammable vapour at a given temperature. Clean the watch in the usual way after this operation. Watch-cases may be cleaned in the same way that silver and gold in general are cleaned—i.e., by plate powders, rouge, common chalk, or whiting. The rims are easily cleaned with a blunt peg, on which is a little moist rouge or chalk. A chamois-leather should be used for the surfaces of the cases, or a buff made of wool and shaped up like a brush, the wool taking the place of bristles.—ALFOJOE.

[47579.]—**Deal Made to Imitate Maple.**—Your job will want well rubbing down; then give it one coat of pale priming—i.e., about 1 of red-lead to 6 of white, mixed with very little oil and plenty of turps: when well dry, give it a coat of body-colour, pale or warm, as you like it, with raw sienna and white-lead; when thoroughly dry, rub well down, and give another coat; when dry, wash with damp sponge and stale porter, into which put a little pumice-stone powder and ox-gall, and when dry, proceed to figure with a sponge raw sienna and beer; when dry, varnish with some good pale oil varnish.—JACK OF ALL TRADES.

[47580.]—**Nightmare.**—One source of nightmare lies in overloading the stomach late at night with hardly digested food, such as pork, pastry, crab, lobster, &c. I well remember having a distinct impression of a havy tree lying across my chest, which subsequent pondering resolved into pastry, taken at supper previously. But the most pregnant cause of the distress is lying on the back. This position in old people obstructs the breathing, goes on to snoring, and then (to persons subject to it) nightmare. And if "Nightmare" makes inquiry, he will probably find that his relative is in that position when the unpleasant occurrence happens. It is difficult to suggest a means of prevention; but, perhaps, some different arrangement of bedding, or a lump fastened on to the sleeper's back, might be of service.—FRED. DAVIS.

[47581.]—**Large Lathe.**—I believe the largest lathe in the world is at the St. Chamond Steel-works, in the Department of the Loire, France. It was constructed for turning 100-ton guns, by Sir Joseph Whitworth and Co., of Manchester, about two years ago. Perhaps some of our Manchester friends could give us some of the leading dimensions of this excellent workshop tool?—FITTER.

[47582.]—**Casting Small Articles.**—If your moulds are bright, blacken them, and you may keep them hot—about 180 or 200°—without the metal adhering to them. There are various alloys called Britannia metal, consisting of about 100 tin with from 4 to 8 per cent. of bismuth and antimony, and from 1 to 2 per cent. of copper, according to what it is wanted for.—JACK OF ALL TRADES.

[47583.]—**Glazing Sanitary Pipes.**—This is done with salt thrown into the fire when the firing is very near completed.—JACK OF ALL TRADES.

[47587.]—**Cross-Bow.** — Lancewood.—JACK OF ALL TRADES.

[47587.]—**Cross-Bow.**—The best wood is English yew, then lancewood; but better than either is steel, far more elastic and powerful.—FRED. DAVIS.

[47588.]—**Moss-Covered Steps.**—Clean down occasionally with water made acid with spirits of salts, and, in intervals, use hard broom to sweep. If whiteness is no object, flood them down with thin wash of Portland cement.—NUN. DOR.

[47588.]—**Moss-Covered Steps.**—Paint them over with a solution of potash, say at night time, and wash off with water next morning. If it is done carefully, and using a strong solution, you will not be troubled with the moss or green on your steps again this summer.—J. P., Aigburth.

[47591.]—**Indiarubber.**—Treat it to a vapour-bath of bisulphide of carbon, and masticate it. Some dissolved in the same will give you a cement.—JACK OF ALL TRADES.

[47595.]—**Copper-Plate.**—If the edges of the engraving are worn round and some fine lines very near obliterated, it is not of much account. It can be raised from the back side and recut, and deep scratches taken out by the same process.—JACK OF ALL TRADES.

[47595.]—**Copper-Plate.**—Perhaps your plate is not worn at all. Heat the plate, and clean out with turpentine, as the ink gets clogged sometimes. Printing ink won't do. You must use copper-plate ink, not too thin; don't rub much. Hand-pressure is not heavy enough; it must be passed through two rollers. Scratches can be taken out by burnishing with a steel burnisher, which must be well polished, as the plate is very easily scratched. After you burnish it, polish with charcoal and oil, then rottenstone and oil; or any engraver will do it cheaply for you.—R. MCBEAN, Edinburgh.

[47600.] —**Deodorising Paraffin.** — Without apparently knowing it, you are asking for something that would be of considerable commercial value. Many attempts have been made to disguise the odour of paraffin oil, with, however, only limited success; but such as they are, you will find them described in back numbers of the "E. M." There are several oils in the market which have but a slight odour, but they are too expensive for lubricating purposes. As you are "only" an "Amateur Mechanic," and presumably do not use many quarts of oil in a year, suppose you try almond.—G. H.

[47603.]—**Plating with Gold Inside and Silver Outside.**—Fill the cup with the gold solution, hot, attach the wire to the handle, and hang the piece of gold in the centre; do this after electro-plating the cup with silver.—J. P.

[47603.]—**Plating with Gold Inside and Silver Outside.**—No great difficulty in that. Gold solution inside, with gold anode; standing in silver bath, with silver anode. I guess you do not want to know how to couple them up.—JACK OF ALL TRADES.

[47603.]—**Plating with Gold Inside and Silver Outside.**—The cup must first be plated with silver inside and outside. When that is accomplished fill the cup with gold solution, and suspend the gold anode in it; twist the other wire of the battery round the stem of the cup; you will so gild the inside. It is as well to have the outside of the cup dry, so that the solution will not creep over the edge.—OS.

[47603.]—**Parcel Plating Gold and Silver.**—First electro-plate the whole cup, outside and in, with silver. Then dry, and carefully fill cup with gold solution, and reduce again. N.B.—The gold reduces very rapidly, one touch sufficing to give a deposit.—FRED. DAVIS.

[47606.]—**Brake Power on Goods Trains.**—About six years ago some interesting experiments were made on the L. and N. W. Railway with a goods engine, No. 1629, with a load of 45 waggons of coal. The result elicited the fact that one tender and one van hand-brake had but little control over such a train if on a gradient of any severity. The Midland Company also made some experiments, the results of which your correspondent will find in a book published by the company entitled "Midland Railway Train Brake experiments," in which every detail of all experiments relating to brake trials is fully set forth and ably explained. The said book also deals fully with the experiments made relating to the Kildwick Accident, in which, it will be remembered, an unfortunate driver was actually found guilty of manslaughter upon the statement that he had brake-power at his command wherewith to stop in 400 yards; whereas, when engines 815 and 892 were tried, it was found that the poor driver had not the necessary power in his hands.—A. S. H.

[47607.]—**Kitson's Steam Brake.**—I am able to state positively that Kitson's steam brake was not tried at Newark, for I was there, and if your correspondent will refer to Mr. Stretton's able and useful little book, which is now before me, he will find the following, page 8:—"The Midland company fitted an engine and tender with Kitson's steam brake, and the programme previously issued contained it in the list; but this engine did not arrive at the place of trial." As the engine was not tried, of course the official description does not appear in the report, and therefore, I am unable to give any reply to the part of the question relating to the water-jet. Two hydraulic brakes were tried—Barker's fitted to 135 engine, and Clarke's fitted to 891; but I am unable to remember or find in my notes any mention of a water-jet.—A. S. H.

[47611.]—**Silicate Cement.**—Rather a queer subject to deal with. If your varnish is too full of gum, a skin will form over it and prevent it drying. Precipitated silicate from silicate of soda, with salt or hydrochloric acid, well washed and fired, the highest rectified spirit, or better, naphtha, 1 pint, shellac 1oz. The shellac, when dissolved, should be allowed to settle perfectly clear, and poured off for use.—JACK OF ALL TRADES.

[47612.]—**Re-whitening Stucco Figures.**—Milk of lime, then hot lime-wash.—JACK OF ALL TRADES.

[47618.]—**Bills of Sale.**—How is it that no amount of exposure seems to prevent people from dealing with loan office swindling and bills of sales? The ruin of victims, the denunciations of judges, the adjurations of public writers, all, all, seem to have little effect. A new debate in Parliament upon bills of sale cannot repress the mania! The blood-sucking scoundrels of these loan offices are, with very few exceptions, *ad hostes homines*—enemies to the human race. The present immunity from legal consequences is on account of the state of the law, enabling them to scandalise English civilisation up to, or down to, madness. I could nearly fill our English Mechanic with examples, both from my own reading, and personal knowledge, that would disgrace the lowest race of savages in cruelty. Look at the case of the poor widow the other week, who, in the affliction of a recently buried husband, and a house full of young orphan children, applied—alas! in vain—to the magistrate to save her furniture against a bill of sale for £1 15s., the remains of usurious interest which the loan vampires were about to put into force, which bill her deceased husband had unfortunately signed just before his fatal illness. I never was in the clutches of these infernal fiends myself, nor anyone belonging to me; but my hatred arises solely from personal knowledge and what I have read. Several of the newspapers are powerful agents on the loan office side for the sake of the standing advertisements, as the 300 per cent. scoundrels can afford to pay well and promptly. In one very shocking case a prominent daily paper wrote a strong leader in confirmation of the exposure and severe indignation expressed by the judge about the doings of a loan manager that had been tried before him. Yet, notwithstanding all this, that very newspaper had the advertisement day by day as usual, and, although the inconsistency of denouncing plundering rascality and taking money for advertising it was pointed out, yet that same loan-office, dirty and foul as it was shown to be in court, is still kept in its place in the advertising columns of the same journal! Newspapers, as a rule, preserve some link of morality between their writing or teaching, and their advertising, whilst some do not.—A Templar.

[47622.]—**Bisulphide Prism.**—A bottle 2½in. diameter, with two sides ground to 60° perfectly flat, is the best. Tin will not do; shellac will last some time to hold the plates on, or marine glue is better. Ordinary plate glass is perfectly useless to use with a telescope; by accident two plates good enough may be got, but optically worked parallel plates are the only sure things. Far better to get two prisms of flint-glass sp. gr. 3·84 1in. high, refracting angle 60°; this will show D clearly double with a power of 12 on the telescope; that is if the prisms are fairly good.—Prismatique.

[47625.]—**Clock Dial.**—If you live in London, take your dial to a Clerkenwell trader, and it will be perfectly restored for you for about 1s. 6d. or 2s. I venture to say you will not succeed in making a pleasing job of it yourself. Dial-painting is very different work to ordinary painting. The paint is of a special kind, and is, I believe, in most instances floated on; not put on with a brush, the plate being made hot before the paint is applied. The flat smooth appearance, so much like enamel, could not be got perfectly with a brush, as you will find if you try it. Of course I am now speaking of well-finished dials. If you intend to do the whole job yourself, scour the old paint off smooth with pumice, wash and wipe dry, and prime with a preliminary coat of paint, which allow to dry thoroughly before the final one is applied. The paint will adhere better if the plate, or dial, as I should have called it, is slightly heated, avoiding any touching of the face with the fingers. Previously trace the position of the figures on thin paper. When the dial is properly prepared and dry, lay the tracing upon it in position, after having rubbed a little charcoal on the back. Trace the figures over with a point. This will give a faint outline upon the newly-painted dial. Then finish up the figures with a fine camel-hair brush, and japan black, or other black paint.—Alfojoe.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

47038.	Mustel Organs, p. 293.
47040.	Filmography, 293.
47041.	Rain-spots on Green Velvet, 293.
47044.	Gramme Dynamo, 293.
47046.	Telephone Experiment, 293.
47063.	Hydraulic Motor, 293.
47072.	Zinc from Spelter Fumes, 293.
47074.	Steam Whistle, 294.
47076.	Bunsen Battery, 294.
47078.	G.W. Engines, 294.
47084.	Ebonite Coefficient of Expansion, 294.

47304.	Division Plate, p. 388.
47306.	Slide-Rests, 388.

QUERIES.

[47629.]—**Compensating Lever.**—Will Mr. Stretton, or some of your railway readers, explain the arrangement of "compensating lever" used on the point rods? In Barry's book on Railway Appliances, a diagram is given showing a short lever pivoted at its centre and connected by short links at its ends to the rods. But it is so shown that a pull on one rod would move the other in the reverse direction; whereas the lever should be so arranged as while compensating for expansion or contraction, it so unites the two rods, that they both move in one direction when pulled by the point lever. I can understand if there are to be two of these compensating levers between the points and the lever; but the book does not say so.—A Railway Student.

[47630.]—**Brakes.**—Your interesting notice of Mr. Reynolds's book (on p. 439) has recalled to my mind a question which I raised a year or so ago in another mechanical paper, and that is, "Whether a brake is most effective when it entirely stops the wheel, or when it is so applied as to be just short of stopping it?" I think I was told the former, although I am not quite sure on the point, was the best. However, my opinion is that the latter is the most effective; and this is confirmed by a guard whom I have questioned. Mr. Reynolds would appear also to endorse it; but the muddled sentence in his book unfortunately leaves me in doubt still. Mr. Stretton will doubtless be kind enough to relieve me of it.—H. Stooke.

[47631.]—**Polarity.**—Will any of your correspondents kindly give a consistent definition of polarity in electricity? Something, in fact, more consistent than "a certain kind of two-endedness."—J. H. W.

[47632.]—**Model Loom.**—I am anxious to learn tweed designing, and think that a small model loom would be a great assistance. Could any of your readers give me instructions how to make one?—Diana.

[47633.]—**Bird-Stuffing.**—I have a quantity of foreign bird-skins to stuff. Will any correspondent tell me the best way to relax them? When I relax them in damp sand they either come out not soft enough or rotten, and when set up they always look shrivelled and not of good shape. I can set a skin up with the body new taken out very fair, but its softening the old skins that puzzles me.—Bobolink.

[47634.]—**Organ Stops.**—Thanks to "H. and S. B." for reply to my last query. I should have said that the pipe lips in the stop referred to are inverted. In that case, should there be ears on the pipes, and will "H. and S. B." kindly tell me if the above is the usual form of the stop, as I am uncertain about it?—L. G.

[47635.]—**Home Study—Universal Political Geography and Physical Geography.**—Will any one well acquainted with the subjects kindly sketch out a course by the study of which (with a moderate outlay for books and atlas, &c.) I can obtain a fair knowledge of them?—Anglo-Indian.

[47636.]—**Gas-engine.**—I have a 3 man-power "Sunlight" gas-engine, but cannot get it to work, and am told that the engine is useless Can any of our readers who have bought from "Sunlight," give me any information (I have written him, but letter was returned) about it? Is the engine any use? If it is, I shall be glad to correspond with any one who can assist me, and if not, I should like to know, as I have already spent a considerable sum over it without any result.—Dun Browne.

[47637.]—**Locomotive.**—I would be much obliged if any reader would tell what became of the express locomotive, built by Messrs. Sharp, Stewart and Co., of Manchester, and exhibited by them at the Paris Exhibition of 1878?—Crank Pin.

[47638.]—**Painting.**—I have a large signboard to paint and letter with gold leaf. I can very well do the lettering, but how must the board be prepared? I find that many blacks in time discolour and tarnish the gold. What is the best black, how mixed, and how many coats on new board, and how to proceed with an old board? Would it be better varnished when finished?—Amature Brush.

[47639.]—**Legal.**—To Mr. Wetherfield.—Will you kindly say if it is necessary to have a gun license for the purpose of killing birds destroying fruit, such as currants, &c., in a garden?—B. J.

[47640.]—**Unipolar Induction.**—In the "Minutes of Proceedings of the Institution of Civil Engineers," Vol. LVIII., p. 430, under the head of "Unipolar Induction," by E. Edlund, it is stated that a metallic cylinder with a steel magnet inside is made to rotate by connecting the current from a battery to different parts of the cylinder. Would some of your numerous readers say by what force this cylinder is made to rotate? What metal the cylinder should be made of, what strength of battery is required in Bunsen elements, how the wires from the battery are connected to the cylinder, and what should be the shape of the steel magnet?—X. Y. Z.

[47641.]—**Dandelion and Rhubarb Wines.**—Can any reader inform me how to make dandelion and also rhubarb wine?—Inquirer.

[47642.]—**Silicate of Soda.**—Can any of your readers inform me if silicate of soda will of itself, used as a paint, keep damp out of outside walls, or if mixed with anything, with what?—Inquirer.

[47643.]—**Spiders.**—To Sir John Lubbock.—How do they manage to fly or float? Last Sunday, at noon, in church, I saw a very small blackish spider running up on the shoulder and white straw hat of a lady, and being unable to proceed higher, at last went to the edge of the hat, span a thread about an inch long, hung on it, then worked for a short while, and flew off over my head. It seemed to float like a balloon, its legs half-stretched and bent and motionless. I should have liked to follow it with my eyes, but would not look round amongst so many people.—H. F. L. Meyer.

[47644.]—**Legal.**—Will Mr. Wetherfield kindly give me his advice on the following: I take a business house and sign usual agreement for yearly tenancy, with quarterly rent payments, and six months' previous notice to quit (terminating at Christmas) at £80 per year; two years later the landlord raises rent to £100, without any further agreement. The landlord dies (having only life interest in house), I continue to pay rent to successor of business; presently the trustees (the vendors) put the house up by auction, without giving me any notice whatever of the sale. The chief condition of sale is that "the purchaser shall, on the completion of his purchase, enter into possession or into receipt of the rents and profits of the premises, as from the 25th day of March, 1882, &c." The purchaser soon after sale, serves me with notice to quit, or in default, double rent, &c. Now the question is—(1) Was it not the duty of vendors to give me six months' notice to quit, for the purpose of sale. (2) Has the purchaser any legal right to serve me with notice to quit, seeing that I have received no notice from vendors who *was* the purchaser, or who is entitled to rent? (3) Can I claim compensation for improvement to house and business, having spent £200 upon sinking floors, new doors and windows, chimney pieces, &c., and having given £300 for goodwill, &c.?—Ignoramus.

[47645.]—**Measuring Railway Curves.**—Will some friend be pleased to give me a simple authentic rule to find the radii of curves (after they are laid down) with chord and versed sine.—Ipse Dixit.

[47646.]—**Artificial Milk.**—Twelve months ago I made inquiry through your journal if any one could give me Dr. Frankland's recipe for making imitation human milk from cows' milk. Mr. L. W. Stansell, on the 29th of July, 1881, replied in the "E.M." that the recipe was to be found in Dr. Frankland's "Chemical Researches." I have not been able to get a sight of that work, and shall feel greatly obliged to you or any of your subscribers if you or they would send the recipe to the "E.M." I think it would be appreciated by many besides—W. A. Hunter.

[47647.]—**Boiler.**—Will some reader of the "E.M." give me particulars of a boiler capable of driving a pair of 1in. stroke cylinders, in a boat 4ft. long, beam 6in.?—J. R. G.

[47648.]—**A Cabbage-Broccoli.**—The English Mechanic is, I know, a favourite journal with my brother gardeners. Can any of these tell me anything about a reported achievement of Mr. R. Gilbert, head gardener to the Marquis of Exeter, who, as it is reported, has, with the assistance of Dame Nature, achieved success in the production of a new vegetable? He describes it as a direct cross between a cabbage and a broccoli, and he has named it Chou de Burghley, after the garden in which he works. The new vegetable is said to be a success admirably adapted to the kitchen garden, and a great acquisition to the present limited number of winter vegetables, being very hardy and totally unaffected by the most severe frost.—W. T. B.

[47649.]—**Legal.**—To Mr. Wetherfield.—I should feel obliged if you would answer the following query: About 13 months since I employed a solicitor to collect a debt; a short time after he told me he had issued a county court summons and it would be heard in about a month, but from then till now he has kept finding some excuse for the delay—he says he will push it on, but I am inclined to think he has not taken any proceedings at all; what is the best and cheapest way of compelling him to do something in the matter? Would the Law Institution do anything if I wrote them all particulars? He has some money of mine in hand, enough for five summonses of this amount? If my debtor is not now in a position to pay would solicitor be liable to me?—T. M. B.

[47650.]—**Annual Loss of Life by Fire.**—Will any reader of the "E.M." kindly give an approximate estimate of lives lost and value of property destroyed annually by fire in England.—Fire.

[47651.]—**Examination of Malt.**—To E. S. Beaven.—Thanks for reply and kind offer to give further information. Will you please inform me how, after having prepared a solution as you directed, to find with Fehling's solution the amount of grape-sugar and dextrine present, and then calculating upon the amount present, what heats should be employed in mashing such malt in order to produce mild beers for immediate consumption, when mashing 5qrs. malt with 9 barrels liquor, running under 2½ barrels and sparging the remainder?—Phœnix.

[47652.]—**Faure Accumulator.**—Would Mr. Lancaster or some other subscriber kindly inform me how far the plates of a Faure accumulator should be apart. I have placed them ⅓ to ½in. apart, but I think they are perhaps too near; but I cannot find out whether that is the cause of my failure or not. I made one cell with 8 lead plates, 4in. by 6in., coated with red-lead and wrapped in flannel very closely and placed in acidulated water, and then charged the cell for about half an hour with a dynamo machine used for plating, and then discharged it by letting it drive an electro-motor, charging and discharging it several times in opposite directions until it had been charged altogether 7 or 8 hours. It then gave out a current which heated one inch of No. 36 iron wire red hot. But although freshly charged overnight, not the least indication of a current could be discovered in the morning after it was charged. I have tried various strengths of acid, but with the same result. Possibly you could explain some accumulator simpler in construction than the Faure.—W. Barton.

[47653.]—**Oiling Fish-lines.**—Will some of the readers of "ours" be good enough to say how the better qualities of silk fishing lines are oiled? I notice they have mostly a lemon colour with shining surface and are beautifully got up. I should be glad to know the modus operandi to be pursued by an amateur, as I am desirous of preparing my own.—Pecheur.

[47654.]—**Printing.**—"A Practical Printer" (20326, page 477) gives much valuable information; would be kindly contribute a little more upon colour printing? How are red and blue words, sentences, or whole lines interspersed in printing among ordinary black type? Perhaps he can name some work which fully explains the method of putting these coloured passages in?—J. D.

[47655.]—**Cotton.**—A friend of mine has made a purchase of a considerable amount of calico for dyeing purposes, which at the time of purchase was represented as pure cotton; but we have been told that it contains a considerable amount of jute, which is, I believe, an inferior class of material whose affinity is also less for colouring matter. How may we ascertain for ourselves the presence of this fraud?—W. Binns.

[47656.]—**Woollen and Worsted.**—What are the characters which distinguish the above? Upon what depends their value in the raw and manufactured state?—W. Binns.

[47657.]—**Railway Signal-boxes v. Thunderstorms.**—In case of a severe thunderstorm are the electric instruments in a signal-box considered a source of safety or danger to the signalman there employed?—A. S. H.

[47658.]—**The Becker Brake.**—Is the Becker brake (a German invention, I believe) in use in this country, if so, where, and what are its leading characteristics?—A. S. H.

[47659.]—**Tricycle.**—I have geared my 44in. machine down to a 25, which makes it very powerful in hill climbing, but the spokes often break on straining up hills on the driving side, though they all seem properly tight; spokes No. 10 wire direct, screwed into 4in. hubs, with $4\frac{1}{2}$ gear wheel, 60 spokes in wheels. Will someone of "ours" kindly explain the reason of the breakages? They always break off at the top of the screw, which makes it a difficult job to drill out.—Ex.

[47660.]—**Metallophones.**—I have now several choice pupils receiving instruction on the pianoforte and harmonium. Experience taught that there is great advantage in the lessons given at the same time to several pupils, not only as to economy of time, but, above all, as rapidity of training. I would extend this system to more pupils, but cannot buy half a dozen costly pianofortes. I fancied that two or three octaves metallophones might be made somewhere at a moderate price, and replace the pianoforte for common practice. I vainly inquired here and found nothing but playthings, without any solidity, and having black keys only painted on the white ones, therefore I have nothing better than to apply again to the kindness of the Editor to get, if possible, one information more through this valuable paper.—P. Robin, Cempuis (Oise), France.

[47661.]—**De-alcoholised Wine.**—In a recent pamphlet entitled, "A Great Natural Restorative," the writer states how he cured himself and others, after all other means had entirely failed, of a complication of diseases by the use of de-alcoholised wine. His directions for preparing the purified wine are, in substance, these:—"Select either of the light, inexpensive, natural wines, such as claret, Bordeaux, medoc, or the like (the heavy wines not being so suitable), boil it rapidly with the lid of the saucepan on for 10 or 12 minutes until it becomes perfectly spiritless, which can be ascertained by applying a light to the vapour, which will cease to burn when all the alcohol is driven off." The writer states that he is "not chemist enough to account scientifically for the wine's wonderful transformation." He only knows from experience that it has been converted into a wonderful healing agent. Now, will some competent reader of the "E. M." kindly say if the above is a trustworthy process for the entire extraction of the alcohol, and, if not, what effectual method could be adopted for that purpose? Would not boiling it in an open vessel facilitate the escape of the alcohol? Also, would it not be preferable to use wine which had not undergone the process of fermentation? Does not the fermentation neutralise or destroy some of the properties of the grape which constitute its restorative and healing effect on the human system?—G. T.

[47662.]—**Circulating Decimals.**—What is the rule determining the maximum number of digits in the circulating period of the decimal corresponding to a vulgar fraction whose denominator is p^n, p being a prime number? When the denominator is the product of the different primes p, q, r . . . . is not the maximum number of digits = L. C. M. of $p-1, q-1, r-1$ . . . ? Is not this contradictory to a statement which I find in the "Mathematical" column of an old *Educational Times*, to the effect that if we multiply a circulating decimal having m figures in its period by another having n figures in its period, the product will be a circulate having $9mn$ figures in its period, when m is prime to n. I have to thank "S. J." for his obliging offer in connection with my former query on this subject, but I live so far from town as to make it impossible for me to inspect his copy of Clarke's "Rationale." Does he know anything of Clarke's "Doctrine of Chances"? Is it the same Clarke?—A. J. Smith.

[47663.]—**Joints and Crossings.**—Is there any system or plan in use which is considered an improvement on the present joints and crossings? Of course, it is known that the wheels of a train have to pass over a space of about 2in. wide in every crossing. The result is jarring, wear and tear, and now and then trains off the line. The present crossing is put up with because a better substitute does not come out; but what we want is some means by which joints and crossings should be continuous rails without any space to jump over. Another objection to the present plan is that in consequence of a crossing a junction or a curve cannot possibly be given the proper amount of super-elevation of the outer rail. This absence of elevation has caused many accidents—for instance, had there been no fixed point for the engine wheel for No. 813 to have struck at Werrington Junction the fearful accident could not have happened. Only last week I witnessed a number of waggons leave the line in consequence of a slightly defective crossing, which makes me ask if there is any better system invented.—A. S. H.

[47664.]—**Brake Failures.**—I should be much obliged if a correspondent will clear up a discussion now existing as to what continuous brake it was which recently failed at Bedford Station, M.R., when engine 823 and an express train completely ran past the platform, as there is considerable controversy on the subject.—A. S. H.

[47665.]—**Government Inspector of Mines.**—Will some correspondent kindly say what is the nature of the examination to be passed for obtainining this appointment, and if there is any difference in the examinations for metalliferous or coal-mining inspectors?—Miner.

[47666.]—**Construction of Maps.**—Can anyone favour me with a proof of the law that any map can be painted with not more than four colours, no matter how many the divisions be? I can find no allusion to the law in Hughes' book; see answer to query 46902.—A. J. Smith.

[47667.]—**Partnership.**—To Mr. Wetherfield.—A. and B. wish to carry on business on the same premises. There is no incongruity between their trades, but yet they are quite distinct businesses. They have thought of entering into partnership, each to have the entire control of his own branch of the trade, be responsible only for his own debts, and get all the profits of his own branch. They wish, in fact, neither to gain any profit nor take on any responsibility for the other. The partner who is to live on the premises takes on himself the rent and taxes, and the other common expenses, such as advertising, &c., to be equally divided between both. Could such an agreement be legally drawn up? I expect while the deed of partnership may specify the arrangement about the management and the profits, &c., each must become responsible for the other's debts. In drawing up such an agreement, would it be necessary to get an attorney to do it? If so, what would be his probable charge? What would the stamp cost? Is the law regarding these matters, and also regarding leases, administrations, legacy duty, &c., exactly the same in Ireland as it is in England.—Shan Sholus.

[47668.]—**Lease.**—To Mr. Wetherfield.—What would be the legal cost of getting a 31 years' lease of a house at £26 a year rent, drawn up? Could a covenant be inserted in it, forfeiting it if it left the person's possession to whom it was granted? If so, would such a clause prevent money being borrowed from a building society on it as security, in order to alter the house and put it in thorough repair?—such repairs and alterations being permanent and necessary improvements.—Shan Sholns.

[47669.]—**Grapes.**—I have a small glass-house with several vine trees; one of them is sweet-water grape, and as fruit ripens nearly every one of them bursts open. I should be glad if any one could instruct me if there is any way to prevent their continuing, or is it the wrong sort of fruit tree to be in a house?—Grape Amature.

[47670.]—**Study of Electricity.**—To "Sigma."—What instruments do you recommend as best suited to a student entering on the practical study of electricity, more particularly with reference to the electric light? Any hints as to the best plan of study and the making of the required instruments will much oblige—Phosphorus.

[47671.]—**Institute of Chemistry Exams.**—I am desirous of sitting for the practical examination of the "Institute of Chemistry." Before doing so it is necessary to hold the advanced certificates of the Science and Art Department in Chemistry, Electricity, &c. Can I sit for the advanced examinations in these subjects at once, or is it necessary to pass the elementary examinations in the same subjects previously? If so, can the elementary and advanced certificates be both obtained next May?—Old Subscriber.

[47672.]—**Limelight.**—Will some kind reader give me instructions how to make a cheap and powerful limelight for illuminating in the open air, how to make the burners, the retort, and whether the bags used in a barm press by brewers would answer?—Gasfitter.

[47673.]—**Electric Lighting.**—Can any readers of the "E.M," recommend a good "arc" lamp of small power, say about 200 candle-power, so that 2 or 3 lamps per h.p. of engine may be used? The "Lampe Soleil" or "Sun Lamp" is highly spoken of in prospectus, but I cannot find any reliable information as to its practical working.—D.

[47674.]—**Electrotyping.**—Will Mr. Lancaster or some other of our friends say if they think it possible to deposit copper $\frac{1}{8}$in. thick on the inside of a plaster of Paris cast, with design on the inside (say of a cylinder), and how the cast could be made water-tight so as to make it into the depositing bath, and put anode inside, and have the cast free from air-bubbles? If any of our friends could help it would be a great boon to—E. Bailey.

[47675.]—**Vacuum Gauge.**—To Mr. Lancaster.—Will you kindly give me some information on the following? 1. What is the best form of vacuum gauge for air-pump, and how to make the same? My pump has a small receiver-plate at the end of foot with screw-plug, evidently for the reception of gauge. 2. Can I use a Voss induction maceine to exhibit Gassiot's cascade, aurora borealis, vacuum tubes, &c.?—Air-Pump.

[47676.]—**Magnetic Exploder.**—To Mr. Tolman.—Will you be so kind as to give me full directions how to make a magnetic exploder for firing small fuses? Also directions how to make a machine for depositing about 1oz. of good tough copper on metal surfaces in one hour? Please state the power required to work ditto, and the speed at which it would have to run.—One in a Fix.

[47677.]—**To Unsize Paper.**—I have a number of well-illustrated circulars which are printed on ordinary sized paper, and shall feel very much obliged if anyone can inform me to how unsize them, so that they may be used for blotting-paper.—D'Evlynn.

[47678.]—**Scratched Plate Glass.**—The counter of my shop is fitted with plate-glass cases, the surface of which is so scratched by the constant friction of money on them that it is impossible to see the goods through. Will one of your numerous subscribers kindly inform me if this can be remedied, and by what?—Argyle.

[47679.]—**Induction Coil.**—Will Mr. Tolman kindly send particulars of the coil he mentioned a week or two since, which would go into the waistcoat pocket?—Os.

[47680.]—**Locomotive Boiler.**—To "E. L. P."—Thanks for sketch you sent in the "E. M." of steam dome and starting valve. Should the dome be placed over fire-box or in centre of boiler? Would not seven or eight 1in. tubes be better than the $\frac{5}{8}$in. diameter simply for this reason—When so small in diameter and crowded together should they leak at any time, there is no getting the soldering-iron between them. Would not it be better to have large tubes, and have them placed more apart from each other, so that the soldering-iron could get at edges of tubes? Ought the fire-box and tubes be brazed? How would one large tube through boiler answer, which would be easily got at to repair? Please find my address in this week's Mechanic.—W. H.

[47681.]—**Painting Stove-poles.**—Can anyone recommend a smooth enamel paint which will form a hard smooth coat on the wooden poles which we use for hanging cotton-hanks on to dry in the stoves? Without this, the wood chips and splinters and the yarn is broken thereon.—Mill.

[47682.]—**Electro-Magnetism and Magneto-Electricity.**—Can any reader favour me with a simple explanation of the mode in which, by aid of the principle of conservation of energy, the discovery of Faraday, which forms the basis of magneto-electricity, can be shown to be a necessary consequence of the original discovery of Oersted?—J. H. G.

[47683.]—**To Electricians and Mechanicians.**—I have 30 bichromate cells with windlass, &c., jars $4\frac{1}{8}$ by $2\frac{5}{8}$ by $6\frac{3}{4}$ (inside), carbons and zincs 7 by $3\frac{1}{2}$; also 20 double fluid cells, jars $4\frac{1}{2}$ by $2\frac{1}{2}$ by 7 (inside), porous pots $3\frac{1}{4}$ by $\frac{7}{8}$ by $6\frac{1}{2}$ (inside), carbons and zincs, $2\frac{1}{2}$ by 7. It is my desire to light three or four Swan lamps for about five hours every night, and for this purpose I am willing to purchase additional porous pots, carbons, or zincs, to convert the whole of the above into a suitable battery of 50 cells, for I imagine the outside jars to be practically the same size. The inconstancy of the ordinary bichromate and the expense and trouble of keeping the Bunsen cell working, make them quite out of the question. Yet I notice that when the plates of the former are agitated (as drawn up and let down again) the original strength of the battery seems to return for a short period, so—(1) To counteract polarisation—suppose I were to make the 50 cells into 5 trays of 10 bichromates—could I not use a piece of mechanism, driven by a weight, to raise and lower each set of 10 once in five minutes, so that there would always be 40 cells available for work at one time, and the whole 50 would have been raised and lowered once in every five minutes? Or—(2) Suppose I cut my large plates to the same size as small ones, buy more porous pots, and charge the whole 50 as a double-fluid bichromate battery, or some other, which requires little attention (Daniell's, could I use these to charge some secondary battery, say "Sutton's," during the 19 hours my lamps are not burning? If (1) be feasible, would some kind reader of "ours" design the clockwork for me? I think I could manage the disconnecting part myself. If (2) be practicable, will someone kindly tell me how many accumulators I should require, their cost, &c.? And if both ideas are useless, can anyone suggest anything to help me?—S. H. Salt, 96, Regent's Park-road, N.W.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Aug. 9, and unacknowledged elsewhere:—

R. E. Oakes.—H. King.—South London Machinists' Co.—E. E. Barnard.—W. Blackett.—E. P. Alexander.—A. C. Malley.—Glasgow.—G. Fryer.—Engineer.—Anxious to Know.—E. Martin.—Cremona.—Country Johnny.—A Constant Subscriber.—W. J. Lancaster.—T. H. Delbridge.—A. T.—James Parkinson.—A Constant Reader.—Geo. Revell.—J. H. Huxley.—Cetewayo.

Amateur Astro. (Purely an optical illusion. 70 time 14′ = 16°. Remove a halfpenny 18ft. from your eye, and it will subtend this angle. We do not know what almanac you employ, but the conjunction of Venus and Mars took place at 11 a.m. on August 2nd, at which hour Mars was 5′ South of Venus. Uranus *was* to the North and Westward of Venus at the time you mention, but it is obviously impossible for us to assert definitely that that was what you saw.)—Delta. (You should procure some water from stagnant ditches, and look up the back numbers for many hints on the use of such an instrument.)—Fred. Davis. (Do you really imagine that the device is new?)—A Brakesman. (Should be carried in earthenware or glass. The acid of the fruit attacks the tin.)—One Who would Like to Know. (They can be cut out or removed by the use of caustics, but an ugly scar may be left.)—G. F. (See pp. 535, 607, 621, 622, last volume, and look through the indices.)—W. Walker. (Answered many times—most recently on p. 431.)—H. Graham. (See pp. 97, 120, 141, 167, 240, last volume, and many replies in back volumes.)—Blacksmith. (A pressure of 60lb. actual in a steam boiler is equivalent to a temperature of 307° Fahr. Water boils at a lower temperature on the top of Mont Blanc than it does at the bottom of a coal-mine shaft, because the atmospheric pressure is less.)—J. Mitchell. (We have really no room for weather forecasts clipped from other papers.)—W. F. Denning. (Sorry to have to keep your letter over a week in order to engrave the cut; the Bank Holiday has thrown things a day behind this week, or it could have been done.)—H. Stoke. (We may as well see the finish of "Stonehenge and Sun Worship" before inserting. How much more is it likely to make?)—J. B. (If you do not take proper medical advice and wear a suitable truss, the inconvenience mentioned may cause you serious injury. No amateur doctoring is likely to help you.)—A Tenant. (You have taken your house on a yearly tenancy, and you are bound to give half a year's notice, terminating at the time of year you took the house; consequently, if you give notice at Michaelmas you can leave at Lady Day, 1883.)—Detector. (We are in no way responsible for advertisers' statements, and could not attempt to verify them.)—Candidate. (You would have to trust to the good faith of any one to whom you confided the details of your invention before you had secured protection for it.)—Steamy Windows. (Must either be thoroughly ventilated or else made nearly air-tight inside, with the lamps outside. Ventilation is the best remedy.)—A Young Electrician. (Your question has been frequently answered. See p. 457, for instance.)—B. N. (Leave well alone. If so excessive as to become really weakening, consult a medical man, as personal examination would then be necessary.)—A. B. C. (You have nothing to do but to fry it in oil, taking care that the oil is in sufficient quantity for the fish to "swim" in it. Use nothing but dry flour on the pieces. Almost all kinds, but white fish preferably.)—J. L. (Practically, yes; but at the moment when just escaping from the gun it moves quicker than at any other time.)—Electrical. (Instructions have been given many times. Make the machine described on p. 179, No. 840.)—H. S., Ashford. (Messrs. W. H. and H. Le May, the factors who sold the pocket, inform us that the price mentioned in the *Echo* and the other paper was quite correct, and they add that this is the worst year for blight ever known. £50 per cwt. is certainly a very long price for hops.)—Wm. Cannon. (Any good optician will fit you with glasses to correct your unequal sight. Queries as to prices, &c., should be put privately to Mr. Lancaster and other makers who advertise in these pages. There is no book that we know of on the subject you mention, but any amount of information in our own back vols. The last query we do not understand, but will endeavour to do so if you put it more plainly.)

CHESS.

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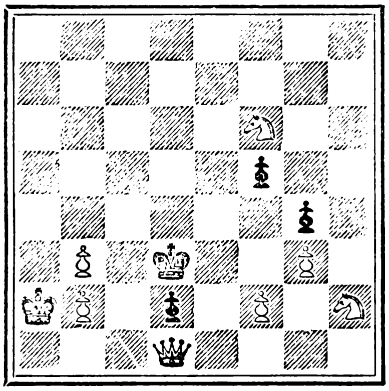
All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden. W.C.

PROBLEM DCCLXXI.—By J. P. Taylor.

Black.

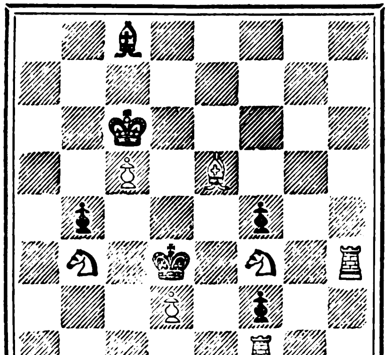


White.

White to play and mate in two moves.

PROBLEM DCCLXXII.—By F. Arthur Hill.

Black.



White.

White to play and mate in two moves.

Solution to 767.

White.	*Black.*
1. Kt to K 2	1. P to Q 6
2. R to Q sq.	2. P to Q 7
3. Kt to Q B sq.	3. P takes Kt
4. R mates.	

Solution to 768.

White.	*Black.*
1. Kt to Q Kt 5	1. Anything
2. Q, Kt or P mates.	

NOTICES TO CORRESPONDENTS.

Correct Solutions to 768, by Celsus and Schmucke; to 766 and 767 by Celsus.

Celsus.—We think you are wrong about 765. How do you mate if $1.\ \frac{\qquad}{\text{B to K B 3}}$ $2.\ \frac{\text{K takes P}}{\text{B to Q 2}}$?

H. F. L. Meyer.—Many thanks for the problems, which are very acceptable.

Game played by Correspondence between E. J. Line (Isleworth), and W. Mead (Brighton).

(Evans Gambit).

White (Line).	*Black* (Mead).
1. P to K 4	1. P to K 4
2. Kt to K B 3	2. Kt to Q B 3
3. B to Q B 4	3. B to Q B 4
4. P to Q Kt 4	4. B takes P
5. P to Q B 3	5. B to Q R 4
6. Castles	6. Kt to B 3
7. P to Q 4	7. Castles
8. P takes K P	8. K Kt takes P
9. Q to Q 3 (a)	9. P to Q 4 (b)
10. B to K 3 (c)	10. B to K B 4
11. B takes P	11. Kt takes Q B P
12. Q takes B	12. Kt takes B
13. Kt to Kt 5	13. P to K Kt 3
14. Q to K R 3	14. P to K R 4
15. P to K Kt 4 (e)	15. Kt takes B
16. Q takes Kt	16. B to Kt 3
17. Q to K B 4	17. Q to Q 5
18. Kt to K 4	18. Q takes K P (f)
19. Q takes Q	19. Kt takes Q
20. Q Kt to Q 2 (g)	20. Kt takes P
21. Kt to Q B 4	21. B to Q 5
22. R to B sq	22. K R to K sq
23. K R to K sq	23. P to K B 4
24. P to K R 3	24. R takes Kt
25. R takes R	25. P takes R
26. P takes Kt	26. P takes P

White resigns.

Notes by W. Mead.

(*a*) Staunton recommends this move, and gives the combination 9 Kt to Q B 4, 10 Q to Q 5, 10 Kt to K 3, 11 B to R 3, 11 R to K sq, 12 R to K sq, and White has a good game. I think Black might very well play 10 P to Q 3, to be followed by 11 B to K 3 in most cases. According to the last edition of the *Handbuch*, 9 B to Q 5 for White is irresistible.

(*b*) This seems a bad move, but it was played to get out of the ordinary lines.

(*c*) Why not B takes P?

(*d*) 11 Kt to Kt 6 would not be good on account of 12 B takes P (ch.), 12 R takes B (best), 13 Q takes Q, 13 Q R takes Q, 14 P takes Kt, &c.

(*e*) Unsound play, as the sequel shows.

(*f*) Black dare not take the R, *e g*, 18 Q takes R, 19 Q Kt to B 3, 19 Q to Kt 7 (if 19 Q takes R (ch.), 20 K takes Q, 20 K to Kt 2, 21 P takes P, and wins; and if 20 B P moves, 21 P takes B P and wins), 20 Q to R 6, and mates in four moves.

(*g*) If 20 P takes P, 20 B to Q 5 wins the exchange or a piece. In any case, Black must win with three Pawns ahead.

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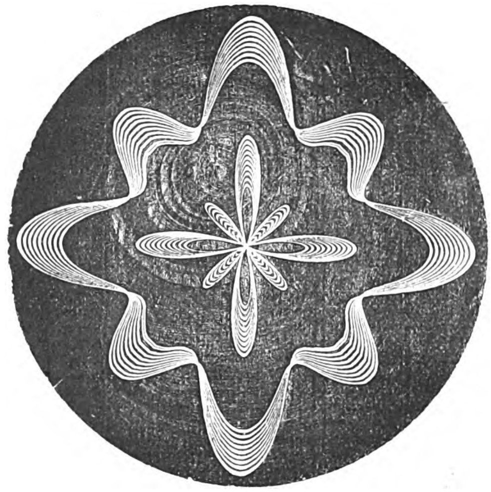
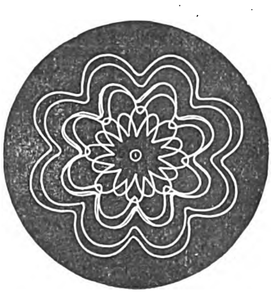
The English Mechanic
AND
WORLD OF SCIENCE AND ART.

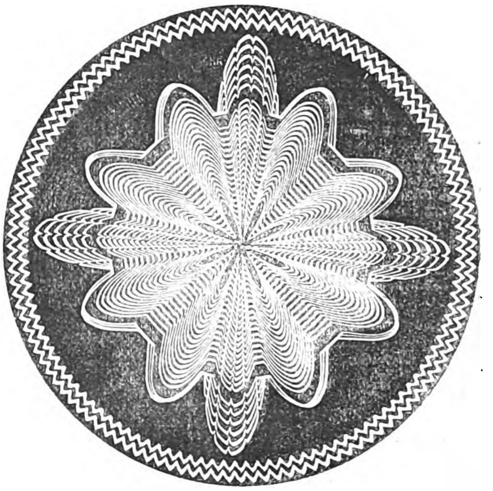
FRIDAY, AUGUST 18, 1882.

THE PRODUCTION OF LOOPED FIGURES BY GEARS.

THIS subject has not apparently received the attention which it deserves, owing, probably, to the fact that it has been chiefly advocated as a means for what an irreverent writer has called scratching patterns. This "scratching," however, when done by able hands produces effects which an artistic eye never fails highly to appreciate; but the work is, nevertheless very tedious, except when done by the aid of that elaborate and ruinously expensive device known as Plant's Geometric Chuck, or by some other apparatus *which does not need the use of a division-plate and index.* These latter appliances call for an amount of patience and resolution which I candidly acknowledge Nature omitted to bestow upon me. To start and stop a lathe some hundreds of times; to tax the eyes and memory by ceaseless peering into a division-plate and remembering the right number of holes to be passed by, is "a caution." Hence, I suspect, originated the geometric and other geared chucks, and also the rose-engine, to say nothing of the geometric slide-rest, rose-cutter, and similar appliances. The self-adjusting index, of which one or two modifications have appeared, only partially meets the difficulty alluded to. The object of the present paper is to call attention to the gear-wheel appliances, by which a repetition of form may be produced; or a repetition of some given motion (as that of a sliding-plate), which, combined with rotary motion, results in the production of waved or looped figures. In the geometric chuck, which is undoubtedly the most perfect of such appliances, the figure is the result of multiplied circular, or cycloidal, or epicycloidal motion, complicated by the eccentricity of certain adjustable slides; while the oval or ellipse chuck and rose-cutter depend for their action upon the motion of a sliding-plate, a given number of times during a single rotation of the mandrel. The rose-engine and geometric-rest carry pattern-plates acting upon the mandrel in the first and on the tool in the second. But in the former, the number of movements to and fro, or oscillations of the mandrel-head, are just so many, and no more, as the undulations on the edge of the rosette; while in the geometric-rest, these oscillations are multiplied by gearing any required number of times. The principle of this rest, therefore, is the same as that of a *geared* rose-engine lathe; and the rest itself is, in all respects, well suited to the intended purpose of cutting many-looped figures. Its cost is, as usual, its one drawback, prohibiting the majority of turners from using it. It does not appear that due attention has been given to the multiplication by gearing of a single simple movement—only one or two amateurs having carried it out in practice. Probably the rocking lathe-head is the best and simplest arrangement to work with, and it is easily fitted up. The lathe-head is mounted on centres, and there is, very generally, a web cast in the bed, just in front of the mandrel-head, which serves to take the centre screw at that part, and if such is not the case, it is easy to insert a plate and secure it by a couple of small bolts. I need not, however, at present enter into details, as any mechanic will readily find means to make so simple an alteration to his lathe. The head and mandrel being thus capable of a to-and-fro or rocking motion, the next consideration is how to produce it. We can put an eccentric disc upon the mandrel with a hoop on it, and carry an eccentric rod to some fixed point behind the lathe, to the wall for instance, which was the fundamental arrangement of the ornamental lathe of the late Mr. Taylor. Or we may put on the mandrel an eccentric disc without any hoop, and let it act against a fixed rubber as the mandrel revolves. Or we may go a step further, and instead of a simple eccentric disc, we may put on the mandrel what is known as a rosette, *i.e.*, a pattern plate of waved outline, or a square plate, or any other. Placing a fixed tool in the slide-rest, faced round to the work, or placing a paper-holding chuck on the mandrel, and a pencil in the slide-rest, we shall find ourselves in possession of an apparatus by which to copy the rosette; but thus far we can do little more. We can make the design large or small, and by certain adjustments of the parts we can somewhat modify the pattern; but we cannot make a rosette of four waves, produce a design of five or six or more, nor can we thereby produce complex-looped figures. But if, as in the geometric rest, we contrive to introduce change-wheels between the rosette and mandrel, we are at once in possession of means for the multiplication to any extent of the oscillations of the lathe-head; and, by giving a suitable ratio to the gears, we can cause a line to travel on and loop itself again and again during a large number of revolutions of the mandrel before returning into itself. Thus the most exquisite looped figures are producible by the simplest means. Then, again, an ordinary rose-engine template, or rosette cannot readily be cut with very deep waves, therefore the undulations are generally rather shallow; but a geared disc, arranged for slow motion, readily produces such a design as that given below. To cut a rosette of such form to work without gears would be a costly matter. The same rosette served for the inside part of the pattern. The second design is also cut in an equally simple way—the pattern plate being, I think, a plain eccentric disc, or a square one—I forget which — but the many undulations are merely the result of the gearing. I have no good block now in my possession of looped figures, although I have some prints of such, showing work that would be taken for that produced by the geometric chuck.*







Now, this kind of lathe merely needs a second mandrel to carry the discs or rosettes. It may be behind where the back-gear is usually fitted, or in front, or above, but so placed as to admit of change-wheels on a radial arm, as in a self-acting lathe. The second mandrel may be carried on centres or in collars. Some kind of fixed bracket fitted to the bed will carry a rubber or rubbers to act on the rosette. An amateur can turn a disc at all events, and set it eccentrically on its mandrel, or fit a cog-wheel; but he will not cut a good rosette, such as those ordinarily used. And there is really no part of this contrivance that ought to be beyond his powers, if he can use fairly the turning tool and file. I do not, however, propose to go into these details of construction in this first paper, but merely to call renewed attention to the capabilities of a lathe of this kind. Nor do I wish to suggest specially this simple and effective mode of working surface patterns. I merely point to it as devoid of the labour and tediousness of eccentric work, and I certainly think it vastly superior in its results. Indeed, nothing but the geometric chuck can excel it in this respect. But I would also suggest the arrangement as a means for producing solid forms. The motion is very slow; it is of necessity of this character, owing to the jar that would otherwise take place at the close of each oscillation, these oscillations being far greater in range than those of a rose-engine. This would allow a revolving cutter—a horizontal one, for instance, driven at speed—to cut out a solid block of the same form as that of the outline of the pattern, much in the way that the Blanchard or copying-

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* I will lend these for inspection.

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lathe does its work. Or, again, an outline of great beauty may be traced on the surface of a block, and the fret-saw and other tools may then be used to cut the material. But I know of no other plan by which such outline could be well and quickly drawn. I can say, however, that these, when pencilled (which is easier, even, than cutting them), make excellent designs in outline for instruction in freehand-drawing, because all the loops and curves are accurate.

It may, probably strike the rose engine-turner that his own machine will allow the rosettes to be shifted on their axis, or used in combination, so as to enable more complex figures to be cut. But so can those of the present lathe—and they can be used in combination by adding other rubbers, and likewise in conjunction with the eccentric chuck on the mandrel. But the cost is that of plain discs, as compared with rosettes. One can be turned, the other must be designed, drawn, and sawn (or cast), and filed up with the utmost accuracy—one of the most difficult operations, and, consequently, most costly. As to the results, they are not to be compared, the complexity and beauty of those produced by gearing being immeasurably superior.

I have never yet been able personally to understand why the plan advocated of producing many looped patterns by starting with what may be called a single-looped disc, has not been practically carried out by lathe-makers. It is most interesting to watch the gradual development of a design thus produced, whether by Plant's chuck, or such an appliance as the geared rose-engine. Putting gears in the ratio of 12 and 7, we first get, I think, 168, after 24 revolutions of the 7, and 14 revolutions of the 12 wheel. Round and round the mandrel goes, but the line looks hopeless—a very entanglement of bewildering loops—till at last it meets, when least expected, and you have a complex and beautiful pattern. You can deepen it, if you like, for the tool will now start again, and retrace its old path without possibility of error. Keeping the same disc, but altering its eccentricity, you get similar results; but the windings are not so deep. Put the pencil or tool the opposite side of the centre, and all the hills become dales, and *vice versa*. There is not one plan so inexpensive, so simple, or so easy to manipulate; but for really best work the gears should be cut, and all well fitted, and the pattern cut by a fine drill driven by the overhead. The revolution of the mandrel should be by a tangent-screw driven by winch handle, or by a slow-motion pulley on the crank-axle. The small block which I must fain leave to the engraver to copy is the result of a simple square rosette geared as before, and I send it merely to show what unexpected results occur in this mode of tracing patterns. I am well aware of the fact that patterns, even at best, are not equal to solid carving, being chiefly used on draughtsmen, and boxes and stands of various articles. Still, they are extensively worked by the eccentric and other chucks and cutters, and form a not unimportant part of legitimate lathe work. They should be clearly cut, and rather deeply, in order to give the best results, and not merely scratched. Their beauty depends, in fact, on a great measure on the lights and shadows of the delicate tracery. Hence, a printed block gives but a poor idea of the appearance of well-cut designs. I think there is no comparison between rose-work and that produced by an eccentric chuck, even by that of Ibbetson; but if gearing is arranged as well, a very simple rosette of the usual kind will produce work of exquisite delicacy and beauty, and instead of several rosettes being required, two or three and one eccentric disc, quite plain on the edge, will afford means for producing endless combinations of waved and looped figures; and whereas a rose-engine will cost, perhaps, at least, £50—and generally is priced at four times that figure—a good lathe for geared apparatus might be made for £20, capable of far finer work.

J. L.

A CROWN-GLASS ACHROMATIC TELESCOPE.—III.

Aperture.

It now remains to inquire what amount of aperture an instrument of given length will bear. Of course, this will depend upon the exactness of the correction of the various aberrations. Now, if, as in the first number, we suppose red and blue rays to emerge, not parallel, but to be brought to the same point, on the principal axis for direct refractive, or on the secondary for oblique, since there is no secondary spectrum the proposed method would seem to be preferable and more exact as far as chromatic aberration is concerned. Moreover, I have calculated a combination in which the spherical abberration is reduced to something less than the two thousandth part of that of the convex lens alone, which I believe is a more exact correction than has been obtained by the other method; so that we may fairly assume that the ratio of the aperture to the focal length of the convex glass may be made at least as great, if not greater, than when flint glass is used.

Most likely the proportion used by Mr. Wray is, upon the whole, the best for glasses in contact, that is an inch of aperture to about 15in. length of telescope, or, as it may be shown, to 6½in. focal length of convex lens. Thus, for instance, suppose that the focal length of the convex lens is 26in., it will bear an aperture of 4in., and the length of the telescope will be 60. But in the example which I have spoken of above, the length of the telescope, that is, the distance from the convex lens at which the image will be formed, I find to be only 44in., so that an instrument of this length will bear at least as large an aperture as an ordinary one of 60. Moreover, 44 or 45in. is the length of an ordinary 3in. instrument, so that the aperture which the proposed instrument will bear, for a given length, is greater than that of the other in the proportion of 4 to 3, or more.

Focal Length of Instrument.

In ordinary cases, where the convex and concave glasses are in contact, the focal length is identical with the actual length; but when they are separated, it is far otherwise, the actual length is the distance between the image and the convex lens, which is quite a distinct thing from the focal length of the equivalent lens. The focal length of the telescope, I find to be, in the case of the combination above mentioned, 50in., whereas the length of the instrument is only 44.

Recapitulation.

We may now recapitulate the advantages which may be supposed to be attached to this method of construction. The following three appear to be the principal ones:—1. There is no secondary spectrum. 2. The instrument will admit of a larger aperture than one of the usual construction of the same length, in the proportion of 4 to 3. 3. It has greater power, in proportion, 10 to 9. Now, one would really like to know what there is to counterbalance these advantages to such an extent as to make it advisable to use the old method. Perhaps, it will be said, that the practical difficulties of construction will be great. But this only comes to saying that, to produce a first-class instrument a first-rate artist will be needed. Of course, he will, just as with any other method. Each will, doubtless, have its own difficulties, which will require an amount of care and skill which only the best makers are able or willing to bestow. That great exactness is necessary in making the curves of the lenses, I have quite satisfied myself; for, having examined carefully a multitude of combinations, I find that a very small variation in the curves affects the spherical aberration to an extent that was wholly unexpected, rendering thereby great attention to the work necessary. For this reason, I have not added to the list of advantages "a considerable reduction in price;" for though I still suppose that by the method proposed, more optical assistance may be obtained for the money, it will not be to the extent that might at first sight have been expected. One first-class telescope may, on account of the mode of construction, be cheaper than another which is made differently—just as an American clock made by machinery may be cheaper, and perhaps also better, than an English hand-made one. But, as a general rule, whatever requires a first-rate artificer, will always command, more or less, a high price. *Nothing of real excellence can be produced cheaply.* Excellence is what I hope for, rather than cheapness.

As to the mechanical difficulties of construction, the two methods have this in common: that the curves ought to be extremely exact; and, perhaps, this is the only necessary difficulty attaching to the usual method. But in the proposed, there will be an additional thing which requires care—namely, that the *optical centres* of the lenses should be at precisely the proper distance apart, which, however, I suppose will be no difficulty to a good optician. And to this may be added a suggestion made by "F.R.A.S.," that in an ordinary dialyte a source of imperfection is very likely to be incorrect centring; but in this case this difficulty is easily avoided by making the two glasses of the *same size*, and fixing them each at one end of a cell or tube of sufficient length to give them the requisite separation. The cost of making the concave glass as large as the other will not be materially increased, for, by so doing, all trouble and difficulty as to the setting of the concave correctly are avoided. In the example above given, the distance of the lenses is 6½in., the aperture of the convex is 4, and that of the concave 3; that is, the rays transmitted by the former would cover an area of 3in. diameter in the second. If, instead of the latter, we were to substitute one of 4in., we should add but very little to the expense, and, as it will be easily seen, be even less liable to error of centring than when the two are in contact.

But, perhaps, as good a way would be to take a concave no larger than it is wanted, *i.e.*, 3in., and fix them both in a *conical* cell 6½in. long, and 4in. at one end and 3in. at the other. This would render less brass necessary in the main tube, and would, perhaps, be the cheapest. This is Mr. Lancaster's idea.

W. G. Penny.

(*To be continued.*)

PRACTICAL NOTES ON PLUMBING.—XXXIX.*

By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page* 394.)

Lead-Burning.

In directing the attention of my readers to this subject, I am at once introducing them to one of the most interesting and useful branches of the plumbing trade, without a practical knowledge of which, no plumber should consider himself entitled to be ranked as a first-class workman, inasmuch as I consider it to be the most difficult branch of the trade to execute. I also consider that it is the best class work when properly done, because the joints, so to speak, are coalescent. It is a common impression amongst many in the trade, that lead-burning is quite a new art; this, however, is an error, as it is considerably older than is generally supposed. This invention, indeed, like many others, has been doomed to share the usual fate, and has many claimants for its originality, the common idea being that it was invented by Count de Richmont, of France, who, it is reported, instructed one Luke Herbert (a patent agent of the time), to patent the system in England, the patent bearing the date of 1838, though statistics prove that the method was much practised in England far anterior to that date. This only goes to prove that we cannot depend upon dates in the case of many most useful inventions connected with the plumbing trade—for example, ventilation, traps, &c. It is often extremely difficult to arrive at the real origin of many inventions. We read, for instance, of such things as reaping-machines being used on the plains of Rhortia, A.D. 70, or 1812 years ago, and at least 1600 years anterior to the date of our first patents.

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Now, since this art of lead-burning was known, as we are aware, at least forty years ago, and much talked about, why is it, we may reasonably ask, that this valuable invention is so little known, and only practised by the leading members of the trade? The answer is, that the machine, as also the bellows necessary for the work, has not been perfected till within this last year or so, and further, sound instruction, in connection with experiments, theoretical and practical, is much wanted from the hands of the practical workman; for it is folly to expect sound and practical instruction from the hands of an unskilled teacher. Such there are to be found scribbling away, professing to teach the whole of the science and art of lead-burning. The teachings of these men only tend to impede progress. They follow in the old rut, which requires new metal to pave the way. They tell a tale about the old square-box machine, and recommend zinc cuttings. I may here remark that there is more difference between this and the modern machine than there is between an old-fashioned brick barrel and a good glazed pipe-drain. The old square machine is clumsy, and totally unfit for general work about a building; whilst the modern one is handy, good working, and not unsightly. Then, again, there is another reason. We have not many good plumbers proficient in the art of lead-burning, who are willing to work in the building trade, no matter how large the firm may be. The few that can burn (I speak of my own burners) are chemical works men, and they are of so selfish a turn of mind that if a lad or stranger asks their advice respecting the art, they are unwilling to give any information—I suppose for the simple reason that they think if a direct and intelligent answer be given that the knowledge will henceforth and for ever be imported from them, and that this is all they will ever be able to learn. Such men should disappear from the company of their co-workers, for they can do better without them. This greediness or unwillingness to impart knowledge is one of the greatest mistakes in the world, and altogether a wrong feeling, based upon a wrong principle, which I will endeavour to overthrow, for experience teaches me that the more a man knows, the more he can learn, and the more willing he is to impart that knowledge, by the very imparting of which he improves himself, thereby becoming more valuable to himself, to society, and to the world at large. It should be known that I am thankful to be able to say that I have not asked any man one solitary question respecting the trade during these last six years of my writings, and that that which I reveal is my own work, not that of my workmen or others. I should, before closing this preamble, state that I have, during the thirty years of my experience and practice, only met with two thoroughly competent lead-burners who were willing to reveal its secrets to the uninitiated in the art—viz., the Messrs. James Pullen and Son, the well-known U-trap makers.

THE ACHROMATIC OBJECT-GLASS.—VIII.

By W. Bradbury.

(*Continued from page* 490.)

I SHALL next give tables of curves computed by Barlow's rules. The compound focus is assumed to be 1,000, and the flint curves invariable for all values of the crown index.

C. Indices.	F. Indices.	O.G. with Plano-concave Flint. Crown curves. δ = 0·55		δ = 0·60		Object-Glass with Double Concave Flint. Crown curves. q = 10 . δ = .60		q = 10 . δ = ·65		q = 8 . δ = ·65		q = 8 . δ = ·70	
·50	·58 ·60 ·62 ·64	413·1 402·3 392·8 382·5	491·1 510·5 526·5 516·5	412·4 400· 388· 377·2	389 2 400· 412·7 426·6	370 359·4 352· 342·8	435·3 453·4 463·1 480·1	359·1 341 2 335·3 328 3	341·3 359·2 366· 374·7	356 310·2 330 7 317·8	350 360·2 371·6 389 7	328·8 320·7 309·6 303·	275·8 281·8 290·4 297·
·51	·58 ·60 ·62 ·64	428·4 417·2 406·1 385·8	494·2 510· 527·4 539·6	427·9 415·5 402·9 393·3	389·8 400·7 413·2 423·8	382·7 371·9 364·5 354·9	437· 449·1 463·1 479·6	372·7 354· 347·7 340 2	342·5 360· 366·7 375·5	361·4 352·8 342·7 332·3	352·6 361·2 372·5 385·5	341·5 333·2 321·9 314·2	277·1 282·8 291·5 298·1
·52	·58 ·60 ·62 ·64	445·3 431·9 423·6 410·4	493·1 510·6 525·5 511·5	444·3 431·4 418· 408·3	391·1 401·6 413·9 424·	400·2 386·4 377·9 368·1	433·1 438·7 462·5 478·1	387·3 368· 360·9 352 5	343·3 360· 367·1 376.1	376· 366·7 355·6 345·2	352·7 361·3 372 6 384·9	355·3 346·3 333·8 326·9	278· 283·8 292·8 298·3
·53	·58 ·60 ·62 ·64	463·4 448·1 436· 417·4	491·4 507·5 524· 553·6	463·4 449·4 435·6 424 6	390·7 401·2 412·9 423·3	415·7 401·3 392·2 382·0	432·6 448·8 461·4 476·3	391· 381·7 375· 365·8	352 9 360·8 467· 376·3	390 8 381·2 369·7 358 5	353· 361·3 372·3 384·3	370·5 360·1 348·5 340·2	278·5 284·6 292·4 298·4
		Flint Curves Invariable for all Values of the Crown Index.											
	·58 ·60 ·62 ·64	474·4 490·8 507·1 523·5	Back surface plane.	386·6 400· 413·3 426·6	Back surface plane.	425·4 440· 454·6 469·2	4254· 4400· 4546· 4692·	343·6 355·4 367·2 379·	3436· 3554· 3672· 3790·	351·3 363·4 375·5 387·6	2810·8 2907·7 3004·6 3101·5	279·6 289·3 299·0 308·6	2237·2 2314·3 2391·4 2468·5

To illustrate the use of these tables, we will take the example previously computed, viz., indices: 1·51 and 1·62, and dispersive ratio = 0·6. By reference to the table, we find for δ = 0·6, that the flint may be either plano or double-concave. Taking it as of the latter form, we find 10 a suitable ratio for the curves. Then at the bottom part of the column headed q = 10· δ = ·6, and in a line with the flint index value ·62, we have 454·6 and 4546· the radii required. Next, in the same column, for the part corresponding to the crown value ·51, and in a line with the flint value ·62, we find 364·5 and 463·1 as the requisite crown radii. These numbers agree with the results we have previously found by calculation.

The next short table is given for the purpose of comparing Barlow's rules with Herschel's. I have taken a fixed value for the ratio of the flint curves, and the inner surfaces are generally adapted for marginal contact. These numbers serve for *one* value 1·5 of the crown index only.

C. Indices.	F. Indices.	O.-G. with Double Concave Flint. Crown curves. q = 4 δ = ·70		q = 4 δ = ·75	
·50	·58 ·60 ·62 ·64	285· 277·9 270·4 265·	316·6 325·8 336·8 315·4	259·4 252·5 243 9 240·	241·3 247·5 256·4 260·8
·51	·58 ·60 62 ·64	294·9 287·9 280·9 273·5	317·8 326·1 336· 347·1	269·2 262·6 253·1 249·1	242·1 247·7 256 9 261·1
·52	·58 60 ·62 ·64	305·9 298 4 290 9 283 4	318·3 326·8 336·3 316 9	280·1 373· 263 1 258·4	242 5 248·2 256 9 261·6
·53	·58 ·60 ·62 ·64	318 310· 302·1 294 9	318· 326·3 335 7 311 9	291·5 283·9 273·6 268·7	242·8 248·4 256·9 261 3
		Flint Curves.			
	·58 ·60 ·62 ·64	310·7 321·4 332·1 342·8	1242·8 1285·7 1328·4 1371·2	241·7 250· 258·3 266·6	966·8 1000· 1033·2 1066·6

Barlow's rules are useful for finding what kind of crown lens is suitable to combine with a given flint; the reverse process requires a different method. Of course with the aid of the tables, one result can be obtained just as easily as the other; but using only the formula given in the synoptical table, the ratio of flint radii, or value of q', cannot be obtained directly from the value of p. The tables, however, show within what limits the value of q must lie, in order that the inner curves may preserve a definite relation; and we can assume a ratio which we may be certain will give a greater depth to the inner negative curve.

C. Indices.	F. Indices.	O.-G. with Concavo-convex Flint Lens. Crown curves.		Flint curves.	
		δ = 0·5		q = 3	
·50	·56 ·58 ·60 62 ·64	707· 701· 655· 628· 601·	386·7 388·6 404·3 415 3 427·	373·3 386·6 400· 412·3 426·6	1120· 1160· 1200· 1240· 1280·
		δ = 0·55		q = 3	
·50	·56 ·58 ·60 ·62 ·64	815· 774· 726·3 687·6 650·7	310·8 317·2 326· 334·4 344·1	305·7 316·4 327·3 338·2 349·	917· 949· 981·8 1014·5 1047·
		δ = 0·55		q = 4	
·50	·56 ·58 ·60 ·62 ·64	641·5 626 4 577·7 549·4 485 5	341·9 351·1 358·3 381· 410·6	343·5 355·9 368·2 380·4 392·7	1374· 1424· 1473· 1522· 1571·
		δ = 0·60		q = 4	
·50	·56 ·58 ·60 ·62 ·64	698· 685· 626· 596· 568·4	280·3 289· 293· 301· 308·6	280· 290· 300· 310· 320·	1120· 1160· 1200· 1240· 1280·

Commencing with the lowest value of the dispersive ratio, it will be seen that this condition of things requires a back *convex* surface: for one not so low, this surface may be *plane*; still, increasing, it becomes *concave*, and beginning with a ratio of 10 to 1 for a value of δ = 0·6, this number may be diminished as δ is increased, until a ratio of 3 or 4 to 1 may be taken as suitable for the highest value of δ.

These approximate guides to the requisite form of the flint lens can only be applicable when the crown is nearly equi-convex, or has its back surface slightly flatter than the front one. The general problem of matching two lenses requires the aid of a simpler formula than that of Barlow: this is supplied by Coddington, whose method we now proceed to investigate.

There is an essential difference in the methods of computing aberration adopted by these theorists which at the outset it may be well to explain. The spherical error of a lens may be considered in two ways—first, as *longitudinal*, and, secondly, as *lateral*—aberrations.

The focus of a ray, nearly coincident with the axial ray, is taken as the standard point from which we estimate aberration. As the ray falls nearer to the margin of the lens, its intersection with the axis is in front of the axial focal point; the difference between these foci is the longitudinal aberration, due to the aperture embraced between the central and marginal rays. If we hold a card square to the axis at the standard focal point, the aberration causes a luminous disc to appear on it, this is termed the circle of *lateral* aberration. Hence longitudinal error is measured *on* the axis; lateral error on a line *square* to it. The former may be said to form the *axis*, and the latter the *radius*, of the base of the aberration cone. Barlow computes the longitudinal error, and treats it as an increment of the focal length, thereby obtaining an intricate expression, which does not admit of reduction or simplification to a convenient form for easy calculation. Coddington computes the lateral error, treating it as an increment of the focal reciprocal; and the expression thus obtained consists of an easy quadratic equation, containing essentially all that is necessary for combining two or more lenses.

Reciprocal quantities enter very largely into optical theorems; and expressions arising therefrom, representing the value of very small quantities, should be kept in reciprocal form wherever possible. Calculations are thereby much facilitated, as we can treat these reciprocals as definite quantities, and take their sum, difference, or product much simpler and easier than by using the actual values.

When a convex and a concave lens are placed in contact, their compound focal length is obtained from the equation:

$$\frac{1}{v} = \frac{1}{F} - \frac{1}{f} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

If now we take into account the error due to a certain aperture, y, we shall have:—

$$\frac{1}{v} + d\left(\frac{1}{v}\right) = \frac{1}{F} - \frac{1}{f} + \omega_1 y^2 - \omega_2 y^2 \ldots. \quad (2)$$

in which ω and ω_2 are the co-efficients of error due to the first and second lenses respectively, and $d\,(1 / v)$ the effect on the compound focus. The lenticular errors are opposite in character; if they are equal in effect a balance of error will result, and the variation of v will be o; or, the focus will be sensibly the same for rays from all parts of the aperture, assuming that it is very small compared with the focal length. As the lenses in contact have equal diameters, we neglect y, and the general approximate condition of aplanatism in a doublet is that $\omega_1 = \omega_2$, or, the coefficient of error must be equal in each lens. Similarly for three lenses, we must have $\omega_1 + \omega_2 + \omega_3 = o$, a condition which implies that one, at least, of the lenses must be concave.

The coefficient of error involves four quantities, besides the constant refractive index; these are the two conjugate focal distances and the two radii. But the sum of the reciprocals of the conjugate foci is constant; so is also that of the radii: therefore each of these pairs may be made a function of one quantity. By this means two values take the place of four, and the aberrational expression becomes simplified to a regular unencumbered quadratic form. A great advantage arises from this result, as one form of equation serves for all kinds of incident rays, for alteration in the positions of the conjugate foci affects the value of one quantity only.

Coddington's expression for the spherical error, when simplified by the rise of the above artifices, takes the following form:—

$$\frac{1}{\mu(\mu-1)}\left\{\frac{\mu+2}{\mu-1}\,x^2 + 4\,(\mu+1)\,ax + (3\,\mu \times 2)\,(\mu-1)\,a^2 + \frac{\mu^3}{\mu-1}\right\}\frac{y^2}{8f^3} \quad \ldots\ldots\ldots\ldots \quad (3.)$$

This is the co-efficient of y or value of ω in eqn. (2); it is the variation, not of the focus, but of the focal reciprocal. Hence, to combine two lenses, we must take the equation of each, and find what valves of a and x make them equal.

The conjugate foci are expressed in terms of a, thus:—

$$\frac{1}{u} = \frac{1+a}{2f} : \frac{1}{v} = \frac{1-a}{2f},$$

or $$a = \frac{2f}{u} - 1 = 1 - \frac{2f}{v}.$$

(a being the radiant and v the refracted focal distance.)

The radii are expressed in terms of x thus:—

$$\frac{1}{r_1} = \frac{1+x}{2f(\mu-1)} : \frac{1}{r_2} = \frac{1-x}{2f(\mu-1)},$$

or $$x = \frac{2f(\mu-1)}{r_1} - 1 = 1 - \frac{2f(\mu-1)}{r}.$$

Or, without using f, we have:—

$$a = \frac{v-u}{v+u} : x = \frac{r_2 - r_1}{r_2 + r_1}$$

That is, x and a are quotients of the difference and sum of the radial and focal distances. The points v and r_2 are measured to the right of the lens; u and r_1 to the left. Ween parallel rays fall on a lens, the value of a is always unity; so that for the front lens $a_1 = -1$. For the second lens, we may express it in terms of the dispersive ratio: f, taken negatively, is the focus of the second lens; u, taken negatively, is the focus of the first, and the ratio of these is δ. So that, instead of $2f / u$ we get $a_2 = (2 / \delta - 1)$, when the crown lens is in front; but if the flint lens be first, $a_2 = (2\,\delta - 1)$.

Hence, for the front lens of an achromatic combination, a_1 is always negative and equal to unity; for the second lens, a_2 is always positive, and may be greater or less than unity; or, if $\delta = 0{\cdot}5$ in the second formula $a_2 = 0$.

From this it will be seen that the second of the involved quantities in the equation may be readily found; one value of x must then be assumed, and it matters not to which of the lenses it relates; as in either case, a similar quadratic equation results, whose roots are easily determined.

Let us examine what values of the root x_1 and x_2 are suitable. If $x_1 = -1$, the lens is plano-convex; $x_1 = o$ equi-convex; $x = +1$ convexo-plane. These are the extreme values; but evidently the most suitable numbers will be small positive or negative fractions not far from zero.

For the second lens, the roots must generally lie between o and $+1$, unless x_1 be a large negative fraction, in which case x_2 may exceed positive unity, showing that the last surface is convex.

When the usual combination is reversed by putting the flint lens in front, x_1 will always be greater than negative unity, and x_2 a positive quantity greater or less than unity.

We will next ascertain the relation between x_1 and x_2 that shall bring the inner curves into contact. For the back surface of the first lens we have:—

$$\frac{1}{r_2} = \frac{1 - x_1}{2F(\mu - 1}$$

For the first surface of the second lens we have:—

$$\frac{1}{r_3} = \frac{1 + x_2}{2f(\mu_1 - 1)}$$

Now, if these equations are alike, evidently:—

$$\frac{1 - x_1}{1 + x_2} = \frac{\delta(\mu - 1)}{(\mu_1 - 1)} \ldots\ldots\ldots\ldots (4).$$

Or, since $(\mu - 1)\,(\mu_1 - 1)$ is the ratio of refractive powers (which we will denote by ρ):—

$$\frac{1 - x_1}{1 + x_2} = \delta \cdot \rho.$$

Either ratio may thus be found in terms of the other.

When the flint lens is first, these expressions become:—

$$\frac{1 - x_1}{1 + x_2} = \frac{\mu_1 - 1}{\delta(\mu - 1)} = \frac{1}{\delta \cdot \rho} \ldots\ldots\ldots\ldots (5).$$

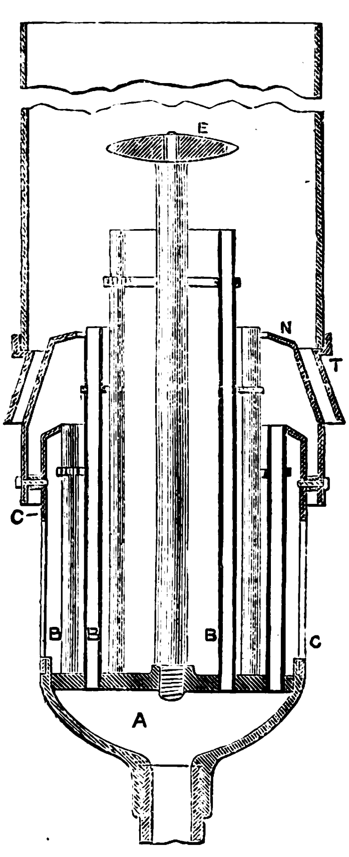
Thus, by slightly extending the calculations, we can introduce the condition of contact between the interior curves; or, by similar reasoning, we can apply any required condition to them.

These are all the preliminary operations that are requisite for using Coddington's formula. Of course, tables of aberrational equations for each refractive index must be formed; this can readily be accomplished by substitution in the literal equation (3) previously given.

(*To be continued.*)

SIEMENS' IMPROVED GAS BURNER.

On page 532, Vol. XXXII., we gave a description of Mr. Frederick Siemens's regenerative gas burner, which has now for some months been fitted to a number of lamps in Holborn and elsewhere. That gentleman and his brother Mr. C. W. Siemens have been devoting much attention of late to the improvement of gas-burners (see the paper on p. 372, Vol. XXXIII.), but to Mr. Fred. Siemens of Dresden seems to have been most successful in the matter of burners, and judging by his most recent device has abandoned the use of the pipe connecting the top and bottom of the "regenerative" burner. The improved burner is of the following construction. From a circular cavity or chamber supplied with gas rise two, three, or more sets of small metal tubes which may be vertical or slightly inclined. Each set of these tubes is arranged in a circle, and the circles are concentric with one another. The tubes of the innermost circle are highest and smallest in diameter, those of the next circle outwards are somewhat lower and larger in diameter, and so on, the outermost tubes being lowest in height and largest in diameter. Outside the outer tubes, is fixed a metal casing perforated at its lower end and having its upper end terminating in a lip or flange projecting inwards level with the mouths of the outer tubes, and this lip is by preference notched or indented so as to present a starlike appearance. Secured to the upper part of this casing above its perforations is another casing of larger diameter, so as to leave an annular air passage between it and the inner casing. This second casing is coned inwards and star lipped reaching nearly to the mouths of the second set of tubes. And in like manner other successive casings are arranged according to the number of circles of tubes. Generally, however, three circles of tubes with two casings as described are sufficient, there being a central star notched button or deflector above the middle circle. Outside of all is a gallery or ring presenting a socket to hold the glass, an annular air passage being formed between this gallery and the outer casing. The gas issuing from the several sets of tubes has air supplied for its combustion partly through the perforations of the lower casing and partly through the annular spaces between the successive concentric casings, and as these as well as the tubes are of metal in intimate connection the heat is very perfectly diffused throughout the burner, and the air is considerably heated during its passage to the flames, increasing their brilliancy, while the cooling effect of the air on the tubes saves them from injury. Although the above mentioned air deflectors are by preference notched, or of star shape, yet they may also be used without notches. In order to regulate the gas supply to the burner notwithstanding variations of pressure a regulator of the following kind is employed. Within a cylindrical casing is fixed a collapsible vessel somewhat like a concertina bellows, consisting of a number of thin rings of elastic sheet metal attached to one another at their inner and outer edges alternately. The lowest ring is attached to the bottom of the casing, and the highest ring is attached to a disc through which there is a small hole or several small holes. The



disc also carries at its centre a cone projecting upwards and entering the mouth of the pipe leading to the burner. The gas enters the bottom of the collapsible vessel from which it can issue into the casing through the hole or holes in the disc, and from the casing it passes to the burners. According as the pressure of the gas is greater or less the collapsible vessel becomes more or less distended so that the cone on its disc throttles more or less the passage leading to the burners.

The sectional figure annexed shows the general construction of the burner. A is the gas chamber connected direct to the supply, and rising from it are the three concentric rings of tubes B. Surrounding the outermost ring is a casing C fixed to the chamber A, but having around its lower part a number of slots through which the air enters freely. The second ring of tubes is surrounded at their upper parts only by another casing N which terminates at the top of the tubes in a notched air deflector. A third casing T serves as a gallery to support the chimney and to admit a further supply of air for cooling the glass. A notched air deflector E is carried on a central stem and is fixed a short distance above the tops of the inner ring of tubes. The tubes are so graduated in size that the inner give the shortest flames, the object being to insure the termination of all the flames at about the same level. The air entering through the openings in the lower part of casing C passes between the tubes of the several rings and rises up in a more or less uniformly distributed manner, as does also that entering the lower ends of the casing N and being caused by the several notched deflectors to impinge in divided streams upon the ignited gas jets issuing from the tubes, produces an intensely luminous flame. All the metal parts of the burner are in solid connection with each other, so as to prevent the injurious overheating of certain parts, by causing the heat to be more or less uniformly distributed by perfect conduction, which heat is then in great measure taken up by the entering air, thereby also increasing the luminosity of the flame. In consequence of the good conduction of the heat from all parts of the burner, the use of porcelain or steatite for the mouths of the burners can be dispensed with, but the central deflector E is by preference made of porcelain in order to act as a reflecting surface for the light. The heat conducting powers of the metal gas tubes B and the comparatively large issue orifices effectually prevent the deposit of solid carbon within the tubes, and as the air becomes heated by contact with the external surfaces of these, an upward draught is produced whereby a comparatively short glass chimney is rendered applicable.

PERRY'S METHOD OF DISTRIBUTING ELECTRICAL ENERGY.

A METHOD of distributing electrical energy has, together with the apparatus necessary for carrying it out, been recently patented by Mr. John Perry, the professor of mechanical engineering at the Finsbury College of the City and Guilds Institute. In any scheme for distributing electrical energy, it is of the first importance to so arrange the wires, &c., that any consumer may use the current for the purpose of illumination, or for motive power, just as he pleases, without being interfered with in any way by the fact that other consumers have turned off their lights or turned on their machines. Various methods have been suggested for effecting the constant and unvarying distribution of electricity; but the method preferred by Prof. Perry consists in combining with the dynamo-machine, one or more magneto-electric machines or other form of electrical machine or battery which will produce in a circuit an electromotive force which is constant and independent of any other electromotive forces in the same circuit. First: When the consumers' wires are arranged in parallel arc, it is usual to employ a "series" dynamo, and in that case is introduced into the main circuit a magneto-electric machine or battery producing a constant electromotive force equal to the electromotive force which ought to exist between the supply cable of any consumer and the return cable or earth. The dynamo-machines ought to get constant speeds, being driven by engines with good governors, and these speeds ought to be what have been termed the critical speeds. That is, the speed of each dynamo-machine ought to be such that the electromotive force created in it by its motion ought to be proportional to the current circulating in the coils of its field-magnets. In scientific language the intensity of the magnetic field in which the armature rotates ought to be proportional to the magnetising current. It is evident that one large dynamo-machine is preferable to two or more smaller ones in such a case, and it will be better to employ larger field-magnets than are usual in dynamo-machines; but to use the dynamo-machines at present in use will not introduce much discrepancy from the conditions required. As an example, if there is only one dynamo-machine, and if the resistance of the main cable, return cable, and machines, in fact of that part of the total circuit which is supposed to be constant be, let us suppose, 3 ohms, then we find that the dynamo-machine ought to be run at such a speed that the electromotive force in volts produced in its moving parts is three times the current in ampères which flows through the field-magnets; consequently, this speed can readily be found by experiment. Suppose the constant electromotive force of the magneto-machine to be 50 volts; its resistance 0·3 ohm, and the resistance of the dynamo-machine and of the other unchanging parts of the circuit 2·7 ohms, and suppose that the speed is that at which the electromotive force produced by the rotating armature of the dynamo is 3 times the current. Now let there be a consumer's resistance of 2 ohms, the total resistance is 5 ohms. Evidently the electromotive force produced in the dynamo is 75 volts, and the total electromotive force in the circuit is, therefore, 125 volts, and, as the total resistance is 5 ohms, the current is 25 ampères, giving an electromotive force of 50 volts between the ends of the consumers' part of the circuit. Now if the consumers' resistance increases to, say, 12 ohms by some of the consumers ceasing to use their circuits, there is an instantaneous alteration of the electromotive force produced in the dynamo to 12½ volts or 62½ volts in the whole circuit, and 62½ divided by 15 gives 4 1-6th ampères; and this means 4 1-6th multiplied by 12 or 50 volts as before between the end of the consumers' part of the circuit. Instead of using the dynamo-machine of the ordinary type, that is with its field-magnets forming part of the main circuit, it is sometimes used in the form where the field-magnets act as a shunt. When using a dynamo-machine of the shunted field-magnet type, it is preferred to place the magneto-machine or other source of constant electromotive force in a part of the circuit which is quite outside the machine; that is in the main circuit, so that the current passing through it is that which goes to the supply cable. The speed may be determined, which will produce the desired result. Second: So far, we have considered the lamps or machines which are supplied with electricity to be "in parallel arc"; when, however, the lamps or machines to which electricity is given are "in series,"—that is when the same current is to go through them all, what we effect is that they shall all receive the same current of electricity, however the resistance of one or more of them may vary. This is attained by using, instead of an ordinary "series" dynamo-electric machine—one or more dynamo-machines constructed so that their field-magnets are a shunt between their brushes, or the binding screws connected with their brushes, combined with one or more magneto electric machines or some other form of electrical machine or battery which will produce an independent electromotive force. For simplicity, take the case of one dynamo-machine and one magneto-machine. Let the shunt part of the dynamo be called M, whether it contains merely the wire of its own magnets, or has the magneto-machine inserted in it. Let the part of the dynamo which contains the wire of the revolving armature be called A, and let us be able to insert a magneto-machine in this portion of the circuit if we please. Now the two ends of A and the two ends of M are the same, and these may be called the binding screws of the machine. If these binding screws are joined to the two ends of any external wire or cable or system of lamps in series, which we may call the external circuit being really the part of the whole circuit which is external to the machine, then if we introduce a magneto-electric machine in the part A or in the part M, or if we have a magneto-machine in A and another in M we can, by giving a certain constant speed to the machine, deliver a constant current of electricity through the external circuit, however the resistance of that circuit may vary. The constant current we find to be that which the magneto-machine or machines would produce in a circuit whose total resistance is equal to the resistance of A. Thus if a magneto-machine or other constant source of electromotive force producing a constant electromotive force of 100 volts is inserted in A, and if its internal resistance is 0·3 ohm, and if another magneto-machine whose constant electromotive force is 160 volts and internal resistance is 2 ohms be inserted in M, and if the resistance of the revolving part of the dynamo (from brush to brush if it were working in the ordinary way) be 0·5 ohm, then when joined up to an external circuit in the manner described, and run at constant speed, the current in the external circuit will be the sum of 100 and 160 divided by the sum of 0·5 and 0·3, or 325 ampères, or else it will be the difference of 100 and 160 divided by the sum of 0·5 and 0·3, or 75 ampères; the latter case being one in which the magneto-machines oppose each others' actions. But in either case the current in the external circuit will not alter although its resistance be altered. The constant speed at which the Dynamo-machine should be run may be determined by experiment and calculation. The speed should be such that the electromotive force produced in the armature by rotation is equal to the current in M which includes the field-magnets multiplied into the sum of the resistances of A and of M. It is possible by running even an ordinary Gramme machine at lower speeds than usual to get the electromotive force produced in the armature to be proportional to the current in the field-magnets. As to the distribution of electrical power to persons who consume it in parallel arc, and distribution of electrical power to lamps or machines which are joined up in series in one circuit, the dynamo-machine must be run at a constant speed. Suppose it is found by calculation that it is necessary to run a dynamo-machine at such a speed that the electromotive force in volts produced in the revolving armature is equal to the ampères of current passing in the field-magnets multiplied into 2 ohms. Make an experiment letting a current of 20 ampères pass through your field-magnets, and let them be disconnected from the armature circuit. Revolve your armature at a speed of, say, 200 revolutions per minute, and let us suppose that you find that an electromotive force of 160 volts is produced by the rotation. If the machine is a suitable one for your purpose, so that the proportionality of electromotive force to the product of field-magnet current and number of revolutions holds, then the constant speed required is 2 multiplied by 200 and by 20, and divided by 100, or 80 revolutions per minute. In the process of electroplating, we have exactly the same conditions as there are in the distribution of electrical power when the consumers' connections are in parallel arc; that is, in an electroplating bath there ought to be maintained a constant difference of electrical potentials between the two sides of the bath however few or many objects may be undergoing the electroplating process. Instead, therefore, of employing a single dynamo-machine, which is the common plan at present, Prof. Perry employs in the circuit one or more magneto electric or other electrical machines or batteries, which will produce a constant independent electromotive force, as well as one or more dynamo-machines. In the process of charging accumulators the current that should pass through each cell depends on the size and weight of the accumulator, but not at all on the number of accumulators to be charged. When it is desired to vary at will the number of accumulators to be charged, we arrange them partly in series and partly in parallel circuit, and use either the first or second system of supplying constant electric energy to each accumulator. With the first arrangement, when it is desired to increase or diminish the number of accumulators charging, we increase or diminish the number in parallel circuit, leaving the total number in series unaltered. On the other hand, when the second arrangement for supplying constant electric energy to each accumulator is employed, and it is desired to increase or diminish the number of charging, we increase or diminish the number in series, leaving the number in parallel circuit unaltered.

Prof. Perry gives the following explanation with algebraic formulæ:—"In the first case where we want a constant difference of electric potential a established at the two ends of a resistance r, if R is the resistance of a magneto-machine or battery and dynamo-machine and any other unchanging part of the whole circuit; then let the constant electromotive force produced by the magneto-machine be a, and we know that we can have the electromotive force produced by rotation of the armature of the dynamo-machine proportional to c the current, say that it is equal to $n\ b\ C$ where n is the number of revolutions per minute, and b is a constant number which can be determined by experiment. Then the whole electromotive force of the arrangement is $a + n\ b\ C$; but by Ohm's law this must be equal to $R\ C + r\ C$. If, now, we make $n b$ equal to R it is obvious that $r\ C$ must always be equal to a, however r and C may vary. Again, in the second case, where we want a constant current C to flow through the external circuit of a shunted dynamo-machine. Let there be a magneto-machine, or battery of constant electromotive force inserted in the armature circuit of the dynamo-machine, and let the current in the armature be c, in the magnets c^1, and let the electromotive force e produced by rotation of the armature be $e = n\ b\ c^1$. Then we know that the following statements are true, R being resistance of dynamo armature from brush to brush, R^1 being resistance of magneto machine, r^1 being the resistance of the shunt circuit of dynamo, r being variable resistance of outside circuit. $c + a - (R + R^1)\ c = r^1\ c^1 = r\ C$ and $c = c^1 + C$. It follows from this that $C \left\{ (R + R^1)(r + r^1) + r\, r^1 - n\ b\ r \right\} = a\, r^1$. Hence, if $R + R_1 + r^1 - n\ b = o$, then $C = \frac{a}{R + R^1}$ and is, therefore, constant. Again, in the second case, if the constant source of electromotive force a is inserted in the magnet circuit, we have $c = n\ b\ c$, $e - R\,C = (r^1 + R^1)\ c^1 - a = r\ C$, $c = c^1 + C$. It follows from this that $C \left\{ R\ r + R\,(R^1 + r^1) + r\,(R^1 + r^1) - n\ b\ r \right\} = a\,(n\ b - R)$ so that if $n\ b = R + R^1 \times r_1$ we must have $C = \frac{a}{R}$ that is the constant current produced in the outside circuit of the shunt dynamo is the current which the constant electromotive force of the magneto machine or battery is capable of producing through a total resistance equal to that of the armature circuit of the dynamo-machine. In the above mathematical demonstration I have only spoken of resistance in the outside circuits as varying; it is obvious that when we work motors or charge secondary batteries, these exert back electromotive forces which may vary, and such varying electromotive forces will enter into the calculations as if it were the resistances that varied."

CHANGES IN MEDICAL OPINION AND PRACTICE.

IN an address at Worcester last week before the British Medical Association, Dr. Wade, physician to the Birmingham General Hospital, dwelt at some length on the change of opinion which had occurred with relation to blood-letting, and the causes which led to it. In 1832 this was an all-pervading method of treatment. Indeed, at first sight, it almost obscured the perception of any other therapeutical means or agents. The difficulty was to name diseases in which it was not used, not those in which it was. Its prevalence might be brought very vividly before them by a quotation from a contemporary author, who said "Blood-letting is not only the most powerful and important, but the most generally used, of all our remedies. Scarcely a case of acute, or indeed of chronic disease, occurs, in which it does not become necessary to consider the propriety of having recourse to the lancet, or to estimate the effects of blood-letting already instituted." But, to get a full impression of this frequency, they must read, one after another, the records of cases in which medical, surgical, traumatical, and obstetrical bleeding from the arm was practised. Indeed, that did not exhaust the category. The chief resource of preventive medicine was to let blood from the arm every spring and fall. Since 1832 a revolution of opinion had taken place, the like of which the history of medicine wots not of. For, be it remembered, this was not the case of a transient phantasy, but the well-established practice of centuries, which had withstood, not only the ravages of time, but repeated volleys from the batteries of wit and satire. In tracing the causes of the revolution which had taken place, he pointed out that the intellect of the period to which he referred was coming to distrust, and ultimately to banish, "violence, harshness—the darker shades of repression—from the education of the young, from the treatment of the insane, from the punishment of criminals, and to substitute for those time-honoured but most ineffectual processes a rational moderation." Well-known political reforms were the work of that period, and the outcome of the spirit just mentioned. Reconsideration of ancient dogmas was the order of the day; and that reconsideration in many instances led to their effacement. Another influence was coming into play. The *vis medicatrix naturæ* had been recognised in medicine from time immemorial; but its efficiency as an antagonist to disease had been at different times very differently estimated. The formula might be the same; but the conceptions it embodied might differ to an extent which was equivalent to a difference in kind. It would seem that formerly nature was esteemed but a very feeble and humble assistant, whose influence was nothing unless rigidly controlled and directed by a more intelligent, or reinforced by a more potent, agent. This idea was all in favour of robust and strenuous therapeutics, and they were accordingly dominant. It was assumed then that nature could do nothing without assistance. We do not assume, but know as a matter of fact, that in many instances nature unassisted can do everything. "Expectant medicine" is the term used to designate the line of conduct, or perhaps rather the mental attitude, which this knowledge imposed upon them. It was sometimes derisively described as the art of laboriously doing nothing—of trusting to Providence; and it was supposed to be a lazy, shiftless mode of shirking responsibility. All sound principles were liable to corruption; and this particular principle might—indeed, in the hands of those who did not appreciate its essence, did—lead to a neglect of therapeutical means. But, rightly understood, it was anything but a lazy and shiftless method; it necessitated a constant, anxious, and laborious study and observance of the tricks and turnings and vagaries of disorder and disease. So far from this system, when intelligently followed, leading to a disbelief in the potentiality of drugs, it seemed to him to do exactly the opposite. Having learnt with more accuracy and greater fulness the natural progress of disease, they were the better able to estimate the extent to which the direction of that progress was capable of deflection by the administration of remedies; and it passed his comprehension how any person who had intelligently and dispassionately watched the progress of disease, when subjected and when not subjected to drugs, could refuse to believe that they held in their hands gigantic forces to oppose to those of an aberrant nature. Various causes, no doubt, co-operated in generating and maturing expectant medicine. One, which we know did at a later period markedly contribute to its development, was even at this period beginning to attract attention. Laymen for the most part do not pretend, and do not seek, to understand the merits of opposing medical theories or schools of thought. It is on this broad ground, and as an historical fact and not a critical opinion, that I say that Hahnemann was commencing to subject, not so much the public mind to his doctrines, as the bodies of the public in this country to his treatment. The bulk of the medical profession rejecting his doctrine of infinitesimal doses, the cures apparently wrought by such medicaments were and are judged to be instances of spontaneous recovery. That interpretation necessarily facilitated the reception of that higher ideal of the powers of nature which was then arising; indeed, from that it was possible that the suggestion proceeded. Such a conception would undoubtedly make more easy the relinquishment of severe and violent modes of treatment, and amongst these blood-letting was conspicuous. But systems were not swept away without some faults inherent either in themselves or in the individuals who administer them, and the misuse of blood-letting, Dr. Wade contended, was the real origin of its abandonment, as the misuse of certain drugs had led to their being altogether discontinued. In 1820 a provincial practitioner, a physician at Nottingham—Marshall Hall—opened the first parallel of the siege, which, in his opinion, eventuated in the razing of this stronghold. Hall's last words on the subject were published in 1836, and but a very few years elapsed before it had ceased to be practised. It was most curious that the intention and object of his publication was to regulate, not to abolish, bleeding. It was true that he clearly demonstrated that it might be, and had been, so employed as to produce not only injurious, but distinctly fatal, effects; but he also taught its utility, authorised and, indeed, recommended its employment, though with limitations not previously laid down. How, then, it may be fairly asked, could such teaching result in its abandonment? The printed records showed distinctly that this remedy had come to be used in all sorts of cases, at all sorts of times, as a matter of course; as one that could do no harm at the beginning of an illness to cut it short, in the middle as routine treatment, and when things became desperate as a forlorn hope—as the last, the only, chance. The plain blunt statement that persons had been bled to death *secundem artem*, the simple detail of the facts of individual cases, proving to the most unwilling reader that this statement was true, must have pricked the conscience of many an honest practitioner. Men came to look at bleeding from an exactly opposite point of view to that which they had previously occupied, and began to see that it was not absolutely necessary at the onset of disease, was of doubtful safety as a routine treatment during its height, and at a grand crisis might even be fatal. Could they wonder that in a few short years the practice had ceased to exist. It would be improper, and indeed be misleading, to leave this subject, without adverting to another explanation of this astonishing change in practice. It had been attributed to a change of type in disease. A chief supporter of this view was one of the ablest and worthiest representatives of medicine in our time—worthy, indeed, of any age—Sir Thomas Watson. "What has not been shown," he says, writing in 1857, "is that the human constitution is incapable from influences to us unknown, of undergoing alterations, in respect to the manner in which it is affected by inflammation, and by the reputed remedies of inflammation. For my own part, I am firmly persuaded, by my own observation, and by the records of medicine, that there are waves of time through which the sthenic and asthenic character of disease prevail in succession: and that we are at present living amid one of its adynamic phases." It was not necessary to discuss the soundness of the view so succinctly stated. For the purpose of his argument, he could have wished to be able to give it an unequivocal assent. It enforced, with the most eloquent brevity, the supreme and paramount necessity of a constant, even suspicious, watchfulness, of their own operations and of the workings of nature. Let them turn to some further considerations, which especially enforced this obligation. Whilst unreservedly admitting that medicine was imperfect, they all believed that it was not stationary, but progressive. Each year furnished more exact knowledge as to the structure of the body; the uses of various organs; their *modus operandi* in health; the manner in which their operations are disturbed by disease; the effect of such disturbance upon other organs; the causes of these disturbances; and the extent to which they may be controlled or interrupted by diet, drugs, or other agents. They were from time to time presented with new instruments, or new means of exact research, with new drugs, and with new facts or theories respecting old ones. But that was by no means all. They were furthermore being, not infrequently, urged to apply that new knowledge, or those new views, to the treatment of disease; to employ a new drug, to discard an old one, or to use it in conditions to which it had heretofore been considered inapplicable, or to use it in doses of much less or of much greater magnitude than they had been wont to administer. Examples would at once occur of beneficial changes, which had of late years been in this way introduced. It was possible that they might have to go much further in some of these directions. As regarded the dosage of drugs, he was strongly inclined to think that both as regards *maxima* and *minima*, we were too closely bound by the fetters of posological tables, or of our habitual prescriptions. It should, however, be remembered that there were frequent pitfalls being daily dug in their path by the constant search after improved methods, and there was especially the danger of too hasty generalisation. It was not so many years ago that there flourished a great clinical teacher, famous alike in the wards of an important metropolitan hospital and by the bedside of the wealthy. Was it a truism that to be sound, medicine must be based on physiology? He was an assiduous cultivator and eminent teacher of this science. In the zenith of his fame he sought, as they knew, to establish the plan of treating acute disease by alcohol in almost unlimited quantity. Was it surprising that his views—earnestly enforced by word of mouth and in fascinating essays, propagated by an enthusiastic and numerous band of disciples, and not without an important substratum of truth—became popular, and that his example was for a time largely followed? What was their position now with regard to alcohol and its administration as a drug in acute diseases? Exactly what it was before this mischievous delusion arose. There was no acute disease in which alcohol was necessarily required. On the other hand there was no acute disease in which special circumstances might not arise which necessitated its use in small, or in large, and even in very large doses. The medical mind never had ceased, and probably never would, to hanker after specifics. From time to time some drug was elevated by its undeniably remedial effects into this position, and their hopes were flattered that they possessed one. The idea was most grateful. In the first place, what a saving of labour, thought, and trouble; nor was there anything in that feeling of which they need to be ashamed; for with many specifics to lean on, their lives would be sufficiently arduous. Then, again, they all felt, though perhaps they might try to hide it from themselves, the uncertainty of medicine. How delightful to know that, to the credit of their own reputation, and to the advantage of their patients, they had for at least one disease a remedy that could not fail. They might, however, depend upon it, that to those who harboured such a wish, and indulged in contemplating the possibility of its fulfilment, the danger was great of erroneously believing that they had achieved the result. The danger was still greater that they would come to look at many drugs in the light of quasi-specifics, and so relax watchfulness over their effects. Dr. Wade went on to adduce further illustrations of past errors and to condemn the widespread prevalence of the practice of unduly subordinating the physiological basis of treatment to the restorative basis, and concluded by urging the duty of untiring observation. They were told that to the few only was it given to extend the landmarks of science, or to reclaim the waste lands of ignorance; but to each one was given the power to cultivate and utilise those which had been reclaimed. To each one it was given to make the practice of medicine more rational, more common sense, and therefore more truly scientific, to render more rare in the future such dark blots as they had regretfully recognised in the past.

RECENT ADVANCES IN PHOTOGRAPHY.—V.*

By Capt. Abney, R.E., F.R.S.

DR. VOGEL has recently introduced a new kind of emulsion, which is a sort of mongrel between collodion and gelatine emulsion. It is made with acetic acid, gelatine, pyroxylin, and bromide of silver; but I will not coat a plate to-night with it, as the smell of acetic acid is very strong. It is a very good emulsion, very clean, and very fairly rapid. I pass on from this, merely saying that plates are more readily coated than by gelatine emulsion, but less so than with collodion emulsion.

But we come now to a decided advance in photography, and that is the doing away with glass as a support for the emulsion. Anybody who has travelled, and had to make mountain ascents, will know perfectly well that glass is a serious drawback to the mountaineer; he would do anything to save himself the infliction of taking twelve whole plates up to the top of Mount Blanc. My friend, Mr. Warnerke, who is generally to the fore in all matters of photography, was to the fore in doing away with glass for carrying collodion films, and is now to the fore in doing away with glass for gelatine films. He has perfected a process by which the photograph is taken on paper instead of on glass, and he has kindly brought me here some illustrations to show the method pursued.

First of all, he has a sensitive tissue, which can be made of any length. I do not know whether he has made it a mile long, but certainly a great many yards, and it can be rolled on a roller, and exposed in the dark slide. By simply turning another roller, a fresh surface is brought into the plane of the focussing-screen. The sensitive tissue is developed in the ordinary way with alkaline development. Here we have it in the developed state. The film can be either stripped off, or else transferred to glass. In the latter case, we come to another point, which is a distinct advance in photography. Mr. Warnerke has found that when you develop a gelatine plate with alkaline development, that is to say, with pyrogallic acid and ammonia, the parts which have been acted upon by light, and which have been developed, become insoluble in hot water. He thus is able, after development instead of using the hyposulphite bath to fix the print, to transfer it to glass, and wash away with hot water the parts of the film which have not been acted upon by light, and he gets a transparency. It should be noticed that, to do this, it is necessary that the back surface of the gelatine film should be exposed to the water, as in carbon printing, and this is secured by transfer to glass. Mr. Warnerke is not satisfied with doing away with glass for the camera, but he does away with glass for printing; and in order to accomplish this, he re-transfers the negative from the glass to a sheet of gelatine. I may say that the glass is freshly collodionised, which enables the film to strip off readily. An advantage of these film negatives is, that you can print from either side, each one yielding sharp prints, which is a desideratum when using the single transfer carbon process, and other such processes where reversed negatives are required. I think that Mr. Warnerke has really made a very great advance by enabling us to do away with glass.

In the matter of gelatine films, we have Professor Stebbing's, which are really workable. The gelatine emulsion is apparently flowed on an insoluble gelatine film on glass, which is then stripped. They are developed by placing them on glass. The next point I am going to touch upon is the enlargement of negatives. Now, the question arises, how are you going to get an enlarged negative? Of course you will at once say "get a transparency by contact, and then enlarge it in the best way you can." The best way you can is, of course, to do it very perfectly indeed; but, unfortunately, by the wet process, an enlargement is very often sadly defective. The best way which I know of getting an enlargement of a negative, is one which was brought forward a few years ago by Mr. Valentine Blanchard, and it is this. He takes the original negative which he wishes to enlarge, and places it in an enlarging camera. He then takes a transparency of the exact size which he wants his negative to be. He next takes a piece of common albumenised paper, and prints that transparency upon it, and by this means get a very soft and beautiful negative. If you have a hard negative it is almost impossible to get a soft transparency by the wet plate process, but by this artifice of "printing out" your transparency, and using that as a negative, you get a decidedly soft paper negative. If you trace the reason of this, it is as follows:—When the albumenised paper is acted upon by light, we know it blackens immediately, and, of course, light acts less violently on the underneath portions where it has been blackened. Thus, in printing from a transparency, the most transparent portions first blacken, then the next most transparent part blackens, before the first blackened part becomes too intense, and so on. So you see, by the shielding of the film by the blackening action, you are able to get a softness which you otherwise would not get. I have here such a negative, which I prepared several years ago, by which you see we get some of this softness. Mr. Blanchard, I am sorry to say, has gone back from his old love, and recommends now that you should use a gelatine plate instead of the albumenised paper. A gelatine plate is a very good thing, but I think the albumenised paper negative beats it when you have to enlarge from a very small negative to a very large one. I think the grain of the paper, too, is an improvement in large photographs, and you get no grain in a gelatine negative. I will next show you how to obtain a paper negative by the ordinary lantern. I will make an enlarged negative from a transparency taken from one of my Egyptian negatives, developing it before you. This is ordinary paper, to which a couple of washes of bromide of potassium were given, and which, when dried, was floated on silver nitrate. Half a minute's exposure to the light coming through the transparency will be sufficient. I shall use the developer, which I recommended to your notice some time ago, the ferrous-citro-oxalate. [The negative was developed and shown to the audience.] We now come to another great advantage of the gelatine process, which is that by it you can get soft transparencies. I am aware that it is said there is a certain amount of blurring in gelantine transparencies, but I am not prepared to say that is necessary; in fact, I should say it ought not to be the case, as I think I shall be able to show you in the next lecture. Therefore, if you have a hard negative by the common process, it is always possible, by the gelatine process, to get a soft negative from a gelatino transparency, in which case you can substitute for the paper, such as I used just now, a gelatine plate, or a collodion plate, or a wet plate, whichever you prefer. The main point to aim at in getting enlarged negatives is to get thin delicate transparencies, with every atom of detail present in them. If you get that you can always get a decent enlarged negative from them. If the detail is blocked up, you will not do so, unless you use a paper printing process, such as I showed you, with the albumenised paper negative.

After these preliminary remarks, I propose to show you one of the new applications of the gelatine emulsion process, and that is the development of a print on paper coated with gelatino-bromide. The paper is prepared by coating ordinary paper with gelatino-bromide (of the most sensitive kind if you like). Such paper can then be exposed to the image formed by an ordinary magic-lantern; by that means you can get an enlarged print. The lantern before you is a triple-wick oil lamp. and I think you will be able to see that I shall get a very good print indeed from the negative, which is at present placed in front of the condenser.

For my own part, I prefer gelatino-chloride paper, as it gives a very black image which beats the bromide out of the field altogether. The reason why the tone is black is that chloride of silver, when developed, is developed in two states, in a red or ruddy state, and also in a green state, and when you put red and green together the result is not far from black. I think you will see, when this is developed, that we shall have the ruddy state first. I use the ferrous-citro-oxalate. It will not bear the ferrous oxalate at first, although it may be brought out more quickly with it. Now, if I turned up the light, you would see it in the pinky state; as it goes on the pinky state gives place to the green, and the two together make up the black, and you will see afterwards that this black is of a most beautiful hue. I want particularly to call attention to the beautiful black tone it has. On the table there are some plates prepared with gelatino-chloride to show the same black tone.

We may thus say that an advance has been made when, by an ordinary magic-lantern, with a good negative, you can get a perfect enlarged paper print by development. Perhaps they will not have that lustre which albumenised prints have, but it is a matter of taste whether you like that gloss or not.

I have now to allude to Mr. Warnerke's invention again. He has found that he is able to mix with his gelatine emulsion colouring matter, and you will at once perceive the value of this. When you wash away the unaltered bromide of silver that is not acted upon by development, you get silver left behind, plus the colouring matter embodied in it. I have a developed print containing colouring matter, and to save time I have placed it on a transfer paper. The image was developed with alkaline pyrogallic acid, and was placed in contact with gelatinised paper, rendered insoluble by chrome alum. I propose to wash away the soluble gelatine containing the bromide of silver and the pigment, to show what a power this discovery places in our hands. I first place it in hot water, and as soon as it has soaked a little the outside paper on which it has developed will peel off, leaving the gelatine film on what we may call the transfer paper. The subject is one of Mr. England's statue subjects, of which he was kind enough to give me the negative. Stripping away the paper on which the print was developed, the picture remains on the transfer paper, and we have the image waiting to be freed from the soluble matter. The print before you was taken in my laboratory with the electric light; and had a very short exposure. The soluble matter is now gradually washing away, and the whites are gradually coming out, and we get a picture in the colour of alizarine. You can get almost any variety of colour; but it is not every colour the operator can use, because some would destroy the sensitiveness of the gelatino-bromide, but most colours he can use. I can hardly thank Mr. Warnerke enough for the trouble he has taken in illustrating this part of my lecture for me. He has furnished me with pictures showing a variety of tints, from sepia and photographic purple to almost any colour, This I may claim as a great advance in photographic printing, and I hope, before long, the public will have the advantage of this invention, which at present they have not.

A TRAIN TELEGRAPH.

A TRIAL was made recently on the Atlanta and Charlotte Railway, in America, of a new plan for enabling a railway car in motion to communicate by telegraph with the stations on the line. It is the invention of Captain C. W. Williams, U.S.A., and consists of a telegraph line laid along the track but interrupted at frequent intervals, and the ends of the break brought to key blocks mounted upon the sleepers or "cross ties." The key blocks carry two metal rollers, to which the ends of the line are connected, and when these rollers are depressed they interrupt the circuit of the line. When in their normal position the circuit of the line is complete. The bottom of the special car, which is selected as a telegraph office, has a projecting shoe covered with two metal strips or bars which, as the car passes along the line, make contact with the rollers and depress them, thus interrupting the circuit at that point, and thereby throwing the telegraphic apparatus of the car into the circuit at that point. This is effected by having the apparatus connected up between the two strips. These are made of sufficient length to keep the car always in circuit with the line by the rapidly suceeding key blocks and rollers. The current enters the car through one roller and strip, and after passing through the telegraph instrument on board returns to the line through the other strip and roller. The advantages of this system may be considerable in certain American districts, or in case of accident. It enables a station-master to clear the position of a train on the way; or two trains to inform each other of their whereabouts. The establishment of such a system would, however, entail considerable expense in this country, owing to difficulties of insulation.

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* Condensed from a series of Cantor Lectures delivered before the Society of Arts.

In the trial at Atlanta some 200 yards of track were adapted to the apparatus; the key blocks being placed every 40ft. Messages were received in the car when at rest and in motion, the highest speed tested being 25 miles an hour.

ELECTRICITY AND EVAPORATION.

It has been very commonly believed that evaporation is an important source of atmospheric electricity. Thinking further inquiry desirable, Mr. Freeman, of the John Hopkins University, Baltimore, lately experimented thus:—

A copper or tin evaporating dish was supported on a wire frame hung by silk threads, and connected with one pair of quadrants of a sensitive Thomson electrometer, the other pair being connected with earth. To prevent electrical disturbance, the whole apparatus was inclosed in a metallic case, in which were openings to facilitate evaporation and observation. Water, alcohol, a solution of chloride of sodium, and other liquids were tried. After eliminating some discovered sources of leakage as much as possible, and correction on account of deflections obtained with the evaporating dish dry, the deflections of the electrometer were found very small—*e.g.*, for water, less than 0 01, and generally less than 0 005 of a Daniell's cell. The sign of the charge, too, for the same liquid was sometimes positive, sometimes negative. Supposing the deflections really due to evaporation, Mr. Freeman, applying them to the case of atmospheric electricity, shows that the quantity of water required to produce a single flash of lightning is very much greater than the actual quantity ever found in a thundercloud; while such a cloud usually gives not one but many flashes. If it be held that the cloud collects electricity produced by evaporation of more water than that in itself, this is met by a calculation (by the author) of the total evaporation from the earth's surface and the resultant lightning, he estimates that observers regularly distributed over the earth's surface, and seeing every flash within 18 kilomètres, would each see, on an average, only 28 in the year (assuming all electricity to be discharged in flashes). Evaporation is at most, Mr. Freeman thinks, a very insignificant source of atmospheric electricity, and the experiments do not certainly trace any electricity whatever to this source.

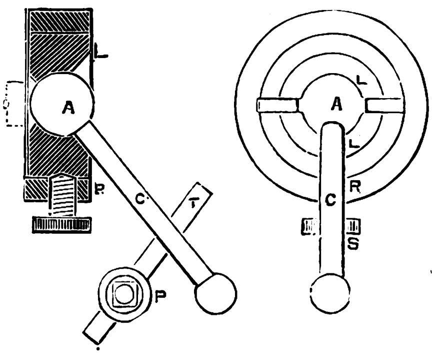
Recently Mr. Blake has followed a line of experiment bearing on the same subject, in Prof. Helmholtz's laboratory. In this case a layer of water (or solution) on one plate of an electric condenser was evaporated by heat and the rising vapour was condensed on the other (cold) plate. The heated plate was also connected with one pole of a galvanic battery, the other pole being led to earth. Both the temperature and the strength of the battery were varied, and a very sensitive quadrant electrometer was used to indicate whether, and how much, electricity was carried away. The conclusion come to was that with quiet vaporisation from electrified water or its solutions, when no drops spring off, there is no convection of electricity.

GRINDING SPHERICAL ENDED CONNECTING RODS.*

In the shop of the Chandler and Silver Water Motor Co., at Lewiston, Me., is used a device for finishing the spherical ends of the connecting rods used in their water motors, which the writer believes to be new and which is superior to anything with which he is acquainted. It is the suggestion of Mr. J. F. Perkins, foreman of a shop in the vicinity, and is based upon the principle that lines of revolution drawn about the surface of a sphere in any direction are circles, and *vice versâ*; if these circles are taken to represent cuts and are made to cross each other in constantly changing directions, the surface developed will be a sphere. In practice, this condition is complied with by a revolving ring, whose axis of revolution perpendicular to the plane of the ring, lies at an angle to the axis of revolution of the sphere operated upon, which axis is determined by the stem of the connecting rod. The process is one of "lead lapping," the ring being of lead and supplied with a mixture of oil and flour emery. The accompanying sketch will give an idea of the device, and although the apparatus was a rough and temporary one, the results obtained were very satisfactory. R is a collar, with a set-screw S, held in the jaws of a chuck on the lathe spindle. L is the lead ring, which is in halves, so that it may be closed up as it and the ball are ground away. A is the ball operated upon, and C the stem or body of the connecting rod. P is the tool post of the lathe, and T a piece of wood provided with a notch in which rests the stem C of the connecting rod. The ring L should be cut away on the front side so that the stem of the rod may swing round as shown to an angle of 50° to 60° with the axis of the lathe, and the angle of the opening O should be something less than the angle of the rod C, as it is necessary that the surface of the lap extend so far around as to pass the axis of the rod C extended. The dimensions are approximate only, and may be varied considerably without affecting the results. If, however, the angle between the axes of the lathe and rod be small, it will be necessary, in some cases, to apply a light end pressure to the rod C to prevent a tendency to wear forward in the ring.

The process is as follows:

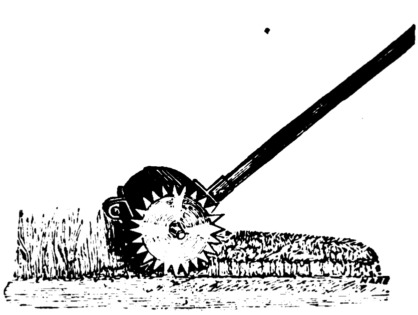
The ball is first turned by a ball-turning device, and then inserted into the ring with the stem C resting in the notch of the stock T. The ring L runs, at a moderate speed toward the front of the lathe, and its friction on the sphere A causes it also to revolve, but as the axis of the rod C lies at an angle with the axis of revolution of the ring L, each particle of emery makes a cut in a diagonal direction, on the surface of the sphere A, and as the revolution of the parts constantly changes the relative position of the surfaces of ring and sphere, the cuts cross each other in all directions, and as the cutting particles all move in circles, the surface produced mnst be that of a sphere. A constant supply of emery and oil is fed to the ball A, and by its revolution is carried into the cutting surfaces of the lap L. The head of the set screw S may be a ratchet on the principle of the star feed, and may strike against a spring stud, thrown up at the will of the operator. It is not necessary that the centre of the sphere and the axis of the lathe should coincide, as the results will be the same in either case. The time occupied in grinding down each ball 1¾in. in diameter, with No. 00 flour emery, the balls being turned up from steel castings with a feed of about 100 to 1in., is about eight to ten minutes, and this includes changing and all necessary operations.



A NEW LAWN-EDGE CUTTER.

Some time ago we introduced to the notice of our readers two useful implements, one for hedge-clipping, and the other for grass-cutting, invented and patented by Mr. Alfred Ridgway, of Macclesfield, which we understand have met with general approval.

The same inventor has just brought out a very efficient, simple, and cheap machine, devised for the purpose of cutting and trimming lawn edges, borders of flower beds, &c., the accompanying illustration of which will give a good idea of its *modus operandi*. The machine, when rolled along the side of the lawn or verge, cuts or clips the same with a continuous series of shearlike cuts, doing its work in a very complete and superior manner. It will also cut equally as well drawn backwards or forwards, which enables the user to cut into any corner or round curves, and, being very portable, it can be easily carried from one place to another.



TRICHINÆ IN SALTED MEATS.

Some time ago M. Colin declared that the salting of meat was a sure and certain method of destroying trichinæ, an opinion opposed to that expressed by German investigators, and also to the fact that several cases of trichinosis, believed to have resulted from the eating of American hams that had long been salted, had been reported. Among other chemists, Schmitt, Chatim Girard and Pabst, and De Benecke and Libon, may be mentioned as observers who had found the trichinæ still living in meats that had been salted for several months. The experiments of M. Colin led to others by M. Fourment, the results of which have just been published as a report to the French Academy. These experiments show conclusively that the salting of meats cannot be regarded as a safeguard against trichinosis. M. Fourment took a piece of meat on the 19th of April, 1881, from some American salted meats examined at the Havre Docks and found infested. This meat was placed in a flask and imbedded in fine salt. It was then hermetically sealed and not opened till the 1st of April, 1882. By this time the meat had undergone a year's salting carried to the highest degree, and if we add the time that must have elapsed since it was first put in salt in America (which could not be put at less than three months), the meat may be said to have been in salt for at least 15 months. The meat was then cut up into small pieces, and these were placed in water, which was frequently changed to remove the salt, and remained for several hours in a temperature of 71·6° F. On the 4th, 5th, and 6th of April this was fed to a mouse, which died on the 7th, after presenting symptoms of diarrhœa. The intestine was evidently inflamed, and contained sexually developed trichinæ. A second and a third mouse were fed with more of the meat, and with exactly similar results in each case Several other experiments were made. M. Fourment says that all show that the trichinæ were then certainly alive and capable of reproduction after 15 months of salting; and it is consequently manifest that salting does not surely and rapidly destroy these parasites. They may die in salted meats as well as in any other situation, and thus explain the negative experiments published by distinguished observers; but they may also live a considerable time without our being able to determine the length of the period after which death necessarily follows latent life. It is also proper to point out that, while salting is too often powerless to kill the trichinæ, one effect is to remove them to a certain extent from the action of heat. This fact is plainly shown by the experiments of Doyere Laborde. It may be useful to point out here that, although several physiologists have found that salting does not destroy the trichinæ, in several sets of experiments they were found to be killed. Zundel, Louis, Rechlinghausen, Kopp, Siegmand, and Dele all made numerous experiments, and in none was it found that, after treating with salt, the trichinæ were capable of development and reproduction. It is very probable that the solution of these disagreements is to be found in the life-history of the trichinæ. It may be pointed out that when the trichinæ penetrate the muscles they are perfectly free, and have no covering whatever to protect them, and a month or more elapses before they accept the situation and coil themselves up, to quietly await their chance of being eaten up by some other animal, which must occur before they can possibly develop into the perfect adult condition. But it is only at the end of three months that a fibrous cyst begins to form around them; and it is, perhaps, a year before the covering is sufficiently dense and impermeable to entirely protect it from the action of salt. Thus, it is seen that at one stage in the life of the trichinæ salt may effectually destroy them, while at another stage it would be almost powerless to act.

DEATH NOT UNIVERSAL.

Whatever lives, we hear it said, whether plant or animal, must, sooner or later, die. It will, therefore, greatly shock many persons to learn that this is not strictly the case. We wish here to give room for no misunderstanding, and, if possible, for no intentional misinterpretation. All animals *may* die, but death is not in all departments of the animal kingdom an inherent absolute necessity. On the contrary, in one of the two primary divisions of the animal world, the Protozoa, it is, though common enough, merely casual, the result of some accident. A Protozoon may be swallowed up by some larger animal; it may be crushed out of existence, burnt, or poisoned by "disinfectants" introduced into the water or other fluid which it inhabits. But it has no natural term of life, and, as we shall presently see, cannot be spoken of as young or old.

That this may be understood we must briefly compare the life history, and especially the reproduction, of the *Metazoa* and the *Protozoa*. In the former group—which includes all the backboned animals from man down to the humblest fish, all the insects, mollusks, as well as lower forms of life which scarcely attract popular notice—there is always a distinct difference between parent and offspring. The latter is certainly a portion separated from the body of the parent—from the female in all those forms in which there exist two sexes—but it is as compared with the parent minute in size, rudimentary in structure, and it has to increase in bulk, and still more to undergo a process of development, a series of transformations, before it reaches the normal stature and make of its species. When this point has been attained it enters upon the task of reproduction, and gives birth to one brood of young ones, or in the higher forms to several. With these it coexists for a longer or shorter time, and then dies, the matter which constituted its body passing into decomposition. If we look at these very familiar facts in the life of a Metazoon, be it a man or an oyster, we find that the ideas of birth, of growth, of maturity, of parenthood, of a natural term of life ending in death, at once suggest themselves. If we examine such a Metazoon we can, in most cases, at once decide whether it is in the immature or the adult phase of its being.

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* By A. J. Shaw, M.E. in the *American Machinist*.

But in the *Protozoa*—as Herr Bütschli has not long ago pointed out in the *Zoologischer Anzeiger*—this is distinctly different.

Let us suppose we are watching through a microscope one of these minute single-cell creatures. We see it expanding into an ellipsoidal figure, which becomes for a time longer and longer. It then begins to contract about what we may, for the sake of popular intelligibility, calls it equator. It assumes the form of two nearly globular bodies, connected, dumb-bell like, by a narrow neck. This neck becomes narrower, and at last the two globes are set free, and appear as two individuals in place of one! What are the relations of these two new beings to the antecedent form and to each other? We examine them with care; they are equal in size, alike in complexity, or rather simplicity, of structure. We cannot say that either of them is more mature or more rudimentary than the other. We can find in their separation from each other no analogy to the separation of the young animal or the egg from its mother, or to the liberation of a seed from a plant. Neither of them is parent, and neither offspring. Neither of them is older or younger than the other.

Or shall we try to regard them as brothers sprung from the same parent? If so, where is that parent? If living, let it be shown; if dead, where are its remains? No organic—or indeed any other—matter was separated out when the two new beings took their rise. All the substance of the body of the original Protozoon is included, and equally included, in the body of the two individuals before us. Thus we see that the essential ideas of the life of the higher animals—birth, growth, maturity, parentage, brotherhood, term of life, and successive generations—have, if applied to these humble and minute beings, simply no meaning.

The process of reproduction, or rather of multiplication, must, as far as we can see, be repeated in the same manner for ever. Accidents excepted, they are immortal; and frequent as such accidents must be, the individuals whom they strike might, or rather would, like the rest of their community, have gone on living and splitting themselves up for ever. It is strange, when examining certain infusoria under the microscope, to consider that these frail and tiny beings were living, not potentially in their ancestors, but really in their own persons, perhaps in the Laurentian epoch!

This consideration opens up another question. These beings are not wholly unconscious. They experience and retain impressions, however dimly and in however limited a sphere. But when the splitting up of one individual into two distinct personalities takes place, as we have described above, we have then the curious phenomenon of two distinct and equal beings whose past life is one, who will remember the same incidents and the same reactions to which such incidents have given rise. Here again is a phenomenon which we cannot realise—two contemporary and coequal beings possessing, up to a certain point at least, a common psychical life. Let us for a moment suppose that the propagation of the higher animals took place in a similar manner. We should see, *e.g.*, the mature man split up into two equal and similar men, each remembering, knowing, believing, and feeling, up to the day of fission, all that the other remembered, knew, believed, or felt; each, too, it might be contended by moralists, equally sharing the merits or demerits of the antecedent form, and each at a loss to say when his own personality took its rise.—*Journal of Science.*

THE THEORY OF WELDING.*

THE operation of welding is one of so much importance in metallurgy, and one around which so much mystery may be said to have accumulated, that any attempt to investigate and explain it on rational principles deserves to be welcomed. To some such attempt we propose now to direct attention. An opinion has lately been gaining ground on the Continent that difficulty in welding is entirely due to the influence of foreign substances, and not to any differences in the condition of the iron itself. Professor Ledebur is the latest exponent of this idea. He tested a number of specimens of rolled iron, both easy and hard to weld, and found that the total percentage of silicon, sulphur, phosphorus, oxygen, manganese, copper, &c., was on the average 70 per cent. higher in the latter than in the former. He also found that the presence of oxygen in chemical combination up to 0·7 per cent. was less injurious than a larger quantity of manganese, silicon, or phosphorus; but that if the oxygen exceeded 1 per cent. welding became impossible. On these experiments he based the theory that all foreign elements, equally with carbon, have an injurious effect upon the welding capacity of iron; and this in two ways—first by lessening its ductility; and secondly, by lowering the welding point. The first evil prevents the molecules at the surfaces to be welded, from flowing into intimate contact with each other under pressure; the second makes the iron so nearly liquid at the welding heat that it flies to pieces under the hammer.

This interesting theory has been partially adopted—but partially only—by another worker in the same field, Herr Reiser, of the Kapfenberg Ironworks in Styria. While admitting that phosphor and manganese, as well as carbon, have a hardening effect upon iron, and thus lessen its ductility, he points out that Ledebur's specimens were, after all, wrought iron, not steel; that they were therefore far more ductile, for instance, than ingots from open-hearth steel containing 0·08 to 0·1 per cent. of carbon; and yet such steel is easily welded. The want of ductility cannot, therefore, play more than a secondary part. With respect to the melting-point, this is no doubt lowered by the presence of silicon, of sulphur, and—especially with a high percentage of carbon—of phosphorus. Manganese, however, even in small quantities, raises rather than lowers it; for steel which, on account of a high proportion of silicon, is red-short, may be cured by an admixture of manganese. Chromium and tungsten have a similar effect, so that the elements enumerated by Ledebur do not all act in the same direction. It seems, then, that other causes for the unfavourable influence of such elements upon iron must be sought for, and these may be found, according to Reiser, in their capacity for oxidisation, their own capacity for welding, and their tendency to crystallisation.

With regard to the first, or oxidisation, it is well known that steel, if heated too long or too highly in the presence of air, becomes weak, and loses its steely properties. This is, no doubt, due to a partial oxidisation of the material. Some kinds of steel are more easily damaged than others; and it is feared that such steels contain higher proportions of elements, such as chromium and tungsten, which oxidise easily at high temperatures, and thereby lose their hardening properties. Now, it is well known that oxidisation of the surfaces is fatal to good welding, and the only advantage derived from the various welding nostrums, such as borax, lies in their rendering fluid, and, therefore, easy to remove any scale of oxide which may have accidentally formed. But supposing the surface thus to be cleaned, yet, if there be oxidised elements deeper down in the mass, their tendency will be to cause the oxidisation to spread again to the surface, and hence we see why the presence of easily oxidised elements is injurious to welding. With regard to the second point, the presence of a metal, even in small quantities, which cannot itself be welded, must of course have *pro tanto* a bad effect on the welding of the entire mass. This applies to copper—which can only be welded by special methods—and no doubt also to such brittle and oxidisable metals as manganese, chromium, and tungsten, though direct experiments on these are wanting; nickel and cobalt, on the other hand, are easily welded. With regard to the third point, iron, to weld easily, must be in a plastic and coherent condition; and this is characteristic, not of crystalline, but of amorphous structure. Steel is harder to weld the higher its proportion of carbon; but at the same time it becomes so much the more liable to crystallise, and at lower temperatures. This tendency reaches its maximum in the well-known crystals of spiegeleisen. The effect of crystallisation, according to Reiser, is twofold. In the first place, the polar forces, whatever they are, which give the form to the crystals, seem to concentrate, as it were, the attraction of the molecules, and prevent them from exercising that attraction freely on other molecules which may come into their neigbourhood, as they do when in the amorphous condition. In the second place, the effect of crystallisation is to bind up in intimate connection with each minute crystal a portion of some foreign substance which melts at a lower temperature than the iron itself; when a welding heat is reached these foreign substances are apt to liquefy, and in so doing to destroy the cohesion throughout the whole mass.

It will be seen that the general conclusion reached by Reiser, equally with Ledebur, is that all foreign substances—except the special fluid silicates, which are known to assist the removal of scale—are an obstacle to welding; and consequently that we may lay down the general principle that the purest iron is the easiest welded. The reasons, however, why these substances exercise a deleterious influence are of high importance, not so much to the theorist as to the practical ironworker, since it is only by knowing the reasons, and knowing them thoroughly, that he can hope to devise means for removing or diminishing the evil effects. Herr Reiser's conclusions are at once practical and scientific, and deserve the attention of all who are interested in the using or making of iron. They add another argument to the conclusion which most engineers will be prepared to endorse,—namely, that wherever iron has to be worked, hot or cold, or to be used for any but the most ordinary purposes, it is worth while to spend very great pains in manufacture, in order to reach the highest practical standard of purity. We do not mean by this that it should reach the excellence of Swedish or best Yorkshire; but that it should at least be as good as the best Staffordshire of former days—iron that a blacksmith or an engineer can take up and use as it comes to hand, secure that it will answer well to any fair test that is put upon it. To take only the present instance of welding, the cost of a bad weld that is discovered will many times outweigh a saving even of some pounds per ton in the prime cost of the iron, while the cost of a bad weld that is undiscovered may be most incalculable, not only in hard cash, but in human life. From this point of view even the carbon of steel must be considered an impurity, since it undoubtedly diminishes, to some extent, the welding ability of the metal. As a matter of fact, however, there is no real difficulty in welding, at any rate, the "mild steel" or "ingot iron" of which we now hear so much. It is true that Dr. Siemens has been charged with committing himself to the opinion that "steel will not weld"; but if his speech on the subject—which was delivered many years ago—be examined, it will be found that he was merely referring to the question whether white-hot fragments of steel, such as a mass of scrap, will close up into a solid and firm mass under the hammer, as iron scrap is known to do. In a word, he denied that steel would weld itself; he did not say it could not be welded. In any case the welding of mild steel is now a simple and every-day fact of the workshop; and steel may even claim a pre-eminence over iron in this particular, inasmuch as, if richer in carbon, it is far purer as regards the more hurtful ingredients than any but the costliest forms of wrought iron can be. Practically, a smith dealing with steel has nothing but carbon, and possibly manganese, to think of; he need not trouble his head about sulphur, phosphorus, arsenic, and other materials, whose influence on welding Herr Reiser has done his best to set forth in detail. No difficulties as to welding will be likely seriously to hinder the advance of mild steel as the metal of the future.

The facts we have been considering may be looked at from another and not less interesting point of view,—namely, as throwing some light on the meaning and nature of the process of welding itself. What has happened when two masses of iron have been welded together? Simply, we believe, that the forces of cohesion, which were previously in action on either side of the bounding surfaces, have now crossed those surfaces, and formed the two masses into one coherent whole. With a perfect weld any signs of the former division should be completely obliterated, and the cohesion over the original surfaces as strong as anywhere else within the mass. Probably this is never quite the case. Recent German experiments are said to have shown that, even with thoroughly satisfactory metal, there was a diminution of cohesion to the extent of about 17 per cent. This average diminution is doubtless due merely to the fact that at certain points of the welded surfaces the causes which prevent the cohesive forces from asserting their action have not been entirely removed. These causes have been already indicated. They fall under two heads—(1) the presence of any coating, whether consisting of a foreign element or an oxide upon the surface of the pure iron; (2) the presence of any crystalline structure in the iron itself. The exact way in which these causes act we cannot hope to determine, until we come to know much more than we do as to the forces of cohesion; but that they do act to the prejudice of welding cannot be doubted. Conversely, the two great requisites for a successful weld are (1) to ensure that the surfaces shall be perfectly clean, and (2) to bring the iron into an amorphous but not into a fluid condition. It only remains to use a moderate pressure, such as shall force the molecules at the surfaces into close and intimate junction with each other, and thus introduce them within the sphere of each other's cohesive action.

On the other hand, any attempt to cement the pieces together by means of a film of fluid metal interposed between the surfaces, is known to be useless, probably because the molten mass oxidises more rapidly than it sets, and thus takes the form of a scale, instead of uniting itself firmly to the surfaces on either hand. It may be suggested to physicists, in this connection, whether the interesting phenomenon known by the name of regelation—in which two pieces of ice, when pressed together, form themselves into a single mass—is, after all, anything more than a case of welding. It has generally been supposed that the union is due to the freezing of a film of moisture enclosed between the surfaces of junction; and much ingenuity has been expended to explain why this freezing takes place, even when the mass is at a temperature of 32° Fah. It seems at least worthy of inquiry whether this film of moisture really freezes at all—whether it is not, as a fact, driven out by the pressure, either at the edges or into the porosities within the mass; and whether the regelation is not merely the junction, by true welding or cohesion, of the still solid material on either side of the surface of junction.

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* From the *Engineer.*

PLATING ORGANIC BODIES WITH METAL.*

THE following recipes, says the author, have been used by me for several years past, and in my hands have proved entirely satisfactory:—

For Silvering without a Battery.

The object to be silvered, after being freed from adherent dust, dirt, &c., is immersed for two or three minutes in a saturated solution of gallic acid in distilled water. It is then dipped in a solution of 20 grains of crystallized nitrate of silver in 1,000 grains of distilled water. This operation is to be repeated two or three times, moving the object alternately from one bath to the other until it has acquired a silvery appearance. It is now rinsed in distilled water and laid on clean bibulous paper to dry. In the meantime have prepared two solutions as follows:—

Reducing Solution.—Grape sugar or honey, 5 parts; quicklime (CaO), 2 parts; tartaric acid, 2 parts; distilled water, 650 parts. Mix, dissolve, and filter.

Silvering Solution.—Dissolve 20 parts of crystallized silver nitrate in 650 parts of distilled water. Add strongest water of ammonia, drop by drop, continuously stirring the solution with a glass rod, until the brown precipitate is nearly but not quite redissolved. Filter and put in a glass stoppered bottle.

If more of the reducing solution be made up than is needed for immediate use it should be kept in a closely stoppered vial, filled to the top, so as to prevent atmospheric action. Equal parts of these solutions are mixed together in a gutta percha or japanned dish, and, after thorough stirring, filtered. The object to be silvered is immersed in the mixture, care being taken that the fluid shall come in contact with every part. The deposition of silver commences in from twelve to fifteen minutes, and continues for two or three hours, until the fluid is exhausted or the object sufficiently plated. The rapidity of deposition depends on the temperature, intensity of light, etc. After the object is plated it should be washed in a solution of carbonate of lime, rinsed in distilled water, and dried. All sorts of organic matter may thus be treated and hermetically inclosed in pure metal. I have thus coated leather, bone, wool, hair, horn, silk, flowers, leaves, insects, and anatomical preparations. Glass, porcelain, and earthenware may be coated without first using the preparatory bath. If the latter (earthenware) be porous it will be necessary to first coat it with water glass or varnish, otherwise there is great waste of material. I have before me a sprig of arbor-vitæ, on which a dragon fly is affixed, silvered by this method more than six years ago. The coating is without a visible break, though it has been somewhat roughly handled.

Processes with a Battery.

The success of these processes depends upon making the surfaces of the objects to be plated good conductors of electricity. The principles and *modus operandi* are nearly the same in all of them. The object to be plated is immersed in a solution of some easily reducible metallic salt, and kept there until its surface absorbs more or less of it. It is then so treated chemically that the absorbed salts are reduced to a metallic state, and so intimately attached to and connected with the surface of the material to be plated that they will not peel off or separate under any ordinary circumstances. The subsequent treatment is the ordinary electrotypic or galvanoplastic one of plating with any desired metal. On account of their easy reducibility, the salts of silver are those usually chosen for the preparatory manipulations.

Cazeneuve's Method.

Dissolve 40 parts of crystallised silver nitrate in 1,000 parts of wood spirit. Macerate the object in this solution until sufficient absorption has taken place. The length of time needed for this will vary according to the material, the horny shields of beetles, for instance, requiring much longer time than the softer parts, or than a piece of leather. Removing the object from this bath it is partially dried by draining off any surplus fluid attaching to it, and immersed in the strongest water of ammonia, by which the easily reducible double nitrate of silver and ammonia is formed. The object is now dried and suspended in mercurial vapour. In a few moments the surface is completely metallised, and can be electroplated in the ordinary manner. This method gives excellent results, especially for hard, compact, organic substances.

Oré's Method.

This process is that which has recently been much used in France for plating anatomical preparations, and when properly manipulated gives exquisite results. The preparatory bath, like the foregoing, is silver nitrate dissolved in alcohol or wood spirit, six grammes of the salt to one liter of the fluid. In this the object is immersed for ten minutes, when it is taken out and carefully drained. It is then transferred to a close box, in which sulphuretted hydrogen is liberated, and left for fifteen to twenty minutes. When it is removed the surface will be covered with a dark deposit of silver sulphide. The object should be exposed for a few minutes to the air before transferring to the galvanoplastic cell where the operation is completed. A human brain prepared by this process over a year ago is still a beautiful object, and bids fair to remain so for an indefinite period. In using this method for the preservation of brains and such material, the object should be kept in alcohol at least one month to give it the requisite hardness and consistency. Pledgets of cotton should be introduced into the fissures so that the circumvolutions are separated and the preserving fluid may penetrate every part. The pledgets must be removed before plating.

To keep Silver Plated Articles Bright.

Articles of silver and silver-plated ware rapidly tarnish when kept in rooms where gas is used for illuminating purposes, and everywhere in cities like St. Louis, Pittsburgh, Cincinnati, etc., where the air is constantly filled with sulphurous vapours. My cabinet of silver-plated specimens, instruments, and water pitchers used to give no end of trouble this way. This is all avoided now by dipping the articles occasionally in a solution of hyposulphite of soda. Large articles, like pitchers and salvers, should be wiped off with a rag dipped in the solution, and dried with a soft towel. A rub with a bit of chamois leather makes them as brilliant as new.

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* By Dr. Frank L. James, Prof. of Chemistry and Toxicology in St. Louis College of Physicians and Surgeons, a communication to the *Scientific American*.

Fauna of Light and Darkness.—It is remarked by Herr Fuchs, in a recent memoir, that while the littoral or shore animals do not extend much beyond 30 fathoms, one finds at about 100 fathoms, over the whole earth, that deep sea fauna whose similarity of composition everywhere is easily recognised, the chief types being deep-sea corals, lampshells, glass sponges, feather-stars, sea-urchins, glasmopodia, and flat fishes. At about 50 fathoms generally, the first of the deep-sea fauna are met with, and that depth may be taken to indicate the critical zone between the two fauna. In the tropics the two are separated by a very sterile region, reaching from about 30 to 89 fathoms; in temperate and cold seas, they mix in abundance in the critical region. It can be shown that neither the temperature nor the chemical composition, nor the movement of the water, will account satisfactorily for this vertical distribution. One factor remains to be considered, viz.,—light—and it is remarkable that the depth to which light penetrates in sea water is stated by Secchi, Pourtalès, and Bougner to be between 43 and 50 fathoms. Herr Fuchs infers that the shore fauna are fauna of light. The deep sea fauna, fauna of darkness. This view gains support from the fact that in some places where the light limit is higher, the deep sea fauna extends higher, and in fresh water lakes, where the light penetrates to greater depths, the shore fauna reaches further down. Again, many deep sea animals have either uncommonly large eyes like nocturnal animals, or are quite blind. They are mostly either pale and colourless, or entirely of one colour; and many have strong luminosity, while none such are found among shore animals. The so-called pelagic animals, which spend their life swimming in the open sea and never need to visit the ground, have much similarity to the deep sea fauna. The great majority are animals of the darkness; remaining in the dark depths by day, and only coming to the surface at night, and they are largely phosphorescent. The conception of the deep sea fauna as fauna of darkness accounts simply for their presence being wholy independent of temperature, and for their being found at nearly the same depth over the whole earth.

SCIENTIFIC NEWS.

WE regret to announce the untimely death of Prof. William Stanley Jevons, M.A., F.R.S., the eminent professor of logic and political economy. Prof. Jevons was born at Liverpool in 1835; he was educated at University College, London, and for some years held an appointment in the Sydney Mint. Returning to London, he took his M.A. degree in 1862, and was made a Fellow of his college in 1864. He was appointed professor of logic and political economy in Owens College, Manchester, in 1866, and professor of political economy in University College in 1876. Prof. Jevons was drowned on Monday whilst bathing between Bexhill and St. Leonards. He had not completed his 47th year. His chief works were the "Principles of Science" and the "Theory of Political Economy," which embody his ripest theories on the fundamental doctrines of logic and economics. A new work from his pen on "Currency and Finance" was almost completed by him at the time of his death, and will be issued shortly by Messrs. Macmillan and Co.

The official programme of the British Association meeting states that the first general meeting will be held in the Victoria Skating Rink on the evening of the 23rd inst., when Dr. Siemens will deliver his address. On Thursday evening the soirée will be held at the Hartley Institution, and on Friday evening Sir W. Thomson will deliver a discourse on the Tides, in the Skating Rink. On Monday evening Mr. Moseley will deliver his discourse on Pelagic Life, in the Skating Rink, and on Tuesday there will be a soirée at the Hartley Institution on the invitation of the mayor and corporation of Southampton. There will be five separate excursions on the Saturday afternoon to various places of interest, including one to Broadlands and Romsey, on the invitation of Lord Mount-Temple, and another to Netley Abbey and Hospital. For Thursday, the 31st, four whole-day excursions are arranged, and advantage will be taken of the opportunity to visit Osborne House. The so-called lecture to the working classes will be delivered by Mr. J. Evans, D.C.L., on "Unwritten History, and How to Read it." That will be given in the Skating Rink on Saturday evening. The Bishop of Truro will preach at St. Mary's on Sunday morning, and the Rev. C. Pritchard, the Savilian Professor of Astronomy at Oxford, in the morning will preach at All Saints. A useful "guide" to Southampton and its neighbourhood has been prepared by Mr. T. W. Shore, of the Hartley Institution.

The French Association also meets at the seaside this year—Rochelle being the selected spot. M. Bouquet de la Grye will deliver a lecture on the deep-water harbour of the port, and M. Hospitalier will discourse on the electric light. Amongst the excursions will be one or several for deep-sea dredging, under the direction of Prof. Giard, of Lille, and others to the oyster and mussel farms in the vicinity of Rochelle.

A minor planet was discovered by M. Paul Henry at the Paris Observatory on August 12. R.A., 22h. 1m.; Dec. south, 13° 35′; small motion south; magnitude, 12½.

Lieut. Darwin, R.E., has been appointed to the Brisbane station for the transit of Venus observations, Lieut. Thomas, R.A., will be at Barbadoes, and Capt. Macinlay, R.A., at Jamaica.

A sum of £18,000 has been voted by the French Chambers for the transit of Venus expeditions, and all the preparations are in a forward state. The French will have three parties in Patagonia, and amongst them will be M. Guénaire, photographer to the Nice Observatory. The results of the photographic experiments during the last eclipse were not remarkably good; but M. Guénaire, by using the Daguerreotype process, hopes to produce some plates from which accurate measures can be made.

The Argentine Republic is fitting up two stations for the observation of the transit, both of which will probably become permanent observatories, in addition to that presided over by Mr. Baring Gould at Cordoba. One of them will be at Buenos Ayres, the other near a place called Tandil, in the south of the province.

In M. Flammarion's *L'Astronomie* for August, the editor has a paper on "La planète Mars et ses conditions d'habitabilité," while M. Schiaparelli describes his new discoveries on the planet, and gives a Carte géographique des canaux nouvellement découverts sur Mars.

A new dynamo-electric machine, patented by Lord Elphinstone, and Mr. C. W. Vincent, of the Royal Institution, is attracting some attention. As the patent is not yet complete, full details cannot be published; but the machine is based on the discovery that the nearer the approach to a closed circuit, the stronger becomes the field, and the longer the iron retains its magnetism. Experiments are, we understand, being made on a large scale.

Sir W. Thomson has also taken out a patent for dynamo machines, in the specification of which several improvements are described. It is No. 5668 of 1881, and contains altogether 59 figures.

Two fires, produced by the use of electric lamps, have occurred in Philadelphia within a few months. In one case, the attendant had neglected to screw on the catch-basin to a Jablochkoff lamp used in a show window of a dry-goods store, and directly the current was switched on, a shower of sparks fired the goods. In the other, an incandescent lamp was joined with bad connections to the leads, the wires becoming white hot, and the insulating material, largely composed of paraffin, blazing away in close proximity to the floor above.

Prof. E. du Bois Reymond has been elected rector of the University of Berlin, and will enter upon his duties in the middle of October.

The fact that lambs have been reared on animal food will probably create some little astonishment; but the idea is not new. All animals reared on milk have been reared on animal food; but M. Regnard has been utilising dried blood from the slaughterhouses, which he dried at 212° Fahr., pressed and powdered in a coffee-mill. This powder of blood was given in doses of ten to eighty grammes daily, mixed with other food. The experiments were made on six lambs deserted by the ewes. Three were fed with the usual diet of beetroot, hay, &c., and to three the powdered blood was given. The first steadily lost flesh, while the latter increased to three times the original weight, and connoisseurs declared that they had never seen such fine lambs of the same age. The animals surpassed their fellows which had been suckled by their dams both in weight and size, and their coat of wool became doubled in thickness. Experiments of the same kind are now in progress with calves, and promise to be as successful as the others. Rickety children are also stated to thrive on the blood diet.

The Institution of Mechanical Engineers commenced its annual meeting on Tuesday at Leeds, under the presidency of Mr. Percy G. B. Westmacott. Amongst the papers promised are, "The Working of Blast-Furnaces of Large Size at High Temperature, with Special Reference to the Position of the Tuyeres"; "On Mining Machinery"; "On a Single-Lever Testing-Machine"; "On Governing Engines by Regulating the Expansion"; and "On M. Fromentin's Automatic Boiler-Feeder." Mr. Crampton was to lecture on his "System for Excavating the Channel Tunnel"; and Mr. J. Fletcher, "On Flameless Combustion."

The population of Lille have been distressed lately by the state of their water-supply from the Emmerin Springs; the water acquiring, especially after rains, a red colour, with bad smell and taste, and giving red deposits. The cause of this is the fungus *Crenothrix Kühniana*, Rabenhorst, whose filaments become charged on contact with aërated water, with a precipitate of sesquioxide of iron, then enter into putrefaction. Its unusual development is due to various causes. The soil has been prepared for it by industrial dejections, especially from distilleries, bringing abundant nitrates into the water-bearing beds (very superficial at some points). The springs, moreover, are near marshes and ponds. Last winter, having been rather dry, the aquiferous sheet was lowered about 16ft., and the spring rains suddenly raised it, engaging the vegetable and animal productions that had been developed in the moist earth. Once more, a part of the aqueduct passing through chalk, pierced with small holes, seems to have sucked in spores and filaments of the fungus whenever the current became somewhat rapid. Prof. Giard advises towns arranging their water supply to seek springs in the deeper strata (so as to avoid *Crenothrix*), to shun waters containing salts of iron protoxide (which is essential to the fungus), and to prefer the subterranean waters, the more aërated waters of lakes, far from all industrial works.

There is a strong tendency, in modern workshops, to bring steam force directly to each tool or machine, and there are signs that electricity will prove useful in the same way. An interesting application of the kind by M. Marcel Deprez, which he recently exhibited when lecturing at the Conservatoire des Arts et Métiers, is an electric hammer. This is composed of a solenoid about 40in. long, formed of a series of flat coils superposed and wire-connected—the whole forming a hollow cylinder, in which a soft iron cylinder, of 25 kilogrammes weight (the hammer), can move freely. With a circular commutator at the side, the system is, in fact, like a Gramme ring, only straight (with its collector). On the commutator are two brushes, at such an angle that they embrace about 10 of the contacts. Suppose, now, that at commencing, the soft iron hammer rests on its anvil, and that the current traverses the 10 lowest coils; the hammer will rise a little, and take a position in the region traversed by the current. On turning the commutator a certain extent in one direction, the current ceases to pass through the lowest 10 coils, and passes through the next 10 above; consequently, the hammer rises again. An opposite movement of the commutator gives the inverse effect—viz., descent of the hammer, which may be varied in speed by varied manipulation of the commutator brushes; indeed, the familiar effects of the steam-hammer can be well imitated.

M. Rousseau states, in a note to the Paris Academy, that while he was looking through his telescope on the morning of the 21st July, about 2 a.m., his vision seemed momentarily to lose distinctness, and he found that luminous sheets, like diffused lightning, filled for a moment the surface of the sky. He saw with surprise, too, diffuse flashes of the same kind, produced at about 20ft. from the ground. The phenomenon was repeated frequently during a quarter of an hour. There were no clouds.

Recently published statistics regarding the length of railways in different European states at the end of last year, show that Germany possessed 34,314 kilometres; Great Britain, 29,232; France, 27,585; Russia, 23,739; Austria, 19,126; Italy, 8,774; Spain, 7,839; Sweden, 7,431; Belgium, 4,123; Switzerland, 2,506; Holland, 2,296; Denmark, 1,696; Roumania, 14,174; Turkey, 1,395; Portugal, 1,219; Greece, 10. The total is 172,372 kilometres; in a straight line this is equivalent to thirty-five times the terrestrial meridian. The extent of new line made last year was 3,953km.; three-fifths of it in France (1,441km.). France counts 1 metre of railway per inhabitant (in this respect holding the first place); Germany, ½ metre. The total cost of European railways is estimated to be about 25 milliards, 855 millions of francs, the interest of which, at 3 per cent., is nearly 800 million francs per annum.

The Society of German cement-manufacturers recently held a meeting in Berlin, to consult on an attempt lately made in Germany, to bring into the market Portland cement mixed with other materials of less value. A powder of blast-furnace slag is chiefly used. The meeting considered that the effort in question was calculated to damage greatly the good reputation for solidity of the cement manufacture of Germany. Leaving the question open whether certain additions of small value to Portland cement, after burning, improve or deteriorate the quality, the Society agreed to consider that all such additions should be regarded and dealt with as adulterations where it was not stated on the barrels and sacks that such a mixture had been made. Only such additions, to an extent of 2 per cent., as are fitted to communicate certain properties to the cement—*e.g.*, gypsum, should not be regarded as adulterations. All cement works should be invited to agree to this, and the names of those that did not, should be published after October 1.

The electric resistance of glass at low temperatures has been recently measured by M. Foussereau. He tried three kinds of glass, ordinary glass, with base of soda and lime, Bohemian glass, and crystal. In all cases, lowering the temperature produced rapid decrease of conductivity —*e.g.*, ordinary glass at + 61·2° C. had a resistance (expressed in millions of megohms per cubic centimetre) of 0·705; at + 20° of 91·0, at − 17° of 7,970, this last representing nearly twice the resistance of a copper-wire 1 sq. mm. in section, reaching from the earth to Sirius. The hard Bohemian glass was 10 to 15 times more conductive than ordinary glass at the same temperatures, whereas crystal insulated 1,000 to 1,500 times better than ordinary glass at the same temperatures. The method was to send through a stoppered test-tube the electricity of a battery. This was collected in a condenser whose armatures were joined to a Lippmann capillary electrometer. The test-tube held and was immersed in concentrated sulphuric acid, into which entered platina electrodes. The outer vessel was in a glass envelope, the air in which was dried by sulphuric acid. The apparatus was put in an oil bath surrounded by a sand bath.

An interesting observation on tree rings is recorded by Prof. Bachelart in *La Nature*, during a visit to the ruins of Palenque, Mexico, in 1859. M. Charnay caused all the trees that hid the façade of one of the pyramids of the palace to be cut down. On a second visit in 1880, he cut the trees that had grown since 1859, and he remarked that all of them had a number of concentric circles greatly superior to their age. The oldest could only have been 22 years of age, but on a section of one of them he counted 250 circles; the tree was 60 to 65ctm. in diameter. A shrub, 18 months old at most, had 18 concentric circles. M. Charnay found the case repeated in every species, and in trees of all sizes. He concluded that in a hot and moist climate, where Nature is never at rest, it may produce, not one circle a year, as with us, but one a month. The age of a monument has often been calculated from that of trees that have grown on its ruins. For Palenque, M. Larainzar calculated 1,700 years, having counted 1,700 rings in a tree. M. Charnay's observation requires the number to be cut down to 150 or 200 years, making a considerable difference, 1,500 years. Prof. Bachelart asks whether M. Charnay took account of certain coloured rings which some tropical trees present in cross section, and which are to be distinguished from the annual circles.

At the works of Saint Chamond, in France, a new method has been adopted for annealing pieces of artillery of large calibre. A trench is formed, 22m. long, 13m. broad, and 16m. deep. In the middle is a pit of 4·75m. diameter, and 15m. deep, containing an enormous vertical tube with oil. The furnaces for heating the cannon are placed in the trench, and above them, at the level of the ground, are cranes for raising the piece from the trench and immersing it in the oil tube. Hitherto artillery pieces have been placed horizontally in a vessel of oil, and this method has the drawback of slightly arching the guns, whereas the new system produces no deformation.

Mosquito Oil.—A correspondent from Sheepshead Bay, a place celebrated for the size of its mosquitoes and the number of its amateur fishermen, recommends the following as a very good mixture for anointing the hands and face while fishing:—Oil of tar 1oz., olive oil 1oz., oil of pennyroyal ½oz., spirit of camphor ½oz., glycerine ½oz., carbolic acid 2drms; mix, and shake well before using.—*Drug Circular.*

Pearl Life Assurance Company.—The Eighteenth Annual Report of this Company records a great advance on any previous year's income, the net increase on the premium income being nearly 45 per cent. more than that of any previous year since the incorporation of the Company. 201,194 new proposals have been received during the year for which policies have been issued representing a new annual premium income of £101,967 10s. 5d. The total premium income for the year amounts to £110,283 10s. 4d. which represents an increase of more than £18,000 over the previous year's income. The annual premium income on the policies in force at the end of June amounted to £137,092 7s. 2½d. the amount being nearly double that of the year 1879.

Any one requiring sponge-cloths should send for a gross to Mr. J. R. Rhodes, of Barton Arcade, Manchester. His cloths are 22in. by 15in., good material, and only 11s. per gross.

LETTERS TO THE EDITOR.

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[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original." —*Montaigne's Essays.*

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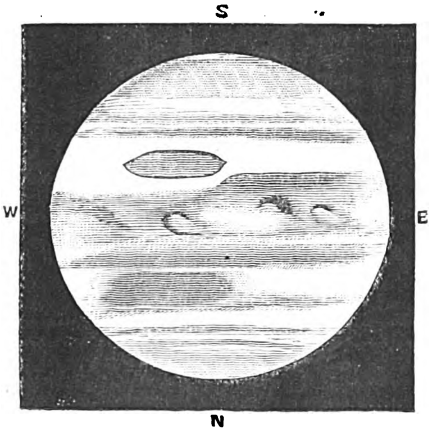
JUPITER.

[20380.]—On August 5th, 15h. to 16h., I obtained an excellent view of Jupiter. The brilliant equatorial spot crossed the central meridian at 15h. 4m., and at 15h. 12m. the middle of the great red spot was observed in transit. The former object moves so much swifter than the latter, that it gains 13m. 24s. (= 8·1° Jov. long.) per day, so that it is evident the two spots must have been in conjunction at about 0h. 44m. on August 5th. This observation enables us to compare their relative motion during the last few months with that derived in 1880 and 1881. In the *Monthly Notices*, Vol. XLII., p. 97-8, I stated that between Nov. 19th, 1880, 9h. 23m., and December 24th, 1881, 9h. 43m., the greater velocity of the bright spot had enabled it to complete nine revolutions relatively to the position of the red spot. The period of the bright spot was found to be 44d. 10h. 42m. 13·3s. Now, between December 24th, 1881, 9h. 43m., and August 5th, 1882, 0h. 44m., five more revolutions have been completed, with an average period of 44d. 17h. 24s., so that the time appears to have lengthened slightly during the present year. I believe the explanation is to be found in the fact that the slackening motion of the red spot has not been continued during the last four months.



Between July 8th, 1881, and March 30th, 1882, I obtained 63 observations of the red spot, and found that relatively to the times of passage of Mr. Marth's central meridian, computed on the period of 9h. 55m. 34·47s. (= 870·42° daily motion), the spot lost about 5m. or 3° of long. per month; for on July 8th and 10th the middle of the spot came to transit about 8 minutes after the assumed first meridian, whereas, on March 30th, 1882, the interval had increased to 48 minutes. Had this marked retardation been sustained during the last four months, the middle of the spot should now become central, 1h. 8m. after Mr. Marth's first meridian (*Monthly Notices*, June 1882, p. 391); but this is not the case. On August 5th, at 15h. 12m., the spot was exactly central, and the time may be relied on as very accurate, as the details of the planet were splendidly well defined. On this date the assumed first meridian passed the middle of the illuminated disc at 14h. 21·6m., or 50·4m. before the middle of the red spot, so that since March 30th the motion of the latter object has closely corresponded with the period of 9h. 55m. 34·47s. In other words, its velocity has been accelerated to the extent of 18 minutes, compared with that observed in the summer and winter of 1881.

Several new features are now visible on the planet. In the N. hemisphere, between the N. equatorial belt and the belt further N., there is a large dark mass connecting the two belts. It looks something like the red spot though not so well defined, and it occupies nearly the same longitude. It is about as far N. of the equator as the red spot is S. of it. This new marking is a very conspicuous object, and it will be interesting to find whether its period of rotation coincides with that of the red spot.

Another part of the planet has greatly changed since the last opposition—I refer to the region of the great south belt following the red spot. Under the *f.* end of the latter there has been seen, during the last two years, a narrow belt connected with the equatorial bands, and running a considerable distance along the southern outskirts of the great S. belt. This part of the disc is now a mass of dark matter. Under the *f.* end of the red spot the belt is apparently bulged out, so that the eastern side of the spot lies S. of a great cavity. The belt is very dark in this region and far to the eastward; but, on the whole, I believe the equatorial bands and the red spot are somewhat fainter than last year. The markings near the equator of the planet now exhibit signs of great disturbance, being broken in places and showing many dark and bright spots. The new spot N. of the equator, and the distortion of the great S. belt are now amongst the most conspicuous features of the planet, and I trust that some of your readers will examine them at an early opportunity.

W. F. Denning.

Bristol, August 6th.

CATALOGUE OF SUSPECTED VARIABLE STARS.—VII.

(*Continued from page* 520.)

[20381.]—**Taurus—Triangulum—Ursæ, Major et Minor—Virgo—Vulpecula.**

	Taurus.						
303.	Neb. 768	3	38	+ 23°	20	Var. nebula	(?).
304.	L. L. 7172		46	+ 7	24	6¾ — 8	Gould.
305.	P. iii. 213		54	+ 22	52	Comites Var.	Secchi.
306.	Aldebaran	4	29	+ 16	16	Var. Col. Mag. and Spectrum.	Secchi. Espin.
307.	....	5	27	+ 21	51	8½ — 11½	Schmidt.
308.	132......................		41	+ 24	33		Gore.
	Triangulum.						
309.	P. ii. 89	2	21	+ 29	22	6·5	Webb
	Ursa Major.						
310.	σ²	9	0	+ 67	37	Comites Var.	Sadler.
311.	....	10	36	+ 68	10	6·5	Franks.
312.	57	11	23	+ 40	0	Comes Var.	Webb ?
313.	65		49	+ 47	9	Comes Var.	Smyth.
314.	δ.........................	12	9	+ 57	42		Schmidt.
315.	η.........................	13	42	+ 49	55		Lalande. Espin.
	Ursa Minor.						
316.	B. A. C. 4166	12	14	+ 84	42	6 — 8·0	Tennant.
317.	B. A. C. 4193		19	+ 84	45	6 — 8·5	Tennant.
318.	β.........................	14	51	+ 74	41	2 — 2·5	Struve. Espin.
319.	ζ.........................	15	50	+ 78	10	4·2 — 4·7	Espin.
	Virgo.						
320.	β Virginis	11	44	+ 2	27		Webb.
321.	B. 277	12	19	+ 1	26	6 — 7½	Birmingham.
322.	B. 281		24	+ 5	46	8½ — 9½	Birmingham.
323.	γ.........................		36	— 0	47		Struve.
324.	L. L. 23824		40	+ 6	38	6·5	Gould.
325.	Σ 1686		47	+ 15	41	8·2	Struve ?
326.	Σ 1734	13	15	+ 3	34	Comes. Var.	Secchi.
327.	63		16	— 17	4	5·2 — 5·9	Gould.
328.	68		20	— 12	4	6·0 — 8·0	Secchi.
329.	69		20	— 15	19	4·8 — 5·4	Gould.
330.	72		23	— 5	49	6·7	Gould.
331.	....		23	— 8	56	8	Hind.
332.	74		24	— 5	28	5·0	Franks.
333.	ζ.........................		28	+ 0	1		Herschel. Gore.
334.	....		54	— 20	9		Knorre.
335.	L. L. 26031...............	14	5	+ 3	0	4·8 — 5·5	Gould.
336.	....	14	10	— 2	36	6·5	Gould.
337.	ν.........................		13	— 1	41	5·0 — 5·6	Gould.
338.	L L 26200		13	+ 0	57	6·5	Gould.
339.	φ.........................		21	— 1	40	4·8 — 5·4	Gould.
	Vulpecula.						
340.	B. 487	19	3	+ 23	59	6½ — 7½ Var. Col.	Birmingham.
341.	α.........................		22	+ 24	21		Franks.
342.	....		45	+ 24	37	5 — 7	Schmidt.
343.	32	20	48	+ 27	29		Franks.

T. E. Espin.
W. H. Gage.
T. Read.

ζ HERCULIS—4·56in. / APERTURE.

[20382.]—I have read with much interest the letters which have recently appeared in the English Mechanic concerning Zeta Herculis, and I can assure Mr. Simms (letter 20213, p. 377) that there is not the slightest shadow of a doubt in regard to my divorcing Zeta Herculis in June, 1880, for I not only repeatedly did so myself, but both Mr. Masters and Mr. Weed had no trouble in making the same observation on several occasions, and this, strange as it may seem, was when we could not divorce Zeta Herculis with a 4½in. Wray. I mention these two facts in juxtaposition to show the utter ridiculousness of depending on that erroneous and antiquated formula, 4·56in. / aperture. It is hardly necessary to point out that, according to the E and A formula, the 4½in. Wray ought to have divorced it, and it ought to have been impossible with a 3½in. aperture; but the truth was exactly the reverse of this. It may well be asked, What was the cause of such a difference in the performances of the two glasses? This was due, in my humble opinion, to four things. First, the quality of the objective, the eyepieces, the eye, and collimation. Though all those causes may have been concerned, still, the main cause was the eyepieces. With such eyepieces as came with the 4½in. Wray, I should consider it a "large order" to divorce Zeta Herculis with 8½in. One of them made a flag-pole look as crooked as the handle of a jug, another we call the London fog, and I am afraid we condemned and sent back a fine objective, when the whole of our disgust ought to have been vented on the eyepieces. However, by discarding the whole coterie as useless, and getting new eyepieces, we are now pleased to say our 4½in. Wray begins to work as if it had no respect for that E and A formula. And why should it? That E A formula only represents the performance of ordinary objectives, with common eyepieces, under ordinary atmospheric conditions. It does not give the limit of good American objectives, and, in my humble opinion, our 4½in. Wray will split below it. Alvan Clark, a short time ago, promised to make Mr. Weed a 4in., on the very condition *that unless it split to* 1″ he was not to take it; the maker of my 3½in. offers to make me a 4½in., that unless it splits to 0·8″ I need not take it.

James H. Gardiner.

Newburgh, N.Y., August 1.

RIVETING CHINA, &c.

[20383.]—Queries relating to this subject have frequently appeared in the "E M.," but according to my ideas, the replies have been of a meagre and unsatisfying nature, such as left the querist in pretty much the same state of darkness as he was in before. As I promised lately, I here give such as are interested in the work the benefit of my little knowledge of it. It may be observed that it is an unusual subject for a watchmaker to write upon, but then, as I have said, I have had frequent opportunities of seeing the work done, and observing the methods adopted to secure success. It can in no way be called a branch of mechanics; but, as it is a matter with which householders are intimately associated, there may be many readers of these pages who may profit by a little instruction in the art of repairing and riveting china and glass. Glass-blowing and mending I have done on a small scale as a sort of pastime.

FIG. 3.

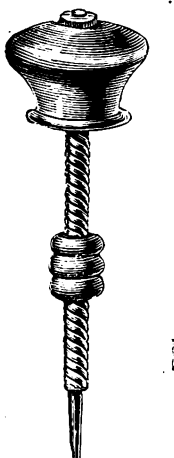


FIG. 11.

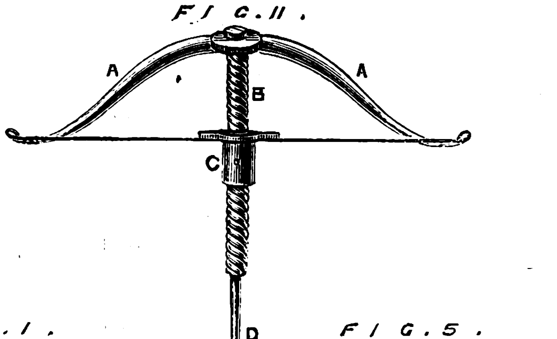


FIG. 1.

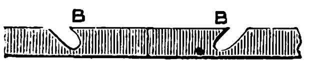


FIG. 5.

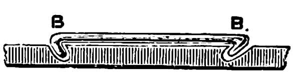


FIG. 4.

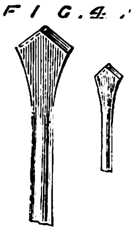


FIG. 7.

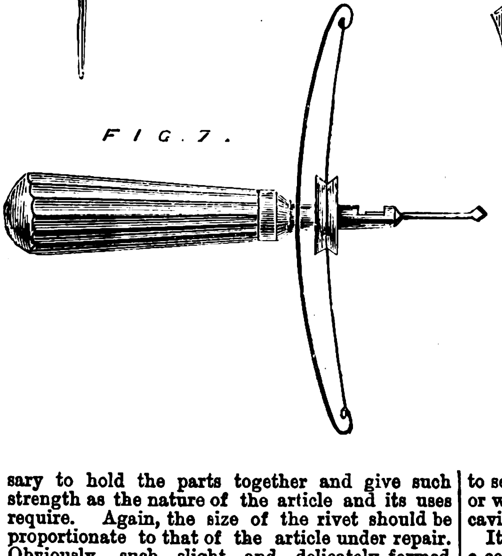
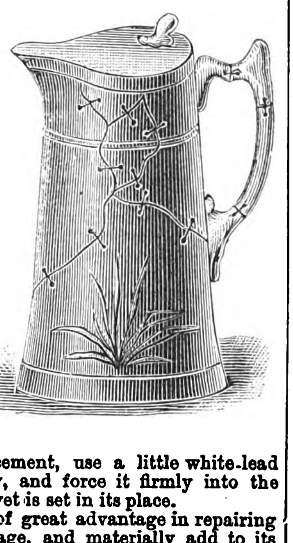


FIG. 6



It has always appeared to me that an unnecessarily large number of rivets are invariably put in the broken articles by the itinerant menders who perambulate the country. It may be that the workman has an eye to getting as much as possible out of the job, or he is led away by a desire to make the article as strong as possible. It is charitable to allow that the latter is the correct supposition. Anyhow, I think for all ordinary requirements, a few well disposed rivets are quite as efficient as a large number crowded together in an unsightly manner. For a simple crack, two or three rivets are ample. A compound fracture necessarily requires an increased number of rivets. There is no great beauty in a rivet at any time, so no more should be used than are absolutely necessary to hold the parts together and give such strength as the nature of the article and its uses require. Again, the size of the rivet should be proportionate to that of the article under repair. Obviously, such slight and delicately-formed articles as are found in some tea and coffee-services, should not be fitted with such large rivets as would be necessary to hold together a punch-bowl or soup-tureen. Yet it is no uncommon thing to see the same sized wire used indiscriminately. The drills and wire should in all cases be consistent with the job. The term riveting is, to my mind, rather misleading, as, in fact, the mending is not riveting at all in its generally understood sense, because the holes are seldom or never drilled right through and the wire hammered over. The holes are drilled only partly through, as in Fig. 1, and at an acute angle, as will be seen in the drawing. The purpose of this will be evident, as by reason of the rivet-ends undersetting in the hole, the possibility of the rivet working out is almost nil. The drill should by preference be a diamond, mounted up as in Fig. 2, or in a somewhat similar manner. The diamond being soldered into a metal tube, slightly coned in shape, as at D. The top part A is a flexible spring, fitted with a drilled collar. The screw B is free to move, when acted upon by socket C, by moving which up and down, the part B is revolved, together with the drill. A common form of drill is represented in Fig. 3. This, I think, is known by the name "Archimedean." It is not so useful a form of drill as the other, because both hands are needed to work it, unless the handle is held against the breast. With the other form of drill one hand is at liberty to guide the drill and hold the article. In drilling, a finger should be placed at the spot operated upon, for the purpose of feeling when the drill-point is nearly through. Its approach will be known by a perceptible warmth and vibration (if I may so term it). It should not be allowed to come through or even to chip the enamel. Although a diamond-drill is almost a necessity for this kind of work, it may be done by a properly shaped and tempered steel drill, when assisted by a little spirit of turps as a lubricant. The cutting edges of the drill should slope in opposite directions, two facets only, as in Fig. 4, representing two sized drills. In starting the holes the drill may be guided by the fingers, or a piece of metal with a hole in may be held down in position as a guide for it. The wire used for riveting should be of brass or copper, well tempered, and accurately shaped and fitted. The rivets should have a little spring, so as to catch under the holes on the inner sides, as at B, Figs. 1 and 5. The rivet faces should be filed flat, so as to set close. For cement, use a little white-lead or well-made putty, and force it firmly into the cavity, after the rivet is set in its place.

It will be found of great advantage in repairing a compound breakage, and materially add to its strength if a little transparent cement, made of acetic acid and isinglass, is applied to the edges of the china before the final job of riveting; or, if time will allow, the broken parts should be firmly attached to each other an hour or two previously. The parts should all be perfectly clean, and be slightly warmed before applying the cement. If they are not heated, the cement gets cooled, and, instead of adhering, forms a hard, loose skin-like substance, which prevents a close fit, and is perfectly useless in its place.

The parts can be effectually and safely heated by immersing them in hot water, and wiping dry on removal. The job should be done quickly, and the parts brought together immediately the hot cement has been applied, as it sets quickly. All that exudes can be removed when cold. Fig. 6 shows an article much broken which has been strongly mended and made thoroughly useful again, with a comparatively small number of rivets. Fig. 7 shows a very handy form of bow drill, the handle of which contains the drills not in use, the end of it unscrewing. The socket of the drill is keyed into the handle, and revolves with the bow and wheel. For very large articles this form of drill is exceedingly useful, as it can be held in any position.

Glass goods are mended in a precisely similar way to china, extra care only being needed on account of the brittleness and thinness of the articles generally. Stems of wine-glasses may easily be joined together by melting the broken ends in a clear gas or other flame, and pressing together when perfectly plastic. The blowpipe will assist in getting the heat up. Glass is such a slow conductor of heat, that no fear of burning the fingers need be entertained, unless the worker is an immoderate time at the job, so that the parts can be held by the fingers without danger to them. When mending glass goods in this way, the surrounding air should be kept perfectly still, and all possibility of a sudden draught of cold air falling upon the heated glass guarded against. A draught of cold air upon the junction would prove fatal to it. The stem can be set upright while the glass is soft. Let all cool gradually.

Alfojoe.

SCIENCE AT SOUTH KENSINGTON.

[20384.]—Evidently, Sir, your article upon the above subject has disturbed Mr. E. Jackson's tranquillity of mind, and other people's, too, but in an opposite direction. No doubt each correspondent is giving the result of his own experience, and trusting that the controversy may be crowned with a good result. A few years ago the writer was "fortunate enough" to be a student at one of those science classes under South Kensington, and the subject under consideration was physiography! However many subjects are included in that "term" now we do not know, but at the period we are writing about it meant "physics, chemical elements, geology, astronomy, and physical geography"; and what is more surprising still, we were beautifully glided through the whole domain (?) of these various subjects in about twenty hours (that is, twenty lessons of one hour each). If the proper designation of such procedure as this be not "cram," we are at a loss where to search for an appellation wherewith to adorn it. We met weekly, or at least should have done, to receive our so-called "science lessons." The method of receiving them was as follows:—The students sat down each side of a long table, and the teacher (?) at the bottom end. After all were duly seated, the strict injunction came, "Take out your books, and turn to page so and so." Then the teacher would commence, and read over the various pages, the students of course looking at their books and following him.

Presently a student, whose curiosity was more acute than his neighbour's, would ask for an explanation of some rather obscure sentence before we proceeded further, to which came the stereotyped reply of "Never mind, you won't be likely to have a question upon that." (Probably a philosopher in embryo.)

Now, Sir, if such teachers are "not responsible" for the replies of their pupils, we very earnestly inquire who is? Mr. E. Jackson cannot accuse the pupils here of not paying attention to their lessons. The profound secret with the teacher was the discovery of all those points upon which he thought there would be questions asked, and a judicious avoidance of the remainder.

During the whole course of lessons we never saw a specimen of rock, and, as far as my memory serves me now, we never had a single experiment performed. One night, by way of a change, we had a small globe to show us the shape of the earth, and the distribution of land and water.

Such is the writer's experience of the Science Classes under South Kensington: the value of it we leave to your readers. **A. Manock.**

[20385.]—"Nun. Dor" is wrong in saying that I show that one half the instances I quote have gone astray from the very objects of the Science Department; I show nothing of the kind. The gentlemen I referred to were trained at South Kensington for the purpose of teaching, and this they have been engaged in ever since they left the school. "Nun. Dor" can satisfy himself on this point as regards my own case by referring to the "Science Directory" for any recent year. As the whole of "Nun. Dor's" argument is based on this misconception, now that I have removed the foundation, the superstructure falls to the ground.

Edward Jackson.

Birmingham, Aug. 12.

STONEHENGE AND SUN-WORSHIP.

[20386.]—I do not know whether the material of which Stonehenge is composed agrees with that of the eocene strata or not; but I fancy that it does not. I have stated that it is my intention to visit the place as early as possible, when I will see if I can detect the protruding rocks spoken of by our friend "Neo." I examined the stone about a year ago; but owing to a heavy storm overtaking myself and friends, we had to beat a hasty retreat, and I was not able to glean quite as much as might have been wished.

I will now exhaust my stock of information concerning the place, and shall not be able to state anything further until I actually visit these noble remains.

Stonehenge is situate about 8½ miles N.W. of Salisbury, and lies not far from an angle formed by the junction of two roads; one leading to Wylye (south), and the other to the north, through Shrewton and Heytesbury to Warminster. On advancing up the latter, we arrive at the avenue leading directly into the temple from the N.E., which is defined by a bank and ditch on either side. The first object which meets the eye is a stone about 16ft. high—"The Friar's Heel"—looking, as a writer on the subject has stated, like "a venerable Druidical figure, with long flowing beard, in an attitude of devotion, bending towards the sacred pile." Still advancing, we enter the area of the work, and find that it is surrounded by a ditch and slight *agger* of earth. This is outside the vallum; and the circumference is 369 yards. In a line with the "Friar's Heel" is a large prostrate stone, which bears the mark of tools, and once stood erect; it is supposed to be the altar on which the victims were immolated. It is 100ft. from the "Friar's Heel," and the same distance from the outside of the stone circle. From Vallum to Temple, and the inner diameter of the Temple itself, are both 100ft. The Britons (or other constructors) seem to have been partial to the proportion of 100ft. Before entering the temple we must observe two stones on the outer circumvallations—one on the south-east side, and the other on the north-west. There are two small tumuli on the opposite points, which are supposed by Stukeley to have supported two vases. The two stones just mentioned he assumes were altars. One of the tumuli, when opened, was found to contain burnt bones. The vallum and agger deviate at the tumulus opened from the circumferential partiality generally apparent, which leads to the deduction that this sepulchral barrow existed prior to the erection of Stonehenge. The trench surrounding the building cuts through one of the barrows containing no metals. Hence, it is again adduced that Stonehenge was not created until after the time of the origin of some of the barrows.

Perhaps, however—and it seems very probable—the trenches were dug by a small force of soldiers at some time or the other. The large stones already erected wanted but an entrenchment to form them into a capital little stronghold in days gone by. On the other hand, it may not be so. The burnt bones would indicate the latter.

The temple consisted of two aisles and two ovals, the latter constituting the "Cell or Sanctum." The outer circle is about 300ft. in circumference, and was composed of huge upright stones, bearing others placed horizontally on their tops, and mortised and tenoned together. "The horizontal ones touched each other and formed a continual corona all round the building." These stones, though irregular in shape, bear tool marks. Originally, there were thirty uprights, and as many imposts; of the former seventeen still stand, of the latter six remain.

The uprights average 16ft. high, and about 18ft. in circumference. The space given between each stone nearly corresponds with their width, which is about 3½ft. The entrance is slightly wider than the other intervals.

The inner circle consists of much smaller irregular stones, which show no marks of tools, and is distant from the outer circle about 9ft. Twenty stones out of a probable forty remain in this circle.

Next we notice the cell or sanctum, consisting of two ovals, a larger and a smaller one. The large oval was formed of five pair of trilithons. These rose gradually in size from east to west One of the uprights of the central trilithon has fallen, and is now in two pieces 26ft. in length. The other upright of this trilithon is 9ft. out of the perpendicular. Apparently, it is supported at the bottom by a smaller stone, which is ribbed or grooved. Sir R. Colt Hoare states, "The adhesion between them is just sufficient to swear by, and that is all." The tenon on the top of this stone is very apparent.

The trilithon next to the grand central one (just noticed) fell outwards towards the west in 1797, and in falling struck one of the stones of the outer circle. One of the uprights measures 21ft. 4in., the other 21ft. 3in., a very nice measurement if executed by an "unknown and long-forgotten race," who presumably had no means of hewing the blocks down to so marked an equality. The impost measures 16ft. The last trilithon (that on the right of the cell) has one upright still standing. The impost, and the other upright, have each fallen into the cell, and each has divided into three pieces. I have a guide before me, which I find a great assistance when visiting the place, obtained from an old person who watches these valuable old mysteries of the past. The inner oval consisted of 19 stones, of which 11 remain. They are inclined to a pyramidal form, and are smoother than the other stones. Within this oval is the altar stone.

The entire number of stones has been put down at from 129 to 140. The following opinions have been advanced as to the origin, &c., of this ancient pile:—

"The origin of this temple appears to have been as deeply involved in mystery in the twelfth as it is in the present century."—F. A. Blake.

"It is mortifying that the history of Stonehenge should still remain veiled in obscurity. . . . . All is darkness and uncertainty: we may admire, we may conjecture, but we are doomed to remain in ignorance and obscurity"—Sir R. C. Hoare.

Campden laments the obscured origin of this ancient pile "with much grief."

Inigo Jones states it is the ruin of a Roman Temple.

"The circle of Avebury, of which only a small portion now exists, may be considered as belonging to the remotest period is evident from its ruder character alone; but to Stonehenge must be ascribed a date long posterior to many of the barrows on the plain from the working of the stones, which could not have been accomplished without the use of iron."—Hatcher.

I agree with Mr. Hatcher on this point, and, consequently, I gave the opinion in opposition to "Neo," concerning the erection of the stones in the Neolithic age; but, referring to my extract from Sir R. C. Hoare, he is of opinion that *all* assumptions are useless. The pile might, as "F.R.A.S." has said, have been created in the Bronze age.

The late Rev. Ed. Duke classes Stonehenge with all similar monuments throughout the world, and supports "Neo" by assuming them to be sun-temples. "I cannot," he says, "but presume them to be the temples of the first heathen, dedicated to the sun."

I have now submitted all the material likely to lead to a just conclusion, although we must despair of having arrived at any really satisfactory expoundment. Ages upon ages have doubtless gone by since these stones were erected, perhaps an age before the Roman invasion; but it is hard for me to evade the idea that iron was used, and I cannot therefore carry its origin further back than the Druids. We know that iron was used in this country when the Romans landed, for their chariots were fitted with scythes.

We must allow for decay when considering the workmanship developed on this ancient monument, the decay of centuries; but whatever be the amount of attempted elucidation, whatever be the extent to which we carry our expostulation, I really do not think we shall arrive at a true verdict, or even at an assumption of any intrinsic value.

H. Stooke.

RAILWAY SIGNALS.

[20387.]—I do not think that such a change of system in the working of signals proposed by "Nun. Dor." would be any advantage. He states that by the present system a driver proceeds unless obstructed; so he would if the system was changed as proposed. In the present arrngement, the all-right is a positive order to come on, so is the danger a positive order to stop, and each is a direct and positive signal.

I agree with "A Driver," that there should only be two signals, the all-right, the old caution, at an angle of 45°, and the danger, at an angle of 90°. I think it would be better to take the angle from the centre of the arm; for if the sides of the arm are parallel to the centre, they would be at the same angle. Also, the all-right light to be green and the danger red. Should the signal indicate any other position, either in the position of the arm or the colour of the light, it should be treated as danger, and the driver to proceed slowly to the next signal-box. Two or three degrees in the position of the arm either way I don't think would matter, but beyond this a signal to be considered danger.

I think that the signal-posts should be fixed on the side that they are best seen, on a straight road on the left, but on curves on the side that the signal will first be noticed. To have them all on one side would necessitate having a separate post for the up and down signal, instead of using one post for the two, which is now done in a great many cases.

In his last letter (20367), Mr. Stooke speaks of the expansion of the wire altering the angle of the arm. Could not this be obviated by a weighted compensating lever? Also, I think the variation of the angle due to the wearing of the axle and axle bearing, could be adjusted by set-screws in the bar which the counterbalance weight falls upon, so as to be able to adjust the fall of the weight; or a shackle, with a right and left-handed thread, could be introduced in the connecting-rod, so as to be able to lengthen or shorten the rod.

J. G. Moon.

[20388.]—"Nun. Dor." (letter 20344) suggests an alteration in signalling, the practical value of which is anything but apparent. In the first place, the suggested alteration is a mechanical disadvantage. In a large number of cases the semaphore arm would have to be moved 90° where now 45° suffice. This means that double the amount of wire has to be taken up by the lever—a serious consideration in a distant signal, raised, say, 20 times in the course of an hour. Again, the normal position of the arm being 90°, the signal must be perfect in its action, and expansion and contraction in the wire counteracted, or the "all right" signal would vary some 20°, according to the temperature; and the arm, when not difficult for the signalman to put on, would look untidy, and be misleading at an angle of some 10° or 15°, and some difficulty might be experienced at night with the coloured glasses.

Were the mechanical defects surmounted, the system would have to be universally adopted, or not at all; it would be scarcely fair to ask a driver to work his train under two systems diametrically opposed, and then hold him responsible for an accident caused by his mistaking the signal. Even let the system be generally adopted, I do not think that the expense incurred would be compensated by any advantage gained.

Cora.

[20389.]—The "radical change" which "Nun. Dor." advocates with regard to signals has certainly an advantage in the fact that the arm would "fall to danger" in case of a wire, rod, or other portion of working gear breaking; but, surely, would not the very confusing alteration involved in the adoption of his arrangement be in itself sufficient to be fatal to its actual use?

In the new-pattern signals on the G.N.R. the arm has a continual tendency to return to danger by gravity, because it is pivoted at its centre, and above the horizontal centre-line of the arm; therefore, in these signals, counterweights are not used when the post is near a signal-box, the weight of the arm and rod being sufficient to overcome the friction of a short distance of wire on pulleys. The G.N.R. has also a good arrangement with regard to the night-glasses. In whatever position on the post these may be, the working gear is so contrived that they are *raised* when the signal is taken off, and so help its return to "danger" by their weight. This arrangement is the reverse of that of some companies, the glasses with them having to be kept raised when the arm is at danger in cases where the glasses and arm are on the same side of the post.

Both for the sake of uniformity and clearness, an angle of 45 for a "go ahead" signal would be the best to adopt universally; except in the G.N.R. projecting semaphores, which are most clearly distinguished when the arm is parallel to the post.

Some of the companies are discarding arms swung in a slot in the wooden posts, and are pivoting them on the outside of solid posts. Of these are the Metropolitan (Harrow Extension), North Staffordshire, and Great Northern, the latter's being all projecting.

Tittesworth.

[20390.]—I do not agree with "Nun. Dor's." proposal to reverse the method of working the signal-arm. We want a conspicuous signal for "danger;" and to obtain such, we must keep the arm in a horizontal position. We *do* give a "positive signal to come on," by giving "clear," and if the arm falls into the post, I have already said the condition is treated as "danger." I do not see what else he can require.

"A. S. H." states the arm should not go lower than 45°. I have stated that this represents "clear"; but we allow the arm to go to 85° as an allowance for expansion. Signals should, if possible, be placed on the left-hand side of line; but engineers have *reasons* when they do otherwise—or, at least, they should have. Our correspondent will observe that green, instead of white, lights are in several places being provided.

Two slight errors have crept into my last, due to bad scribing presumably. After word "off," top of column, page 523, please read, "or when the wire breaks." For the word "curve" in last paragraph, please read "arm."

H. Stooke.

THE VIOLIN MUTED.

[20391.]—In his letter, "The Violin Muted," p. 452, "Fiddler" very properly inquires into the results which would ensue, if the resonator, instead of being fixed near the neck, would communicate in the region of the F holes with the back. If "Fiddler" merely wishes to have the freedom of the top, this is already insured at present, as the hole through which the screw passes is large enough to avoid interference between resonator and top. But a more important question comes up here—viz., how the resonator is to be attached to the back through the F holes. Before settling upon the distance from the neck where the screw should pass, I made a number of experiments to determine the correct distance, and I found that the nearer I came with the screw to the bridge, the less volume I obtained; but I did not take time enough to determine whether the loss of sound was due to a pressure on the back, or to the shortening of the free end of the resonator. The fact is, with this new mode of stringing, an endless change of experiments is before an observant experimenter, and as I very soon will put the resonator in the market, I will enable those interested to make all possible trials. Now permit me to give another information. There is a pardonable tendency on the part of many violinists to discard beforehand the idea of a violin without end to end pressure, as aimed at by me. I am prepared, after some successful experimenting, to offer a compromise, and I now restore a *portion* of this end to end pressure, but under a different form. The latest development combines the merit of the vibrating string holder with light bridge pressure, and end to end tension. Such a violin will be sent to "Fiddler" in about a week, and I dare to anticipate that he, and your other correspondents, will be able hereafter to concede a fulfilment of my promises.

E. Berliner.

Boston, Mass., U.S.A., Aug. 1.

COLOUR.

[20392.]—I am sorry I have not opportunity to write in reply to Mr. Geo. Smith's letter (20373) more fully; but the quotation he gives from Tyndall's "Light" he certainly understands differently to myself. Tyndall says, "On the screen are now 10 coloured rectangles." I understand this to be 10 differently coloured. He then says "by judicious management one of these colours is rendered yellow, the other blue." I take it the remaining eight rectangles are stopped out altogether, and certainly do not think that Tyndall says or implies that blue and yellow contain all the colours of the spectrum. He distinctly says: "I deflect one portion of the colours and leave the residual portion," as Mr. Smith says; but this is clear language in a different sense to the way Mr. Smith understands it, and in this experiment blue and yellow do not contain all the colours of the spectrum, but the "residual portion" only when part has been deflected.

I beg to suggest an experiment with polarised light and a double image prism, whereby two discs of green and red or yellow and blue can be made to overlap, and where they overlap are white in the case of the blue and yellow.

I do not differ from Mr. Smith's statements as to the result of looking through coloured films or glasses at various objects; but I submit these experiments, however interesting, are beside the question.

I agree with him that no natural colours are pure. With regard to the one-tenth of white light mixed with nine-tenths coloured, destroying all trace of colour to the eye, Mr. Smith in my opinion makes an important qualification this week. (I hope he did not understand me to charge him with wilful misstatement.) He says now that "if an aperture of one-tenth be cut in a coloured disc and the disc be rapidly revolved, the effect will be a white ring on a coloured ground." Just so; because the comparison is made with the deeply-coloured portion, and this kills the colour on the apparent white ring: but if the one-tenth be cut away from centre to circumference, and revolved with a totally uncoloured ring left for comparison, it will still appear coloured enough to the eye for all the one-tenth admixture of white light. Why I spoke so confidently on this point was because of the known fact that every object we see reflects back to the eye more than one-tenth of white light mixed with the colour we perceive. I will venture to say that the brightest and most vivid colour reflected by any object is mixed with more than one-tenth of white light, and therefore such mixture does not and cannot extinguish the colour.

The undulatory theory would lead me to expect that very various combinations of rates of vibration would be undistinguishable to the eye. A great many combinations would produce white light, or other combinations green, or blue, or violet, and these might be undistinguishable, from the pure monochromatic colours of the spectrum, as far as the eye is concerned, just as 10 and 2, or 9 and 3, or 8 and 4 will make 12, and if we only saw the total without means of analysing, we could not tell how it was made up. Neither does the unaided eye help us with colours or with white light, but the prism enables us to ascertain the components, and to tell whether vibrations are simple or compound.

E. Holmes.

COLD-WATER SOAP—ALUMINIUM—MELLOGEN—ACETIC ACID—ARSENIC—ARSENIC IN WALL-PAPER—COTTON.

[20393.]—In reply to query 47388, page 436, headed "Cold-Water Soap," this term is usually applied to soaps containing more or less sodium carbonate. Such soaps lather pretty well with hard water. They must not be confounded with soaps manufactured by the cold-water process. I have no knowledge of the particular brand of soap mentioned by the querist.

I fancied "Zelia Naien" really desired information about the production of "Aluminium" (query 47416); but it appears (page 436), that he has mastered the most difficult part of the problem, and now only wants a solution of minor details. I sincerely congratulate him, and the more so as his supplementary discovery of a (cheap ?) method of reducing magnesium and other metals without the aid of sodium is scarcely secondary in importance to the economical reduction of aluminium itself. In writing of the inventor's "hopeful method," I intended to refer to the probable value of it.

I am unable to suggest any formula representing the production of "Mellogen," and far less do I "know" the reaction which occurs.

"Acetic Acid" (query 47524, page 484) is most readily assayed for strength by titration with standard alkali in the manner described by E. S. Beavan, on page 507. Tables of densities of acid of various dilutions have been constructed by Mohr and by Oudemanns. According to the latter chemist, Mohr's observations were made on an impure acid, containing about 5 per cent. of water, although Mohr's figures appear to be those from which the alleged strength of the B. P. acid has been calculated. Careful experiments made by me some years since (*Analyst*, III., 268) proved that serious inconsistencies existed in Oudemann's "Table of Densities." The part referring to 28 per cent. of acetic acid is fairly correct, but the densities of diluted acid are seriously in error. Entirely distinct from the above considerations, there is the fact that acid containing 79 per cent. of $C_2H_4O_2$ is at its greatest density (1·0748), the gravity decreasing both by dilution and concentration. "Phosphorous" will find both Mohr's and Oudemann's tables in Vol. I. of my "Commercial Organic Analysis," together with details of other and better methods of determining the strength of acetic acid.

"Arsenic solution" (query 47576, page 508) is a nasty thing to keep one's fingers in. Why does not the querist wear the indiarubber finger-stalls used by photographers, &c., and obtainable at any india-rubber shop? Or he can extemporise similar protections by wrapping guttapercha tissue round his fingers, and making the joints tight by warming before the fire and pressing?

In answer to query 47261, entitled "Arsenic in Wall-Paper," "Beetle-Crushers" writes": "I suppose, from your query, you understand something of chemistry." From his reply, I suppose "Beetle-Crushers" does *not* understand anything of chemistry. His answer is utter rubbish. Fancy his expecting the arsenious oxide or arsenite of copper to inflame spontaneously in chlorine gas, and recommending this as a test for its detection! Fancy, further, his stating that sulphide of ammonium will give a yellow precipitate, with a solid arsenical compound, and especially with arsenite of copper! Oh, poor, neglected, and forgotten Montaigne!

The readiest way of detecting arsenic in wall-paper is to roll up a strip, some few square inches in area, and warm it with dilute hydrochloric acid till the colouring matter is dissolved. If a strip of bright metallic copper is not darkened when boiled for a few minutes in a portion of this solution arsenic is certainly absent. If the copper becomes covered with a grey coating, another portion of the liquid may be treated with zinc, free from arsenic, in a hydrogen apparatus, and the evolved gas kindled after the air is expelled. On depressing a cold piece of glass or porcelain on the flame, a hair-brown deposit will be produced if arsenic were present. The best method to obtain an idea of the amount of arsenic present is to treat the acid solution from (say) 20 sq. in. of paper with tartaric acid and excess of caustic soda; then pass sulphuretted hydrogen to precipitate the copper and lead; filter, and acidulate the filtrate, when a yellow precipitate of As_2S_3 will be obtained, and may, if desired, be collected, washed, dried, and weighed.

"Cotton" (query 47655, page 532) may be tested for jute by treating it with chlorine or hydrochloric acid and potassium chlorate. The chlorinated fibres are then washed and treated with a solution of acid sulphite of sodium, when those derived from bast (jute) will acquire a fine crimson tint, the cotton being unaffected. **Alfred H. Allen.**

Sheffield, August 12.

FAURE'S ACCUMULATORS.

[20394.]—In your "Scientific News" in this day's (August 11th) Mechanic, it states that a watchmaker in Paris lights his shop with 24 Swan lamps worked by 24 Faure accumulators.

Turning to page 523, in same number, I find the following:—The E.M.F. of a Faure accumulator is two volts. The E.M.F. required for a Swan incandescent lamp is 45 volts; so that two dozen accumulators are required to light one lamp.

It is a pity that people write about what they know little about, causing such absurd and misleading statements to be made.

Some time since I called at the office of the Faure Accumulator Company, in the Strand, and asked the obliging attendant how many cells were required for one Swan lamp. He replied, four; and, as I presume that he would know something about it, I can only conclude that your correspondent, "E." (page 523) knows nothing about it, and that the French watchmaker knows more than both put together. **Caloric.**

CROWN-GLASS ACHROMATISM.

[20395.]—The letter of "Orderic Vital" (20356) has caused me the greatest astonishment.

He says, "f_2 must be less than f_1; for, if not, the convex achromatism would exceed that of the concave when the lenses are in contact, and the error would be increased by separation." But why so? How can he prove that the error would be increased? He gives us no proof, and does not even give a hint as to how he arrived at his conclusion. On the other hand, the real way to ascertain whether it is so or not is to form a general expression for the aberration of the rays after passing through two lenses. Call it u, and call the distance between the lenses a, then find $d_a u$. If this is *negative*, as I find it to be (quite irrespectively of any numerical relation between the convex and concave), up to a certain value of a, it shows that as a increases u diminishes, f_2 being supposed numerically greater than f_1, and, therefore, possibly it may diminish till it becomes 0.

To ascertain whether it does so or not, put the value of u equal to 0, and we shall obtain an equation between a and f_1 and f_2, and the blue and red rays will come to a common focus according as the values of a are possible or otherwise. The equation of condition which I find is

$$(f_1 - d)^2 + f_1 f_2 = 0 \quad \ldots\ldots\ldots\ldots \quad A$$

As long as $f_1 f_2$ have different signs the roots of this will be always possible, whatever be the numerical relation between f_1 and f_2, so that f_2 need *not* be less than f_1. "O. V.," however, is unquestionably right in saying that in order that the focus to which rays converge may be a real one, f_2 must be greater than f_1. This fact I have carefully borne in mind in all the combinations that I have tried.

These things being so, when "O. V." says, in effect, that achromatism is impossible, it is tantamount to saying that eqn. A is wrong. Will he kindly favour us with what he supposes to be the right one—i.e., one which will indicate that f_2 must be less than f_1 in order that u may increase as the separation of lenses does.

In fact, if f_2 and f_1 have different signs, there will be always two values of a, which will make the aberration vanish, and if f_2 is reg. and greater than f_1, the attentive reader will see that one of these values corresponds with a real and the other to a virtual focus.

The fact then that $a = 0$ contains possible roots is in itself sufficient to show without differentiating that the assumption, for such I must call it, that u increases with a unless f_2 is less than f_1, quite falls to the ground.

We might verify eqn. A as follows:—By a well known optical principle, if the course of rays after immersion is reversed they will pass over the same ground as those that entered. If these rays diverge from a point whose distance from the concave lens, which we will still call f_2, and emerge from the convex lens parallel to the axis, these emergent rays, if their course were reversed, would pass through the point whose distance is b. Let c be the conjugate focus to b, then, see Parkinson's optics, $1/c - 1/b = 1/f_2$, or $f_2/b = f_2/c - 1$.

But the condition for coloured rays emerging parallel is—

$$d = \frac{f_1 + f_2}{2 + f_2/b} = \frac{f_1 + f_2}{1 + f_2/c}$$

by the eqn. just found.

Now, since in the above equations the rays are supposed to emerge parallel to the axis of the lenses, it is evident that they must pass through the focus of the second lens, which shows that f_1 is *numerically* $= c + d$, or $c = f_1 - d$, but as c is obviously a negative quantity being measured in a direction opposite to that of the rays, while d and f_1 are measured in the same, so that we must put $c = d - f_1$; and if we substitute this for c in the last equation and then clear it of fractions and transpose all quantities to the left side, we find—

$$(f_1 - d)^2 + f_1 f_2 = 0$$

which is identical with it, so that parallel rays entering lens f_1 would converge to the same focus as that from which the rays diverged above. Also, it may be shown that in both cases the same condition, viz., that $f_1 - d$ is less than f_2, will have to be observed.

In deference, then, to your excellent correspondent, "O. V.," I have reconsidered the whole question to the best of my power. But I may say that, previous to writing about the matter, I probably had bestowed upon this particular question more hours than most of your readers have minutes; and after a careful review, I can find nothing in what I have written that needs correction.

I would respectfully endeavour to impress upon all who would write upon the subject the necessity of working out the question for themselves; otherwise, those who, without doing so, can throw any light upon the matter will be few indeed. A friend of mine, who was certainly the first mathematician of his year, when he presented himself at the schools on the second day of examination, was told that his papers on the first day were so admirable that he should have a first class without any further examination—a thing, I believe, that had never before happened; yet he told me that *he was never sure that he understood a demonstration* until he had worked it out for himself.

In conclusion, I may say that I will try to get a telescope made according to the plan I am advocating chiefly — i.e., where rays converge to a common focus; though I am afraid that this will neither easily nor quickly be done. As far back as last November, an optician, in whom I had much confidence, undertook to make a telescope upon the old idea of achromatism—e.g., where the rays were made to emerge parallel. Its plan was this: Front lens, plano-convex, radius of curved surface, 13½in.; other lens, plano-concave, radius 19½in., the flat sides of both turned towards the eye; distance between lenses, 6½in.; length of telescope, 45½in.; diameter of convex lens, 3⅛in., and of concave, 2⅜in. Instead of which I received one of 34in. in length, and with 10in. between the lenses. The consequences of which mistakes may easily be imagined without being described.

W. G. P.

THE PRESSURE OF WIND.

[20396.]—I do not appreciate the distinction which Mr. Romanes (p. 527), draws between "the pressure was 49½lb." and "the pressure on the square foot was 49½lb."—if that "square foot" is the distinction. Just as when boiler-pressures are spoken of, pressure of pounds per square inch is understood, so in the case of wind-pressure it is understood to be pounds per square foot. But the exact words which have now thrice appeared in the English Mechanic, leave no possible room to doubt that the 49½lb. was on the square foot, especially as we can take the still higher "53lb. on the square foot on October 14th" (the Astronomer Royal).

I do not comprehend such an expression as a "velocity of 53lb. on the square foot," and fail to see why the opinion of so eminent an engineer as Mr. Hawkesley should be taken in preference to an obstinate fact. The primary object of my previous letter was to point out that if the recorded pressures were accurate, tables in which the pressure is calculated by some formula were useless, and as they are, misleading. When Mr. Romanes says it does not seem to strike me that the anemometers might be at fault, he has surely forgotten the second and third sentences in my letter on p. 501. It is partly because I want to know whether the instruments used for measuring the wind-pressure at Greenwich are at fault that I wrote, and to repeat, I say "one would think there can be no difficulty in arranging an instrument to record with accuracy the exact pressure" (p. 501). No one supposes that we have on the surface of the earth such a "storm" as Mr. Simmons experienced; nor would it be necessary to build a house situated at the foot of Blackheath-hill so strong as one placed alongside the observatory. All the same, it is of great importance to learn what is the actual pressure of the wind at any given moment; or assuming the formula to be correct, to take the velocity for one second as one of the data, not the velocity for one hour, which being made up of alternate gusts and intervals of calm, cannot possibly give the maximum pressure at any moment. I thought I had made it quite clear that it would be advisable to take the actual pressure, and not that found by any formula. Perhaps some of your readers can give some definite information as to the actual pressure—now that it seems the Astronomer Royal must take a back seat behind Mr. Hawkesley; and meantime I assure Mr. Romanes that the question is one which is by no means settled in the minds of engineers and architects. By what means is the wind-pressure measured at Greenwich?

F. M. S.

STRING VIBRATIONS.

[20397.]—The "E. M." of Aug. 11th (p. 524), will be famous hereafter in connection with "Fiddler's" discoveries regarding vibrating strings. Certainly, a string vibrating seems to move as a whole, "the greatest impulse being at the centre; but away from that point, the oscillation line seems blurred." But I have been given to understand that a string vibrated also in sections —½, ⅓, &c., of the whole length, and that this secondary vibration goes on at the same time that the string moves as a whole. "Nodes" are those points about which the oscillation takes place.

I am sorry I have not the "E. M.," and cannot follow the subject through previous letters. I see "Fiddler" falls foul of Mr. Schucht for saying that vibrations are communicated through the nodes. As a "node" is a stationary point as regards the section of the string which it ends or begins, it seems to me that the vibration cannot be so transmitted as long as they are simple. But a violin string does not give only one set of vibrations; its motion is the sum of the vibrations of different sections; so that any given node will be at the end of one section, and at the same time in the continuity of another section.

My knowledge of acoustics is small, and I have no book to refer to just now; but as far as I remember, a solid body touching a vibrating string produces a point of no vibration, *i.e.*, a node at the point of contact. Similarly with the soundboard of a violin; the soundpost can only transmit at the most the vibration of those sections whose nodes do not coincide with the contact node produced by the soundpost itself. But this action can only be conceived with the oscillations of those fibres which pass over the post. The rest of the soundboard is unaffected by it as regards the transmission of vibrations to the back.

But, beyond this transmission, the post has an action on the soundboard as a whole, forming a node in it, determining its mode of vibration.

The post, then, has two actions; it transmits vibrations passing across it to the back of the violin; it gives an increased effect to the tone produced by one section of the string by determining the vibration of the soundboard in a definite direction. Variety in the tone of "harmony" to which this ascendency is given, is the cause of the variation in the tones of different violins. I agree with "Fiddler" in thinking the post unnecessary, if the soundboard be moved the right way: I would rather say if it be cut in such a way as to give ascendency to the favoured harmony. But the post seems to me to give a ready method by experiment of adjusting the vibration, when the soundboard is not so cut.

I don't quite follow "Fiddler's" line of argument just at this point. He says if a soundpost be not used the violin will sound louder, *soit*; but further, he says, "and without a node." Given two sounds of the same pitch and timbre, these have the same harmonies, the same nodes. Why, then, "without a node"? The node must be present, whether it be determined by the contact of post with a badly cut board, or by the varying thickness of the board itself. Then why should a "harmonic formation," consequent on a node, according to "Fiddler," weaken the tone? Does it not sound with the fundamental, and, by its combination with that and its fellow harmonic, produce a note of definite timbre? The drift of the following words I can't understand; his "therefore" seems, as far as I can guess at the sense of the premises on which it follows, visually, not logically, to me decidedly misplaced.

"Fiddler's" confidence in himself and his "fledgling" is delicious. A useful instrument "has only to be made the right way to vie with the production of the old masters." "The bass of our new violin is perfected."

"Fiddler's" reasoning again becomes shaky, but here more from insufficient basis than from "pure cussedness." Up to Saturday, I had believed that a drum did not give a musical note.

In the harp and piano the impairment of tone by the unscientific soundboard is so slight, as compared with that caused by the imperfect scale, that a soundpost more or less is of slight importance. The banjo is hardly worth consideration. "Fiddler" seems to think his nut of a series of soundposts hard to crack. Would not the result of their combined action be the determination of a definite mode of vibration, &c.? To sum up, the soundpost acts by transmitting a certain number of vibrations to the back; an action of slight importance. Secondly, by (indirectly) giving ascendency to a particular harmonic—a result which is achieved in "Fiddler's" violin by his skilled hands cutting out the soundboard on mathematically calculated lines.

One question more: Will "Fiddler" be good enough to explain his theory of string vibrations? and, if possible, without so much "gas" as his present letter contains.

Aug. 13. **Nur ein Geiger.**

ON THE CONSERVATION OF SOLAR ENERGY.

[20398.]—The very brief epitome of Dr. Siemens' "Solar Hypothesis" which I represented in these pages did scant justice to the subject, I am aware; but, still, I do not think any statement there can be held responsible for Mr. J. H. Schuct's remarks in your issue of the 11th inst. Mr. Schucht speaks about the idea of shrinkage involved in Dr. Siemens' theory as being opposed to the "laws of nature and against logic," when regarded as being perpetual. He seems to forget that it is only as a counterbalancing action that Dr. Siemens uses shrinkage—"in some measure counterbalancing the expenditure of energy produced at the expense of solar radiation."

"If the oxygen can be dissociated by radiant solar energy, while in a state of extreme attenuation, I cannot conceive how they can come back to the sun's photosphere without combining." I do not know what this sentence of Mr. Schucht's means, when it is considered with reference to Dr. Siemens' theory. What Dr. Siemens supposes is, that a process of interchange is constantly going on; the aqueous vapour and carbon compounds in space, being dissociated on reaching the sun, are compressed into the solar photosphere at the poles, while a current of the same vapour reassociated, is sent out at the equator. That this outflow must take place can be shown on mathematical grounds, the only condition being that space is not empty.

Many questions of a very interesting character have been raised respecting this hypothesis by Dr. Sterry Hunt, Prof. Fitzgerald, and others, in *Nature*, and I refer Mr. Schucht to the last and present volumes of that journal for the correspondence on this subject, where he will find how the objections to the theory, so far, have been met by Dr. Siemens.

Worthing, Aug. 14. **C. H. Romanes.**

GRAVITY ESCAPEMENT CLOCKS.

[20399.]—Sir Edmund Beckett and others interested in Horology, will be glad to know of the progress of the gravity escapement in the United States.

Messrs. E. Howard and Co., of Boston, the celebrated watch and clockmakers, have been using this escapement in their regulators and tower-clocks for some six or seven years past, and value it highly. On a recent visit to their office in this city, I had the pleasure of seeing a very fine turret clock, using the double 3-leg gravity escapement, and striking the hours and quarters. The workmanship was first-class, and the style of the whole thing indicated durability and time-keeping qualities. Their principal regulator was also a 4-leg gravity, and put in an elegant case with mercurial pendulum, altogether as fine a regulator as I ever saw.

Messrs. Howard told me they had made "3-leg gravities," for the *Tribune* building, for Dr. Hall's Church on 5th Avenue, and for the Standard Clock of the "Grand Central Depot," all of this city. They did not give me the rates of any of these clocks, but said they went as well as was expected.

The "City Hall," of New Haven, Conn., has one of the "double 3-leg" clocks, under charge of Prof. Waldo, of Yale College Observatory, who states that it averages *closer than the great Westminster Clock*, having run for several months on a rate *not exceeding* 47-100 *of one second per week* (0·47 sec.) I have written to Prof. Waldo for particulars, but have not yet received them.

Sir E. Beckett ought to be gratified that his clocks go so well and are so much appreciated in the United States, and I have no doubt he is.

Roi ne Puis, Souza Je Suis.

THROWING OIL ON THE WAVES.

[20100.]—In his recent speech in the House of Lords, Lord Sudeley gave an interesting résumé of the chief evidence in favour of the assertion that oil thrown upon waves will "quiet them." That phrase is not more correct than to speak of the oil rendering the sea smooth. All that can possibly be asserted or supported by the existing evidence is that oil to a certain extent prevents waves breaking, and as every waterman and seaman knows, it is not the rolling masses of water that are dangerous, but the waves that break on board. According to Lord Sudeley, the use of oil is not a new discovery, but one that has been tried for years, with more or less success. From the earliest days it is mentioned as well as recorded in Scripture; and it is well known that the inhabitants of the sea-coast of Syria were aware of it in past ages. We know also that in Pliny's time divers made use of oil to smooth the surface, and so produce a more steady light at the bottom. In more recent times, in 1757, Franklin's attention was drawn to this subject, and experiments were made by him of various descriptions. In still later years, many experiments have been carried on, and papers have been read at different institutions on the subject. It is also well known that seamen engaged in the whale and seal fisheries, and also fishermen in Shetland and on the coast of Scotland, have more or less employed this method for a great many years. The experiments at Peterhead will be fresh in the memories of all. It seems to me that if oil has any useful effect in preventing the sea from breaking inboard, a good deal must depend on the kind of oil used. Paraffin oil, for instance, would, I should think, be of little use, from its want of viscidity—the property on which the phenomenon would appear to depend. An oil of the consistence of thin treacle would presumably give the best results. I do not know what oil Mr. Shield used at Peterhead, but his experiments were not at all conclusive, for although the white crests and the spray were controlled, the waves persisted, and after a time the oil was swept away. Lord Sudeley said that in some of the trials which had been made for using oil to calm the surf, and thus enable boats to land easily, curious and very contradictory evidence had been obtained. In the first place, it was considered by very competent authorities whether oil could be used with advantage where there was a force of wind amounting to a whole gale, which might be put down at 10—whether, in fact, it could be used with any advantage against a force of wind exceeding 6. The general opinion was that in a heavy gale it would be of no use. Again, in the second place, experiments had been tried with the oil for landing boats through surf which had proved entirely unsuccessful, owing to sharp currents and tides setting the film of oil along the shore, and thus preventing it being of any use. Further, it had been found very doubtful if, when the wind set full upon the shore, and a high surf was raised, it was possible to prevent the oil being washed rapidly out to sea. A rush of water back from a surf was usually supposed to return as an under current, or as it was technically called the "under-tow," in which people were very often swept away. It had been found by experiment that there was also in most cases a very strong surface current drawing out, and in one instance the oil was swept out so quickly to sea that it was perfectly useless. Some of the experiments seemed to point to the fact that oil could be very well used round a ship to allow boats to approach. There was an idea, which seemed well worthy of trial, to the effect that small bags of oil should be attached to life-buoys, which could be pricked at the moment of throwing them overboard, so as to calm the surface of the sea round them. There could be no doubt that cases constantly occurred of all trace of a lifebuoy being lost after it was in the water; whereas, if there was a smooth oily surface round it, the probabilities were that it would be distinctly seen from the ship, and also give the person overboard more chance of seizing it.

The Board of Trade has definitely declined to undertake any experiments with oil, thinking it their duty not to waste public money; but they are collecting all the authentic cases of actual saving of life, and any trustworthy evidence as to the effect of oil upon sea-waves, with the view of embodying them in a report to Parliament. There seems no doubt—Lord Sudeley admitted as much—that under special circumstances, and to a certain extent, oil can be used with advantage on bars, and in landing boats on broken water; but the Board are not sanguine that any remarkable discoveries will be made by the experimenters who are trying, or about to try, the effect of oil. Can any of your readers say which is the best oil for the purpose, and give the reason why? The cost of oil would no doubt be considerable, but when a fleet of fishing boats are running for harbour, if the bar can be smoothed it will be certainly done if a few tons of oil will do it. **J. O. N.**

ABBE'S APERTOMETER.

[20401.]—In reply to "Antares" (No. 20277, p. 429), regarding the use of Prof. Abbe's apertometer, I have tried every method of measuring apertures that has been suggested for some years past, and have found none so convenient and reliable as this apparatus.

In measuring a large number of high-power apertures, dry, water-immersion, and homogeneous-immersion, I found it advisable to use a microscope with a rotating stage, preferably the Continental form, in which the tube rotates with the stage. On the cylindrical edge of the apertometer disc I pasted thin tissue-paper, to avoid the glare of light. Placing the microscope vertical with the disc upon the stage, I adjusted the lamp-flame in the horizontal plane of the disc about 12in. off. Care was used to see that when the auxiliary lens was fixed to the lower end of the draw-tube (forming, with the usual eyepiece, an "erecting" or terrestrial eyepiece), no diaphragm or other obstacle prevented the lens from being slid sufficiently far down to take up the real image formed by even the highest powers. Inasmuch, too, as the principle of the apertometer assumes that the whole telescopic field of the objective, when used as a telescope, represents the aperture when used as a microscope, we must be careful that the diameter of the auxiliary lens, or the diaphragm of the eyepiece, does not cut down the telescopic field, as would be the case if either of these were less than the active diameter of the objective lenses—in other words, as stated by Prof. Abbe, "for observing the *limits* of this telescopic image, the whole must, of course, be within the field of the auxiliary microscope." That is why the auxiliary lens supplied by Mr. Zeiss is a low power of large diameter, and why the eyepiece itself should also be of low power.

"Antares" opens a question with reference to the precise utility of the homogeneous-immersion formula, which has not yet been treated of authoritatively. He asks whether this formula is to be regarded as useful only where apertures greater than the limit for water (1·33 N.A.) are required? I think experience has demonstrated that all incident pencils from one refracting medium to another of much greater refracting power, beyond the cone 140° in the rarer mediums, make unfavourable angles—angles that cannot be effectually dealt with, and this applies the more the greater the difference between the media. For instance, in a strictly dry lens the aperture between the cone 140° in air (= ·94 N.A.) and 180° (= 1·0 N.A.) is practically of little use; in a water-immersion lens the cone between 140° in water (= 1·25 N.A.) and 180° (= 1·33 N.A.) is likewise of but little service; and equally in a homogeneous-immersion lens the cone between 140° in the immersion fluid (= 1·43 N.A.), and 180° (= 1·52 N.A.) is practically useless. Prof. Abbe has arrived at the conclusion that the limit of useful aperture is a much lower figure than 1·43 N.A. With our present means of construction, however, the lenses which exhibit the finest definition with direct oblique illumination that would utilise 1·25 N.A. are not those lenses of precisely 1·25 N.A., but of higher aperture. It would thus appear that in order to get a well-corrected outer zone of 1·25 N.A., the lens must really have a larger aperture to cope successfully with the difficulties of the marginal aberrations. It should be observed that by the homogeneous immersion formula the higher apertures (say those beyond ·94 N.A.) are more successfully corrected, because the path of the rays is more regular, and can thus be more definitely calculated. This is clearly evidenced by the superiority of definition seen with homog. imm. lenses, when, by the conditions of the object and the illumination, the effective aperture is reduced well within the limits that have already been attained by the water-immersion formula: it is then seen that for all apertures greater than 1·0 N.A. the homog. imm. formula is to be preferred. I believe it is now generally accepted among expert manipulators that the water-imm. formula has seen its best days, and the time is not far distant when it will be entirely superseded.

I note, in passing, a misprint under (2) in the second paragraph of "Antares'" letter. He is made to say that with a homog. imm. of 1·47 N.A., when the aperture was measured with water as the intermedium, he recorded 1·25 N.A., whereas, obviously, under this condition, the record would be 1·33 N.A.—the refractive index of water. Such a lens might be used for testing the refractive indices of all fluids less than 1·47. For very large apertures, a flint-glass disc is advantageous.

So recently as 1876, at the Loan Collection Exhibition, Prof. Abbe used a rectangular plate of glass (as figured in Nägeli and Schwendener's "Das Mikroskop") for the graduations of his apertometer; upon his being shown a semi-cylinder made by Tolles, of Boston, he at once saw the improvement that could be made by putting the graduations on a semi-disc instead of the rectangular plate. Let me now suggest that graduations should be continued on the cylindrical edge so as to permit a direct reading with the auxiliary microscope. **Akakia.**

SCREW-PROPELLERS.

[20402.]—As several of your correspondents take an interest in the problem of screw-propulsion, I send you the following account of Osborne's propeller, in the hope that some of your readers can give further information. The fin-propeller was recently exhibited at the Lambeth Baths, fitted to an iron vessel about 6ft. long. This model was fitted about midships and below the water-line with a rectangular plate, placed parallel to a longitudinal vertical plane at each end, and in its centre line this plate is coupled by a crosshead to a rod passing through the sides of the vessel, and being connected inside to the piston rod of one of the two steam cylinders, placed crosswise in the vessel and having their piston rods extending through both cylinder covers. The cranks of these cylinders being set at right angles to each other, the blades will receive a reciprocating motion, each end moving alternately to and from the sides of the vessel, which latter is by this means propelled. Mr. Osborne does not confine himself to this mode of attaching or working the fin-propeller, he proposes to use one at the stern of vessels, working it up and down instead of sideways, and to attach smaller fins to the side of the vessel to increase the propelling power and give ready means for steering and turning the vessel, which can be very easily done with these propellers by increasing or decreasing the speed of one of the pistons. For vessels of longer dimensions, Mr. Osborne proposes to arrange his fin-propellers in such a manner that they may be drawn up close to the sides of the vessel when not in use, and thus be quite out of danger. Shots fired at the blades would, should they be able to have any effect below water level at all, only perforate the blades without materially affecting their working, unless they were struck at the joints. The little model, which is only 6ft. long, and heated by spirit-lamps, was worked with 30lb. pressure, and run at a speed of about 200ft. per minute; the motion in the water was but very slight, and the vessel itself moved exceedingly steady. Mr. Osborne has brought the invention from South Africa, where his model has been making several trips of over an hour's duration on Simon's Bay. **C. F. E.**

SMALL DYNAMOS.

[20403.]—I am sorry "Tried" did not sign his own name, so that one would know whom he was trusting to. However, "Tried" does not in the least alter my opinion that at present there is not a machine that an amateur can successfully make and use. I am sorry that I feel compelled to disbelieve his statements. I wish I could do otherwise; but when he writes what must be absolutely false, one cannot believe his statements. Will our readers refer to the two extracts which I have taken from "Tried's" letter (29349). "The machine being driven from a *foot lathe* produced current enough to light up, *well, five* 10-candle-power incandescent lamps (mine are the italics). I must add that there were only five in the shop, or else we should have put *six*." Now, then, for the other quotation:—"I took it to my own place, and having *steam power* at hand, put it to what I calculated about a *quarter horse*. I found that running at about 1,700 revolutions per minute it drove at their full power *six five*-candle-power lights." Now, anyone with one grain of sense will see in a moment that with something like *four* times the power, only one-fourth the effect is obtained. To put the statements side by side we have—

Foot-lathe lights six *ten*-candle-power lamps
Quarter horse ,, ,, five ,, ,, ,,

I think it is quite unnecessary for me to write a single word more. Those who have made up dynamos have, I know, in ninety-nine cases out of one hundred, met with disappointment. I have received through the post a number of letters from amateurs who have been deceived, and others who have been led astray by false recommendations, and so long as I am permitted to write to these pages I shall honestly state my own convictions, and even if I sometimes have to appear harsh. I will ask "Tried" one question—Will he, on his honour, declare that the dynamo he refers to, did light up five (I won't say even six) *ten* candle-power incandescent lamps to their full power by the motion obtained from a foot-lathe, at which one man was treading? He says that in the above experiment "the lamps gave *as much light* as they should do." **W. J. Lancaster.**

LEGAL REPLIES.

[20404.]—(47639.)—By the Gun License Act, 1870, amongst persons exempted from taking out a license I find the occupier of any land, or any person by his order, using or carrying a gun for the purpose of scaring birds or killing vermin on such lands. It is, therefore, clear that a license is not necessary for the purpose of killing birds destroying fruit in a garden, which, indeed, would also seem to come under the general exemption, as being used in a dwelling-house or the curtilage thereof.

(47644.)—If a trader is so unwise as to take business premises as a yearly tenant, and to spend his money on improving them without having a lease by which he would have some certain period of tenure, I fear he must take the consequences. The owner of a freehold or a leasehold property has a perfect right to sell it as and when he likes, and he is in no way bound to give any notice of that sale to the yearly tenant, although, of course, it is sold subject to that tenancy. In the case put, the proceedings seem to have been quite regular, and "Ignoramus" has no remedy. It is usual for the vendors to give the purchaser an authority to receive the rent from the tenant in possession—and, doubtless, they have done so—but no other notice is necessary. The purchaser stands in the same position with regard to the tenant as did the former owner, and he can, therefore, give him the same notice to quit or pay an increased rent. This being only a yearly tenancy, there can be no question of compensation for business premises.

(47649).—If a solicitor has money in hand belonging to his client, and he will not pay it over, or take proceedings as instructed, the best way to bring him to book is to issue a summons at the Judges' Chambers of the High Court, calling upon him to show cause why he should not pay over the money so received, and tax his costs, if there be any to charge the client. If the client knows what money has been received by his solicitor, he can of course sue him for the amount. The Law Institution would only interfere in serious cases of fraud, or the like. If a solicitor neglected to sue for a debt after being instructed, and the debt was thereby lost, an action for negligence would lie against him, provided the facts were strong enough to prove such negligence.

(47667).—Partnership.—This is a very curious question, but it is of course possible for two traders to become partners as to their premises only and as to nothing else. As between themselves, any agreement they may make will be valid, and will govern their liability one to another. But if they hold themselves out as partners to third persons, they then become, as regards the world, liable for the acts and debts of each other; and this liability cannot be got rid of by any means whatever, presuming a partnership to exist. People who act as their own lawyers generally live to regret it; and such an agreement, with a sixpenny stamp, would be drawn by a respectable solicitor for two guineas; if under seal, there would be a ten shilling stamp required, which would be charged extra. I cannot undertake to answer general questions as to the law of Ireland, though in most respects that is like the law of England.

(47668).—LEASE.—Lawyers' costs differ; but three guineas, including the necessary 5s. stamp, would be a fair charge for drawing up the lease mentioned. A covenant could be inserted forfeiting the lease if the premises were assigned without the lessor's license; but I never heard of a clause of forfeiture for parting with the possession of the lease itself. Such a provision would certainly be unusual, if not absurd; but it would not be impossible. If it is meant that the forfeiture should happen upon the lessee's parting with the possession of the property, that would be a usual and perfectly valid covenant; but it would not prevent his depositing the lease, and I doubt whether a clause aimed at preventing this deposit of the lease itself would have any effect.

Frederick Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall.

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[46748.]—**Sharpening Carpenter's Saws.**—It is, I think, stated alternate teeth as there shown, and of course the saw must be reversed, and according to sketch, the front of tooth with the set to you and the back of the one from you.—JACK OF ALL TRADES.

[46828.]—**The Guerin Brake (U.Q.)**—The Guérin Brake was tried upon the Tynemouth Branch of the North Eastern Railway, and referred to by Colonel Yolland in his report to the Board of Trade, 1858. It was fitted to carriages, and was put in operation by the compression of the buffers as soon as the train received a check from the steam being shut off and the tender-brake being applied. It could not act on the rear of a long train, and did not protect it in case the coupling-chains broke or became detached. Like the Stephenson Brake of 1832, it was subject to difficulty in backing the train. The Nasmith Brake, tried on the Leeds and Manchester Railway, 1839, a similar system tried on the South Western Railway by Major Robbins, 1852, the Guérin, and many others, are repetitions of Stephenson's Brake of 1832. In reply to the second part of the query, Mr. McConnell applied "steam brakes" to engines, but he was not the inventor. A patent was issued to Robert Stephenson bearing date at Westminster, 7th October, 1833, No. 6484, "Locomotive Engines," in which his steam brake was fully described and illustrated. It was applied by admitting steam to the brake cylinder. He also pointed out that "the same effect may be produced by admitting water from the boiler," and that the same cock may have a double passage to allow steam or water to escape (to release the brake) when in an opposite position, or to shut both when turned into an intermediate position. This brake was first tried on the Liverpool and Manchester Railway, and in March, 1834, it was fitted to an engine named "Samson" upon the Leicester and Swannington Railway. It appears to have been in use but a very short time upon this latter line.—CLEMENT E. STRETTON.

[46859.]—**Indigo-Blue Dyeing.**—Since writing last I have learned who Mr. J. Ormiston is, and I feel rather flattered being told by a person of such experience that "it is simply an impossibility" to dye (as I stated I can do) 700 yards serge with 12lb. indigo in a woad vat. This is my usual day's work; 700 yards of the serge I speak of weighs from 480lb. to 500lb. Knowing the great difficulties experienced by woollen manufacturers in procuring the services of good woad dyers, and rightly or wrongly setting some value on my knowledge of woad vats, I am anxious to know if Read, Holliday, and Sons', or any other patent process, is likely to supersede woad vats, and would be thankful for an answer to one of my queries as to the cost of dyeing the above 700 yards by Read, Holliday, and Sons' process. Mr. Ormiston asks me to give an idea of the depth of colour. Navy blue is generally understood to mean a full deep blue, such as regular yachting serge. I will take the liberty of writing to Mr. Ormiston, perhaps before he sees this. One thing is certain: that no better or more permanent blue for woollen goods can be dyed than that of the woad vats when properly worked.—BLACKWATER.

[47174.]—**Pedal Reeds.**—Fig. 1 is an outline sketch of the instrument, which is 47½in. high, 47in. front, and 29in. deep to back, and weighs about one-third of a ton. Such a height as this, I conclude, "J. H. T." does not design for his instrument, so that it would be difficult to pack into a lower one what is to be seen in Fig. 1. In this it will be seen that wind from feeders passes up the front part and down the back part to the pedal note box. As the distance between manuals and pedals is inconveniently great, and further complications arise from the method of Fig. 1, I would recommend the adoption of Fig. 2, which saves a great deal of woodwork, and lowers the instrument and manuals by 8in., and by having a projecting keyboard, the convenience would be the same as is adopted in an organ. Fig. 2 shows the feeders put under the feetboards (as is sometimes done), letting the wind directly into the pedal note box, and from thence trunks carry it to the wind-chest above. The pedal note pallets open underneath this box, which is not more inconvenient, seeing that in either case the instrument has to be tilted against the wall to get at the said box.—J. H. HUXLEY, Barry-road, S.E.

FIG. 1.

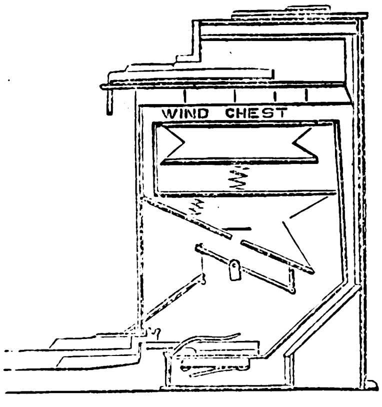
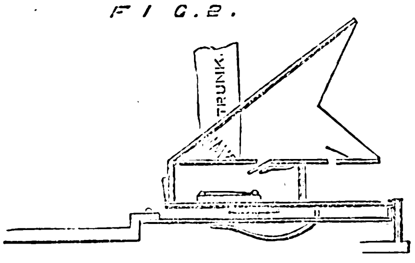


FIG. 2.



[47219.]—**Text-book of Physiography.**—As Mr. A. J. Smith "is acquainted with both Huxley's and Geikie's manuals," we may, in addition, introduce to his notice "Dr. Young's Physical Geography Advanced" (Collins and Sons), and "The Elements of Physiography," by J. J. Prince (John Heywood). The latter, although prepared more especially for the elementary stage, may not be altogether useless for the advanced.—A. MANOCK.

[47322.]—**Injured Thigh.**—For 2d. you can purchase a box of pure Venice turpentine. It is very sticky, and must be poured on to a linen rag and placed on the wound. It will spread itself. Then place on the top of this a simple bread-and-water poultice, fresh night and morning. The turpentine must not be pulled off, but left until it comes off by itself, which it will do after a day or two; then wash with warm soap-and-water, and add another. Do not try to get away the sticky part about the wound; it will do no harm. The better it grows the longer the turpentine will be coming off. Repeat both poultices till quite well; then, if the place is tender, merely put oiled cloths on (salad oil). Also a cure for boils.—SYMPATHISER.

[47323.]—**Steam Launch.**—Has "Ajax" looked through his back Nos.? There are several specifications for yachts and launches—one so recently as p. 286 of this volume—and many notes about them.—LOCRIS.

[47327.]—**Colouring Steel without Heat.**—I believe the colour is nothing more than lacquer. Common kind would be made of shellac dissolved in methylated spirit; others probably of mastic, alcohol, and a little camphor. For colour, use Prussian blue; if orange, the brown shellac will be about right. Should think that several readers could supply you with the actual recipe, though I believe the manufacturers of tools consider their varnish a special secret. The thinner and tougher the coat the better. If no one else helps you, I will see whether I can find anything out for you; but not being personally mixed up with manufactures, it will be only second-hand.—ESSAR.

[47330.]—**Leaking Vats.**—It is not easy to answer this query; but, to prevent the shrinking, cannot you fill up with water instead of leaving it empty? The only remedy is to line the joints with indiarubber (if that will stand the liquids), and bolt up very tight. One might possibly suggest something else if the kind of liquid had been stated.—ESSAR.

[47350.]—**The Baths of Wildbad.**—There may be some special virtue in the waters of Wildbad, but it would certainly be very expensive to bring them over here, and probably in cooling they might lose some of their virtues. Personally, I should attribute much of the salubrity of Wildbad to the pine forests in the vicinity, and I suspect that any kind of wholesome water (provided it were used as frequently as the baths) would answer as well. It may be rank heresy; but you take it for what it is worth.—NUN. DOR.

[47352.]—**Ink—Sealing-Wax.**—You might try printer's ink (good) to which a little glycerine had been added; or to good black writing-ink you might add a paste of ivory black and gum-water, worked up thick, until you made the writing-ink of sufficient consistency. The sealing-wax should preferably be made in a bright copper pan; for colour use powdered verdigris. Either pour into moulds, or roll into shape on a warm marble slab, with a piece of polished wood as a block.—T. P.

[47359.]—**Broadwell's Breechloading System.**—You can learn all about Broadwell's system in his patent specifications, or in some of the engineering papers of four or five years ago; but as to Krupp's use of it, perhaps you know that Krupp denies using it. There was a long controversy on the subject in *Engineering*, I think, about two years back.—T. P.

[47369.]—**Preserving Mosses.**—I believe drying in hot sand is the best way of preserving all kinds of plants, including flowers.—NUN. DOR.

[47434.]—**Lathes.**—In answer to "Miner," I see that he has a desire to have metal bearings to his lathe. That being the case, I should recommend good gun-metal, well-fitted; but I prefer hardened-steel collar and mandrel, as there is nothing to equal them for wear and freedom in running. If "Miner" can favour me with a call, I will personally explain all he requires.—J. H. EVANS.

[47448.]—**Ritchie's Induction-Coil.**—"B. H." (No. 47448, p. 460) says he does not understand my description of R.'s coil at p. 16, No. 859 (Sept. 9, 1881), in the matter of the battery connections. My sketch showed the two tubes, each put, like a cap, over its own end of the primary coil. It is easy to see that the two ends of the wire might escape where the open ends of the tubes meet; but there are a few objections to this. I should drill two small holes in the closed end of one glass tube, and bring the primary ends out thence. It is easy to see that, if the coil be of the upright variety, only one glass insulating-tube is needed, the two wires being brought to the lower end of the coil, and into and through the wooden base. The contact-breaker or vibrator is a small, independent, electro-magnet, wound with wire the same as that of the primary, and set upon the base, near the coil, its wire being connected with battery so as to be in the primary circuit. There is no way of building a coil so good as this "section" plan, which has been followed by Messrs. Ritchie since 1857; but, like other good things, conscientious and faithful work must be used. A little hurry, a little carelessness, a few feet of poor wire put in instead of waiting till good could be had—any slighting work like this will spoil the coil. Take plenty of time, wind close and slowly, insulate thoroughly, and, if the wire is good, the coil ought to work.—ROI NE PUIS, SOUZA JE SUIS.

[47463.]—**On Change-Wheels.**—I may state that the best rule I know of is—multiply the number of teeth of driven wheels by number of threads of leading screw per inch, and divide by number of teeth in driving wheels; the result is the number of threads per inch the wheel will cut. All difficult threads must be done in this manner. The nearest wheels to cut 31 threads with a leading screw of 4 to the inch are: 20 and 55 driven, and 85 and 100 driven, which cut 30 10-11; this is near enough for all practical purposes.—T. F. GELL.

[47463.]—**Change-Wheels for Screw-Cutting.**—To "TRY AGAIN."—You will approach 31 threads to an inch by selecting the nearest number that you have to some multiple of 31; thus, as your train goes as high as 125, then the 125-wheel will be only different by one tooth from 4 times 31. Now, taking my old rule, which I believe to be stated in the simplest possible terms—viz., multiply the number per inch of your leading screw by the distance apart of the threads you require, thus:—

$$\frac{4}{1} \times \frac{1}{31} = \frac{4 \times 4}{124} = \frac{24 \times 4}{124 \times 6}$$

then—

Mandril.		Stud.	Screw.
40	—	60	
—		24	124

would be the exact train required. Now, as you have not 124, substitute 125, which will give a thread of 31¼ to an inch, a difference scarcely perceptible.—J. K. P.

[47464.]—**Wood Shrinking.**—"Anxious to Know" should put his iron rings on his wheels when red-hot, and instantly plunge them into water, when the iron will contract. In fact, the same way as iron tires are put on carriage-wheels, only on a smaller scale.—H. Dixon.

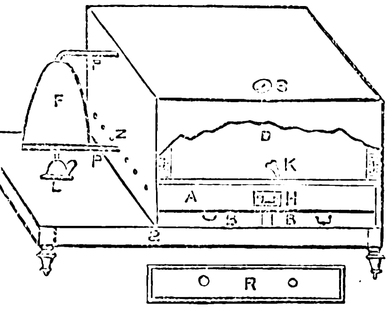
[47491.]—**Magic-Lantern Slides.**—I think Mr. Lancaster's remarks on this subject are intended to apply to those who know nothing of painting; but anyone who can paint a little in water-colours will soon be able to colour transparencies; at any rate, I found it a pleasant occupation during the long evenings last winter, and my pictures are as good as any I have seen in the shops. The colours I used were moist water-colours—Prussian blue, crimson lake, Italian pink (a yellow), and burnt Sienna. These are about all the transparent colours, and from them any other colour can be produced by mixing in various proportions. My transparencies were taken from engravings of Stanfield's sea-pieces, which make very good subjects for the magic-lantern. These were not printed very dark, in order that the colours might have their due effect; the common fault of coloured transparencies being a want of colour in the darker parts—such as trees, deep shadows, &c. It is also an improvement, before copying the engraving, to chalk over certain parts where bright colour is required in the copy; for instance, a fisherman standing up in a barge is to have a bright red cap, which is to stand out from a grey background. In the engraving this contrast is represented by variations in the depth of tint, but by making the cap white with chalk the transparency will have a little space of clear glass where the red cap appears, and this can be filled in with colour. The chief difficulty will be found in laying on light tints over a broad surface, such as the sky, middle distance, &c.; here an ordinary paint-brush or camel's hair pencil is useless, as it leaves all sorts of marks and blotches when used on glass, and I have found the following method very successful: take an ordinary dinner plate or two, and having placed it face downwards, paint over a portion of the white surface with a good strong tint of Prussian blue, not using too much water; then, over other portions of the plate or plates, paint with mixtures of colour to produce the various greys, purples, &c., required for the clouds, and allow to dry. If dried at the fire, allow to cool. All these tints should be of full strength, and appear almost black on the plate. We must then prepare several "dabbers," which are made by cutting out little circles of kid glove the size of a halfpenny, placing little balls of cotton wool in the centre of these and tying up with thread—the smooth side of the glove to be outwards. Hold the transparency in the left hand with a sheet of white paper behind (at a little distance from the picture), and with the fingers of the right hand hold a dabber. Now breathe hard upon the Prussian blue on the plate, and dab on it with the dabber; then instantly make a dab on the transparency, having slightly breathed on it, which will transfer a little circle of blue from the plate to the sky of the picture. Repeat this process till you get a series of these circles covering the sky; then breathe on the picture, and dab all over the sky gently. This will produce a flat tint, if properly done; but the tint will be very light—about the right thing for a blue sky; and it may be shaded off to the horizon by dabbing more in that portion of the picture. Clouds may be produced by using a wet brush, and wiping off the wetted parts with a cotton handkerchief, and then the greys and other tints dabbed on. I should have stated that the transparency should be varnished before the colour is applied with the ordinary negative varnish. It is wonderful what beautiful cloud effects can be produced by this method; and Stanfield's pictures have generally some cloud effects which can thus be reproduced. Having completed the broad effects of colour of the lighter tints, should we require to paint over them or to deepen them, it will be necessary to protect them with a coat of varnish (Canada balsam in turpentine); but do not varnish any part that is not to be painted over again, and do not use the varnish too thick. The colour can then be put on with a brush using a little ox-gall, and softened with the dabber. All dark and bright colours must be varnished with the Canada balsam to make them transparent; but the sky and other light parts are best left unvarnished, as the slightest speck of dust attracted by the varnish is very visible on the lighter parts.—M. I. C. E.

[47518.]—**Balance-Wheel Cutting-Tool.**—I am sorry our friend "Alfojoe" has not the tool, so that he can give "T. F. A." a sketch. I am very much pressed for time, or I would try and send a sketch from the tool I have to sell for a friend. Although the tool looks somewhat complicated, it is not so when in use, although it would be a complicated tool to give a correct sketch from. The tool I have has a division-plate for all the numbers of teeth from 7 to 19; several differently-shaped cutters, so that any kind of teeth can be cut—that is, any angle of escape-wheel teeth. With additional straight cutters, any other wheel could be cut in this tool, providing the division-plate is calculated for a given number of teeth. Example.—If a wheel of 45 teeth is required, each space of the 15 divisions can be marked into three; or, in the same way, we might divide the 19 by 4, and cut a 76-wheel, &c., &c. "T. F. A." can have further particulars by writing to me.—Edward Roberts, 27, New Bond-street, Leicester.

[47553.]—**Problem in Dynamics.**—On p. 530, fifth line from bottom, for "through v" read "through half v." Fourth line from bottom, I should be E.—C. H. Romanes.

[47553.]—**Problem in Dynamics.**—I think that C. H. Romanes is not correct. How could the monkey move the ball at all? For, although he climbs the rope, at no point or time can he exert a downward pressure greater than his own weight. Hence there would always be an upward pressure on the ball equal to its own weight, and no more, and the ball would not rise. If I am in error, will C. H. Romanes kindly state where, and oblige?—Tam O'Shanter.

[47555.]—**Incubator.**—Explanation of Sketch; 2, separate stand; B, tin trays to hold damp sand; A, drawer with perforated zinc bottom to hold eggs; N, handle that folds flush with drawer front; D, tank to fill with boiling water through screw plug S; I, oak sawdust, packed round sides and top of tank to keep in heat; K, tap to draw off water; F, circulating boiler to keep water in tank at required heat, 104°; L, lamp; P P, pipes leading to tank; Z, holes through case and drawer, with pegs to fit for ventilation on 19th day; R, separate front to inclose drawer and trays.—Cetewayo.



[47570.]—**Bronzing Cardboard.**—First make a sieve by glueing a piece of fine muslin or butter-cloth all round a frame, made of deal, 4in. square 1½in. deep, to put the bronze in, next make some glue-water rather thinner than cream, and strain through a fine cloth or muslin; put the glue-water in a basin, and place it where the lid should be on the tea-kettle; place the kettle on the fire to heat the glue (hotter the better). Have your cardboard quite flat; put on the glue-water very quickly and evenly with a 2in. flat camel-hair brush; go over the card with the sieve in your left-hand, tapping the sieve gently with the fingers of your right-hand, it will be ready for dusting in an hour's time; try a piece of card about 14in. by 12in. for a trial.—Practical.

[47572.]—**Midland Tank-Engines.**—There have been 10 six-wheel coupled tank-engines built, which number from 1552-1561. They have cylinders 17 by 24, and wheels 4 by 6. These engines have very short chimneys, and short domes with spring balances on the side of the boiler. The engines which "Meteor" means are bogie tank-engines. He is right with dimensions, but was mistaken with the numbers. 1532-1546 were built for local traffic about Manchester, Bradford, and Bristol. 1547-1551 are fitted with condensing apparatus for the Metropolitan districts. All these have been built at Derby Midland Locomotive Works in 1881 and 1882.—Camomile.

[47576.]—**Arsenic.**—"Prevention is better than cure," and I should strongly recommend B. T. Ord to procure a few indiarubber finger-stalls. They can be obtained from any photographic dealer for a few pence, and will completely protect his fingers from injury.—T. S. H.

[47580.]—**Nightmare**.—Nothing is easier than to prevent, or cure, this distressing and often dangerous malady. This disease is a symptom of indigestion. The persons liable to it are those who indulge in the extravagance of heavy suppers, particularly if their stomachs are in a weak condition. One way to cure it is as follows:—Go to bed without any supper, or take very little, and what little is taken, let it be food easy of digestion. Avoid all intoxicating drinks, and anything that is likely to lie heavy on the stomach. When in bed do not lie on your back, and make a habit of early rising. Get as much fresh air as possible. Always make it a rule to rest an hour or so after taking your supper. I do not think any medicine is necessary, as this disease proceeds generally from abusing the stomach. Nightmare is easily prevented, and is only a punishment for people who are careless in their diet.—G. Fryer.

[47580.]—**Nightmare.**—I am very happy to be able to impart some valuable information upon the subject of nightmare, in return for a few useful hints conveyed to me through your columns. I purposely waited to learn the character of the replies to the query in yours of the 3rd inst.; but there seems to be no new remedy devised. At one time I never dared to fall asleep upon my back, so subject was I to fearful dreams. Subsequently, I found that I could not sleep upon my left side, and I was compelled to adopt the back as the only change, fighting the while against sleep. Now, the shape of the head being oval it follows that the back of the head or one end of the oval resting upon a pillow, causes an unnatural position, to the entire destruction of easy respiration, which, if it does not always produce nightmare, serves to render night hideous as a companion. The remedy is simple, and to this discovery I am indebted for many peaceful nights whilst lying on my back. Place the pillow under the nape of the neck, so that the head may slightly hang over—it may rest upon the bolster. The windpipe now has the passage fully open, and breathing is unrestricted. All I require, in return for my discovery, is a recumbent memorial—the statue to be embellished with representations of Melton Mowbray pies, pork sausages, crabs, lobsters, and tenpenny nails.—Fred. W. Brearey, Maidenstone Hill, Blackheath.

[47586.]—**Pure Silver**.—To obtain the silver chemically pure you dissolve it in pure slightly diluted nitric acid, when it will cause the acid to become green. When dissolved, pour the clear liquid out, and add to it a solution of common salt as long as a precipitate falls. This precipitate will be chloride of silver, which, when washed and dried, must be melted in a crucible with anhydrous (without water) carbonate of soda. Chloride of sodium and silver will be the result after the mass has been stirred with an iron rod and the temperature raised to a very bright red. The silver will be found at the bottom of the crucible as a brilliant mass.—T. Delbridge.

[47586.]—**Pure Silver.**—Absolutely pure silver is very difficult to prepare; but if the querist understands chemical operations, I will give him the method employed by Prof. Stas in the determination of its atomic weight. Silver, pure enough for all ordinary purposes, may be obtained from his scrap by dissolving in nitric acid (aqua fortis), diluting with water, and adding a solution of salt as long as a white precipitate of silver chloride is produced. This white precipitate is then washed well with hot water about a dozen times—pouring on the hot water, allowing to settle, and pouring off. It is afterwards dried, mixed with twice its weight of dry sodium carbonate, and the mixture fused in a clean crucible; the button of silver so obtained may then be cleaned with a little dilute sulphuric acid, and scoured with clean white sand.—T. S. H.

[47590.]—**Honours Chemistry.**—The calculation given by the querist is one of the simplest. The volumes must first be all reduced to 0°C. and 760mm. pressure; but as nothing is said about pressure, except in the first case, we may conclude that it is normal, and the only correction to be made is in the case of the first volume, at 4° and 537·4mm. The corrected volume of air employed becomes:

$$851{\cdot}4 \times \frac{1}{1 \times 0{\cdot}003665 \times 4} \times \frac{537{\cdot}4}{760}$$

or:

$$851{\cdot}4 \times \frac{273}{273 \times 4} \times \frac{537{\cdot}4}{760},$$

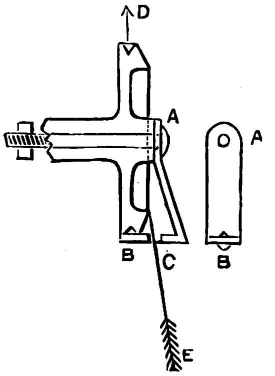
according to the usual formulæ. Call this volume of air V_1. Now the volume of gas which disappears on explosion is $657{\cdot}06 - 374{\cdot}73 = 283{\cdot}33$; but this consists of $\frac{2}{3}$ hydrogen and $\frac{1}{3}$ oxygen, therefore, the oxygen present in volume V_1 of air is $\frac{1}{3} \times 283{\cdot}33 = 94{\cdot}44$, and the percentage of oxygen $= \frac{94{\cdot}44 \times 100}{V_1}$.—T. S. H.

[47597.]—**American Organ.**—"J. P. C." had better put away the idea of enlarging his one-row American organ, particularly as he wishes to add more reeds, which will incur the necessity of a larger bellows, which will also require a larger case to hold it. Some little space will also be required for the mechanism of the octave coupler.

There are three octave couplers applied to the various American organs. One is made to couple up, its action being to bring down its respective note an octave above. This is the ordinary octave coupler. There is also another octave coupler, which actuates so as to bring down each respective note an octave below. Another coupler, known as the divided octave coupler, is so constructed as to bring down the corresponding note an octave above in the treble portion, and those of the octave below in the bass portion of the organ. Let "J. P. C." first decide as to the exact size of the instrument he wishes to construct, and the number of rows of reeds he wishes to have, then, no doubt, he will have the assistance of our able correspondents, as well as every assistance which I can afford him.—G. Fryer.

[47598.]—**Electrical.**—In the beginning of the article it says that a di-electric in allowing electricity to pass through itself may undergo slow inductive decomposition. Consequently, the + ly charged ball, A, acts by induction through B on D, thus charging D − ly and repelling + to C. While so doing, however, A slowly electrifies the part of the side of B nearest to it − ly, and repels the + to the opposite side. This + electricity then neutralises the − ly charged brass ball, D, thus causing the leaves of the electroscope to collapse. As it is only strong enough to electrify the part of B nearest to it, the experiment can, of course, be repeated when a fresh part of B interposes.—T. Delbridge.

[47599.]—**Drilling Bicycle Hubs.**—Take a piece of coach hooping about $\frac{3}{4}$in. by $\frac{1}{8}$in., and bend as shown in sketch; bore a hole in at A for centre-pin, and at cranked end at B a small one for a wire centre to be riveted in. After your hub is lined off and centred, put a longish-pointed drill into the lathe, and just run this drill in the depth of countersunk between centres all round; then apply the angle-piece as shown, and drill a small hole for your back-centre the required angle for back-centre at C, and then proceed to drill them all through, shifting this piece every hole to bring them square, or rather more lineable; see B E.—Jack of All Trades.



[47603.]—**Plating with Gold inside and Silver outside.**—Silver-plate your cup, then pour gold solution, previously heated, inside the cup, and suspend the gold anode in the centre of the cup, attach the negative wire to the handle of the cup. The gold solution must be exactly up to the brim.—J. E. A.

[47604.]—**Bicycle Tires.**—Having been in the same difficulty as "Apprentice Boy," I shall be glad to help him out in the same manner as I was helped out myself. The following is the simplest way to fix a loose tire. Powder or roll into a pencil-shape some of the cement, put it under the tire, then hold a spirit-lamp underneath until the cement oozes out; then tie a piece of string round the tire and rim, and let it remain according to the length of time given in the "Instructions," for the cement. The spirit-lamp will not burn the paint at all which hot-irons do. A spirit-lamp may be made very cheaply, as follows:—get a "Liebig" or similar jar, with a bung in it, bore about four holes in the bung and insert a glass tube in each, and with a few inches of wick and two or three pennyworth of methylated spirits, the lamp is complete. I use glass tube 1-6in. diameter; but I daresay any other material will do. The tubes should be in a straight line across the bung.—Geo. Reavell, Alnwick, A.B.C.

[47607.]—**Kitson's Steam-Brake.**—In my reply, Vol. XXXIV., p. 145, I mentioned that Kitson's steam-brake was not tried at Newark, in consequence of the Midland Company's engine and tender No. 892 not arriving at the trial ground. The following is the official description of the brake prepared for the information of the Royal Commission:—Kitson's steam-brake acts merely on the wheels of the engine and tender, and not upon the train. It consists of two oscillating cylinders—one underneath the foot-plate of the engine, and the other underneath the foot-plate of the tender, the pistons of which are connected with the brake rods. To put on the brake, steam direct from the boiler is applied to one side of the pistons only, the other sides being open to the atmosphere. Strong spiral springs at the backs of the pistons liberate the brake-blocks immediately the steam is exhausted. A simple two-way cock upon the front of the fire-box simultaneously admits the steam to the cylinders, and closes the exhaust-ports, or *vice-versâ*. By means of another cock, steam may be admitted at will to both engine and tender, or to each separately. The brake-blocks are of cast iron, hung from the framing, and are applied to one side only of the driving and trailing-wheels of the engine, and to both sides of all six wheels of the tender. Provision is made for working the brake with an ordinary hand-screw if necessary. Pipes are arranged so that a water-jet can be turned on to the engine tires. Experiments were made on the Derby, Castle Donnington, and Trent line, September 22nd, 1875, and February 9th, 1876, with a train consisting of engine and tender, No. 892, both fitted with Kitson's steam brake, four carriages without brakes, and two guards' vans with ordinary hand-brakes. The results obtained, when compared with the stops made by engine No. 815, fitted with Le Chatelier's counter-pressure steam apparatus, upon the 21st September, 1875 (details of which will be found in Vol. XXII., p. 119), conclusively proved to all present that brakes upon engine-wheels produce far more retarding power than an engine reversed, and full steam against it, even with the Chatelier tap open. —Clement E. Stretton.

[47610.]—**Defective Sewing Machine.**—It is difficult to advise without seeing, as the stitches cobbling underneath may be caused by various means; firstly, see that the upper thread is rightly threaded, and that the tension of same is sufficiently tight; secondly, the take-up spring, through which thread passes just before reaching needle, should have sufficient spring to take up any loose thread, sometimes these springs get loose and require tightening; thirdly, see that the needle does not jar or burr against the presser-foot, or against side of needle-hole in plate; fourthly, see that presser-foot holds the work firmly; to ascertain this, raise the needle and lower the foot, now place a sheet of thin paper under the foot, and if foot is rightly adjusted, you will not be able to draw the paper from between very easily without tearing the paper; fifthly, see that you have shuttle threaded right, possibly, you may have the shuttle threaded too tight; lastly, see that the feed-motion feeds the work forward, as the needle repeatedly going down in the same hole would cause cobbled stitches; you can ascertain this by placing material in machine and working it round as if for ordinary work, but without any cotton in needle. If you cannot get on, should be glad to correspond, if you will advertise address. Perhaps the machine is out of time, that is to say, the needle and shuttle might not be in right time.—E. Martin.

[47613.]—**Photographic Camera.**—To Mr. Parkinson.—In my own practice I use an improved tourist-camera, with horizontal and vertical sliding-front, improved double swing back, hinged focussing screen, and will take pictures horizontal and vertical. You will find this camera the most useful for an amateur's practice; by having an extra front you can adapt your portrait lens, without causing the slightest inconvenience. The cost of a first-class camera with three double slides, would be, $\frac{1}{4}$ plate, £4 10s.; $\frac{1}{2}$ plate, £6 6s.; 1-plate £7 15s. I would not advise you to purchase anything but a first-class set of apparatus; if you do not care to go to the price, purchase a second-hand set of first-class manufacture.—James Parkinson.

[47628.]—**Private Study of French Language.**—You should have lessons of a good teacher so as to acquire the language conversationally. If that plan does not suit you, join a corresponding class, to which Miss Walker, St. George's Hall, Randolph-place, Edinburgh, will introduce you. If you want to study quite alone, get Chardenal's 1st, 2nd, and 3rd French Courses, prices 1s. 6d., 2s., and 3s. 6d.; "Le Petit Précépteur," 1s. 6d.; "French Verbs at a Glance," by Beauvoisin, 6d.; and Chambers's "French and English Dictionary." The corresponding classes are one guinea per quarter.—Maggie Brune.

[47623.]—**Electro-motor.**—The armature A consists of round iron bar, with the pole pieces, P P, fixed on the ends, exactly as shown in Fig. 1. B B are field-magnets, with poles arranged as shown in Fig. 2, which is a top view. The pole pieces of field-magnets are of the shape shown in Fig. 3. When the armature revolves, it encounters no dead point, being either attracted or repelled during the entire revolution. The commutator reverses the current just as the edges *d d* of the armature arrive at the edges, H H, of field-magnet poles. In most electro-motors, that period of the armature's revolution during which it passes the field-magnet poles is wholly wasted; but in the above motor, owing to the relative shapes of the latter, and the poles of armature, this part of the revolution is the most useful of any, as the armature is then nearest the attractive poles, and so subject to the greatest pull. In Trouvé's motor, the length of the armature from pole to pole is extremely small, wherefore it cannot be powerfully magnetised, and there is also but little leverage. The armature of above motor must be of good soft iron. Should any difficulty be experienced in making the field-magnet pole pieces, they may be of cast iron. Any point that is not clear I shall be glad to elucidate.—Conrad.

FIG. 1.

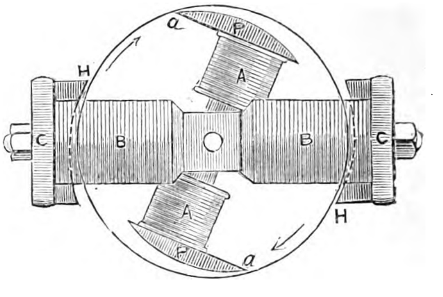


FIG. 2.

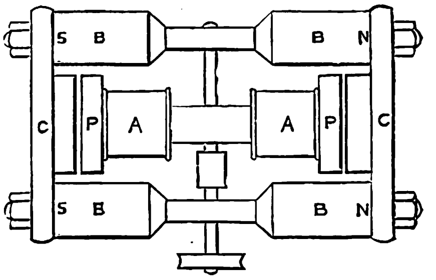
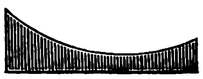


FIG. 3.



[47630.]—**Brakes.**—There is no question as to the answer to this. A wheel touches the rail only in a point; but a brake block covers a wider surface. It is commonly said that friction is only a function of pressure, and has nothing to do with surface. I believe that to be to a certain extent erroneous; but, as you will see, if a wheel is skidded, the point is quickly worn down to a "flat," and the surface being highly glazed, the wheel slips over with the minimum of friction. On the other hand, when the wheel rubs against the block, the latter wears like the tire, uniformly, and a greater surface must be worn away before either tire or block has the highly polished glaze of a "flat"—in fact they never do glaze. Finally, I think you will find that Capt. Galton, in the trials he made on the Brighton, demonstrated by mechanical means that the greatest friction was produced when the wheels just rubbed past the blocks, and I think it was mainly from the facts learned in those experiments that the Westinghouse brake was so arranged that the driver could manage to always keep it just short of skidding. Skidding is an abomination, as it wears flat places, which increase the thumps on the rails, and necessitate frequent turning up of tires. No engine-driver worthy the name will allow his fireman to stop the wheels if he can help it.—Nun. Dor.

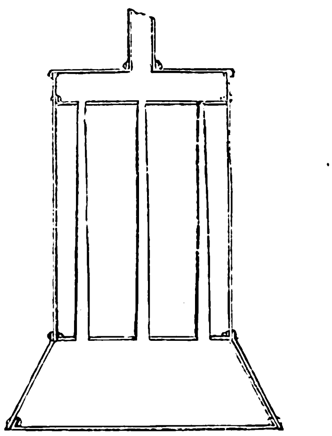
[47630.]—**Brakes.**—To Mr. H. Stooke.—If your correspondent will refer to the details of Captain Galton's experiments, Vol. XXVII., or to my pamphlet on "Railway Accidents," he will find that skidding should be avoided, as the best results are obtained by applying the brake-blocks to the wheels with a pressure as high as possible short of the point which would cause them to skid. The rotation of a wheel is arrested as soon as the friction between the brake-block and the wheel exceeds the adhesion between the wheel and the rail.—Clement E. Stretton.

[47632.]—**Model Loom.**—"Diana" is right in thinking that a model loom would be of great assistance to him in learning tweed designing; that is, if he can work one and make the necessary changes. But I would advise him that he can learn tweed designing in half the time it would take him to make his loom, except he has a mechanic's shop at his elbow. If he has no knowledge of looms, it would take the whole of the 24 pages of our paper to give the instructions he asks for, and he would have a lot of questions to ask as to details the following week. Designing and pattern-weaving are two separate things, and "Diana" can learn one without the other. If he will say what he has done, what he is doing, and where he is stuck, I will help him out, either through the Mechanic or privately; but I don't wish to give instructions that will be useless to him, except he has some knowledge already. If he still wishes to go on with his loom, it would be well if he would state what kind of loom he wishes to make—Jacquard, Dobbie, Barreltapits, revolving or drop-boxes for shuttles: or whether he would make the necessary changes by hand.—W. Stuttard, Breeze-lane, Liverpool.

[47640.]—**Unipolar Induction.**—This experiment is a modification of Ampère's revolving bucket apparatus, in illustration of his magnetic theory. It is fully described in most treatises on electromagnetism of the date 1830 to 1850; but not in the modern textbooks. See for an illustrated account of all the apparatus of this kind in "Sturgeon's Researches," or the older editions of the Encyclopædia.—J. Sutcliffe.

[47642.]—**Silicate of Soda.**—I think this will suit inquirer. Take 1 part silicate of soda, 7 parts water, boil for one hour, decant the liquid and mix thoroughly with 2 parts kaolin. Use this as paint: it will dry with a polish and keep damp out of outside-wall.—Raj Mistry.

[47647.]—**Boiler.**—I should suggest that a pair of 2in. cylinders would be better for a boat 4ft. long, 6in. beam, and the dimensions of boiler for such would be 6in. in all (vertical), a smoke-box ½in., boiler 4in., diameter 3in., fire-box 1½in., increasing in diameter from 3in. at top to 4½in. There should be 9 tubes, ⅛in. diameter at the top and ¼in. at the bottom; the ends should be turned down over the tube-plates, thus holding them firmly together. This boiler should be able to stand a pressure of 40lb. to the sq. in. Fill it up about two-thirds with water. This boiler should be made of copper, and burn spirits of wine. It will work a pair of 2in. stroke cylinders very well. Sketch is exactly quarter-size.—Amateur Engineer.



[47651.]—**Examination of Malt.**—To E. S. Beaven.—1. Estimation of Grape-Sugar and Dextrine.—If "Phœnix" has not already prepared his Fehling solution, let me recommend him to keep it in two parts. It will then keep good a much longer time. In order so to prepare it, dissolve 34·64 grammes of pure copper sulphate in distilled water, and make up to 500cub. centimetres. Keep this solution in one bottle. Then dissolve 173 grammes of Rochelle salt and 65 grammes of caustic soda, and make that also up to 500cc., and keep in another bottle. For each estimation use 5cc. of each solution. The 10cc. will be equivalent to ·05gm. grape-sugar. Before using the test solution dilute 10cc. with 40cc. water, and boil. If any precipitate forms the solution is useless. To prepare the malt extract for analysis, take 50cc. of the 1 in 10 extract previously obtained, and dilute this to 500cc. This will be a suitable strength for estimating the grape-sugar. Measure carefully 10cc. (as above) of the Fehling sol. into a white porcelain evaporating-dish, add 40cc. distilled water, and raise to boiling point. Then run in the diluted extract from a graduated burette, one or two cc. at a time (boiling up after each addition) until the blue colour of the Fehling sol. is destroyed, and all the copper precipitated as red oxide. This operation you will find requires some nicety of manipulation, and the point at which all the copper is just precipitated is not easy to arrive at without considerable practice. It is best after boiling up to allow the precipitate to settle, and then gently tip the dish on one side in a good light, and note if any shade of blue remains. For perfect accuracy, it is necessary to test the hot solution for copper as follows:—Take out with the point of a pipette a few drops of the clear solution, and filter through a very small piece of Swedish filter paper; add a drop of acetic acid and a drop of potassium ferrocyanide. A brown colour indicates that copper remains unreduced, and more malt extract must be cautiously added, and the testing repeated, taking care to use a clean filter and test-tube. The whole operation must be performed as quickly as possible, as the red sub-oxide has a slight tendency to redissolve. The quantity of extract used is now read off from the burette, and is equivalent to ·05gm. grape-sugar. Supposing 16cc. of diluted extract have been required, then (as each cc. equals ·01gm. of malt), ·16gm. of malt yields ·05gm. grape-sugar, or 31·2 per cent. Some analysts recommend adding three or four times the quantity of strong ammonia solution to the Fehling, instead of water. The reduced oxide of copper then dissolves, and a clear solution is obtained. I have performed the process many scores of times both ways, and consider the old method most reliable, although not so easy; but "Phœnix" can have particulars of the other if he likes. Now, as to the dextrine. I presume "Phœnix" has Bale's or some other table giving the proportion or true lb.-weight per gallon of solid extract corresponding to the specific or apparent gravity of the wort. Supposing his original 1 in 10 extract had a gravity of 1,027 (which it will if the malt is good), the table shows this to be equal to ·697lb. per imperial gallon. Now, as his malt is in the proportion of 1lb. to 1 gallon (an imperial gallon of water weighing 10lb.), this is obviously equivalent to a solid extract of 69·7 per cent. of the malt. Deduct from this 31·2 per cent. (the assumed percentage of grape-sugar), and the remainder is dextrine, plus soluble albuminous matter. To determine the dextrine directly, take 100cc. of the diluted (1 in 100) extract, and boil it for two hours in a flask with 2cc. of sulphuric acid; this will convert the dextrine into grape-sugar. Estimate as before with Fehling. Deduct grape-sugar already found, and the difference is dextrine in terms of grape-sugar, which must be diminished by one-tenth to give the actual dextrine. I should have said that I am in the habit of boiling the wort previous to diluting it for the above determinations. Of course, it must afterwards be cooled down to 60° F., and made up to 500cc. The albuminous matter, which does not coagulate, but remains in solution, will be found by difference, and ought to be under 4 per cent. 2. Mashing Heats.—What does "Phœnix" mean by "calculating upon the amount present?" The grape-sugar and dextrine are not present in the original malt. They are formed by the action of diastase upon the starch of the malt in the mash-tun, and the proportions in which they are formed depend upon the temperature of the mash. I cannot pretend to give "Phœnix" instructions in practical brewing, but I will give him a few general facts as to the relation between heats and the formation of grape-sugar and dextrine. And first I would note that I believe many brewers regulate their process of mashing entirely by varying the heats of their liquor, irrespective of the actual heat of the mash itself. Now, it is the mash heat that is of importance, and the heat of the liquor is only a means to that end. It has been proved that the best temperature for the conversion of starch into dextrine (which constitutes the first part of the mashing process) is 145° to 147° but that a considerably higher after-temperature is needed if it is required to convert a large proportion of the dextrine into grape-sugar; 165° to 167° appears to be the most favourable heat for this transformation. Practice and theory unite, therefore, in fixing 145° to 147° as the proper initial temperature of the mash, and according to the extent to which the heat is afterward raised will be the proportion of sugar to dextrine. I have myself obtained experimentally 36 per cent. of grape-sugar, and 24 per cent. of dextrine by maintaining the infusion at 167° for three hours. In practice, this could scarcely be done unless there was a coil in the underback where the conversion would go on at the temperature mentioned just as well as in the mash tun. Finally, the printer has obviously made a mistake in representing you as mashing 5qrs. of malt with 2½ barrels of liquor, but I cannot possibly feel what the taste of your customers may be, and should say, moreover, that the process of fermentation had more to do with modifying the character of the beer than even the mashing has. If, however, a very full bodied, or, which is the same thing, a dextrine beer is wanted, the temperature should not go much, if any, above 160°; but if, as I expect, a saccharine beer which will undergo a ready fermentation and come round quickly is required, I should say that the mash might with advantage be 10°, or nearly so, higher: that is, of course, after starch conversion has taken place. Let it be understood that I refer solely to mash temperature. The mashing is a purely chemical operation. The regulation of liquor heats to obtain a given mash heat depends so much upon the age of the malt, the temperature of the air, and even the position of the tun, that experience is the only possible guide.—E. S. Beaven.

[47653.]—**Oiling Fish-lines.**—Take a piece of flannel, and when your lines are stretched, apply boiled oil, to which a little camphor and turps is added. You can stain it with what you like, and it will dry very quick if the oil is good boiled linseed oil.—Jack of All Trades.

[47654.]—**Printing.**—I know of no work specially devoted to colour printing (letter press), but I imagine all the usual guides to presswork contain a few lines about it. There is really nothing in it, so far as the type is concerned. Suppose we have a prayer-book, with red initial-letters and a red border line. The black type is set up in one forme with the initial-letters omitted; the red type is set in another forme, and in this case consists of the initial-letters and the border line. The compositor's business is so to arrange the types in the two formes that if a sheet of paper is laid accurately to gauge-marks the red letters will fall exactly in their places. The only real difficulty is in the paper, for if after the black is worked, the paper is allowed to dry, the red letters will not fall exactly in their places. If you can see one of Lloyd's Registers of Shipping, you will find numbers of words and signs worked into that; but being done on machine, the register is not quite perfect, though very close. In press work, where the sheets of paper are placed on pins, it is comparatively easy to insure the red falling into proper position. I should mention that there is a method of working advertisement pages in four different colours. Suppose, for instance, a page of this paper divided into quarters for advertisements, it would be possible at one impression to work four colours. That is done by having a four-celled ink-slab, each cell in line with its share of roller and type; then, as the roller has no lateral motion, it will take up on each of four portions a separate colour, and ink the four portions of the page with different colours. Obviously, that can be done to very great nicety; but a little space is necessary between each colour. Before lithography reached its present perfection, a capital imitation of the spectrum was worked from a wood block and printers' inks. The table had a rack each side, and the roller was fitted with spur wheels working in the rack; further, the roller was of greater circumference than the spectrum was long. The inks then being carefully placed in proper order on the table, the roller was passed over, and being regulated by the wheels and the rack, the same part of the roller always fell on the same part of the table. At the press, the block from which the impression was taken had a similar rack on each side, and the roller being placed to a gauge-mark always inked any given part in exactly the same manner. Some excellent copies of the spectrum were thus produced; but, necessarily, the process was more expensive than even the multiple working of the chromo-lithograph. Finally, let me tell "J. D." that while separate colours are, in letterpress, invariably produced by means of separate formes, in the cheap coloured pictures he sees, the tints are often produced by working one colour over another; thus, to make a green, yellow would be worked over blue. Don't imagine, however, that blue and yellow *make* green, as some paradoxers would persuade you; it is only certain combinations of pigments that make the colours which seem just now to puzzle some people immensely. I wonder often whether their eyes always see alike, for pressmen's don't always.—A Practical Printer.

[47655.]—**Cotton.**—Jute is the best of several Indian herbaceous plants, generally Corchorus capsularis and C. olitorius. It consists exclusively of bast-cells, whose greatest diameter in the first-named plant is 16 millimetres, and in the latter 20 millimetres. The fibre is strongly lignified by saturation with moisture. When fresh it has a silky lustre, and white to flaxen colour; but with age it darkens very much, and in a damp atmosphere becomes a deep brown. Cotton is the seed hair of several species of Gossypium; each hair is an individual cell, whose maximum diameter fluctuates between 12 and 42 millimetres, contracting slightly towards the centre, diminishing towards the base, becomes conical towards the tip, and the cell-walls are very thick. W. Binns and friend may easily distinguish the fibres under a good microscope, if they cannot do so by pulling them apart and examining them closely with the naked eye. The weft may be all composed of jute, as is sometimes the case, and it would have made no difference to them if used as bought, without dyeing. The great characteristic of jute is the unequal solidification of the cell-walls, which distinguishes it at once from other fibres. Cotton consists of almost pure cellulose, is unaffected by aniline sulphate, coloured blue by iodine and sulphuric acid, and ammonio-cupric oxide causes it to swell up and finally dissolve. Jute, by treatment with phloroglucine and hydrochloric acid, becomes blood-red, and treated with sulphate of aniline it becomes intensely yellow. I think its affinity for colouring matter is quite equal to that of cotton; but, of course, treatment suitable for a fabric of cotton alone cannot be expected to give satisfactory results on a cotton-jute fabric. Any further information if desired, or I would examine a piece of the cloth.—W. Stuttard.

[47657.]—**Railway Signal-boxes v. Thunder and Lightning.**—I have some useful information on this subject. You shall have it soon.—H. Stooke.

[47664.]—**Brake Failures.**—To "A. S. H."—The failure to which your correspondent refers and about which he remarks there has been "considerable controversy," occurred on 7th July. Upon that date the up night Scotch express was worked in duplicate, the second portion being drawn from Leicester to London by an engine (823) fitted with a steam brake and the Midland modification of the automatic vacuum brake, better known as the "two minute brake." The report of Col. Rich upon the Portskewet Pier accident has most distinctly pointed out the danger to be expected from the use of brakes which leak off, and the frequent failures which occur to this brake upon the Midland and Great Western railways ought to receive the serious attention of the directors of those companies. Mr. Reynolds, in his book on continuous brakes, states, page 183, "that we ourselves are convinced that if the Midland Company abolished the use of the steam-brake on their engines there would be a serious accident in less than a week." This is well-known to be the general opinion upon the railway, and it would not surprise any person who understands the dangerous "leaking off" system to hear of a serious accident being caused by the failure of the two-minute brake; in fact, such an accident has been expected for some time, but so far it has fortunately happened that upon the occasions when failures have taken place and trains have run past stations and junctions, the line has been clear, so that no collision ensued, but there is a very great fear that this may not always be so, especially when the mishap occurs at a crowded junction like Kentish-town, as was the case upon a recent occasion. Under these circumstances we cannot be surprised that the engine-drivers complain about this very inefficient brake. —Clement E. Stretton, Saxe Coburg-street.

[47669.]—**Grapes.**—It is a very rare thing to get the Sweetwater to ripen without bursting. Have you been applying liquids too long to the root and keeping house dry?—Jack of All Trades.

[47670.]—**Study of Electricity.**—Our friend "Sigma" would have to write a volume to answer your query fully. Get "Preece's Telegraphy," "Culley's Handbook," "Ferguson's Electricity," and from them learn the nature of electricity, and the construction of instruments. Cost of the three books not more than 30s., I believe.—H. Stooke.

[47671.]—**Institute of Chemistry Examinations.**—You may sit in May next for either elementary or advanced certificates. The only restriction placed by the Department is, that you confine yourself to one—that is, not to answer questions from both elementary and advanced. Hence, it is impossible to take the elementary and advanced certificates of same subject in one year. —F. G. S.

[47673.]—**Electric Lighting.**—I should use the "Lampe-Soleil" in preference to any other form of arc light. I have carefully examined it, and for simplicity, steadiness, whiteness of colour, and general perfection, it is not approached by any other form of arc light that has been yet brought out.—Caloric.

[47673.]—**Electric Lighting.**—It is impossible to get an arc lamp of the candle-power you mention, three of which would only require 1 h.-p. of engine. The nearest approach to it would be either a small Jablochkoff (the purchase of which you would soon repent) or a Joel semi-incandescent lamp. You would be able to produce from 2 to 3 of the latter, of about 50 candle-power, from 1 h.-p. As regards the "Lampe-Soleil," I am afraid it would not answer your purpose, as each lamp of 1,400 candle-power (so-called) requires at least 2 h.-p. What I should advise you to take, if you wish to illumine a large room, would be an arc lamp of the Brush pattern of about 1,900 candles (2,000 without globe), to drive which 1¼ h.-p. would be ample.—John Bull.

[47674.]—**Electrotyping.**—It is quite possible to accomplish your design, with care; soak the plaster-cast in wax, and brush over with dry and pure black-lead. You had better make a rough experiment to get a thin shell of copper, when you have done so, begin again and try for your ⅛in. thickness, it will take several days, perhaps weeks. —J. Sutcliffe.

[47678.]—**Scratched Plate.**—The only way to remedy this is by regrinding and repolishing, which would cost as much as new glass.—E. Holmes.

[47681.]—**Painting Stove-Poles.**—Glass-paper off with coarse paper and coat with patent knotting. But your poles should be warmed first and perfectly dry.—Jack of All Trades.

[47681.]—**Mill.**—See answer to 47642.—I am not quite sure whether it will stand the heat on the stove-poles.—Raj Mistry.

[47682.]—**Electro-Magnetism and Magneto-Electricity.**—Oersted's discovery was the action of the galvanic wire in producing motion of a magnetic needle. Faraday then showed by experiment that this action was owing to the north and south magnetic poles having a tendency to move round the wire in opposite directions. Arago then discovered that conducting bodies in motion produced motion in a magnet. And finally, Faraday showed that the movement of conducting bodies under the influence of a magnet produced a current of electricity, and in consequence this produced heat. It would take too much space to describe the experimental illustrations of the above. Only a few are given in the small popular treatises of the present day.—J. Sutcliffe.

[47683.]—**To Electricians and Mechanicians.**—You may enlarge your battery by the required number of porous cells, and use as a double-fluid Bunsen; if you, however, prefer the bichromate double-fluid cell, cut the zincs to 7in. by 2½in., and use them inside the porous cells, and the carbon in the outside jars, with small lumps of carbon to increase the surface; set up the 50 cells in two series as one battery of 25 cells; this will give you the best effect. Amalgamate the zincs, and do not try any mechanical agitator; such a thing can easily be made by what is called a water-tumbler, but it would be no use. An accumulator battery is not suitable for your purpose any way.—J. Sutcliffe.

[47688.]—**Painting.**—Give it two coats of moderately dark lead colour, and three or four of black. Ivory black or drop black must be used in both, as it is lamp-black that has so much grease in it, and so difficult to manipulate on account of the manufacture and spongy texture, and will remain for years with grease sweating out of it if in the sun, unless it is put into a crucible and subjected to a red heat; it is the most difficult paint to get to dry properly. Mix your lead colour with one of boiled oil to four of turps, and your black with gold size and about four of turps. See that each coat is laid on uniform, and not too thick, and thoroughly dry before another, and just slick it over with No. 1 or 1½ glass-paper every coat before applying the next, to keep the face free from lumps, blisters, or having the face-measels.—Jack of All Trades.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last C. E. Stretton has replied to 46828.

47095.	Paint for Loco. Engines, p. 316.
47104.	Light Punt, 316.
47114.	Wood-chopping Machine, 316.
47115.	Boiler, p. 316.
47119.	Lathe Speeds, Calculating, 316.
47123.	Electroplating, 316.
47134.	Bicycle-making, 316.
47135.	Compressed Gas, 317.

47320.	Portable Target, p. 411.
47321.	Electro-Deposition of Carbon, 411.
47332.	Engine and Boiler for Small Boat, 412.
47336.	L.B. and S.C. Locos., 412.
47342.	Dialyte Telescope, 412.
47344.	Small Dynamo-Machines, 412.
47345.	Indelible Stain for Stone, 412.
47346.	Boomerang, 412.
47356.	Cold Air, 412.
47370.	Dynamo-Machine, 413.
47374.	Ulcerated Varicose Veins, 413.

Edible Snails.—Snail gardens are common throughout Europe; that at Ulm, in Wurtemberg, sending out no fewer than ten millions of the largest species—*Helix pomatia*—to be fattened in other gardens before being sent to various convents in Austria for consumption during Lent. The proprietor of another "snailery" at Dijon is said to clear about £300 a year by his snails. In this country snails are sent in large quantities from the Licolnshire fens to Covent Garden Market, where they bring about 6d. per quart. Their use in medicine, however, is not unknown in this country; and they have been for centuries prescribed, as cod-liver oil is, for consumptive patients. They are also said to be employed in the manufacture of cream, forming when bruised in milk and boiled, an excellent imitation of the genuine article.

QUERIES.

[47684.]—**Tin-plate Working.**—I want to make some tinware, notably a number of canisters of one size. What tools shall I need? Please give technical names, and price. I can use a bit fairly, but cannot turn up edges. About what quality of plate should I use? Any information as to buying plates, sizes, &c., will be appreciated.—Geo. Chapman.

[47685.]—**Photography.**—To Mr. W. Henderson, Jun.—Kindly state how the marks caused by freckles may be removed or obliterated from a dry plate negative, and oblige—South Tower.

[47686.]—**Legal.**—J. B. became a bankrupt 41 years ago, and died, leaving five children. The debts were £5,800, part of which were paid, some of the creditors having accepted a composition of 8s. 6d. in the £, while others received only 4s. 5d., and awaited more. Balance-sheet showed £900 still owing, but £700 has since been paid, and another £500 is now expected to be. Is it of any use the children putting the matter in the hands of a solicitor with the view of getting some part of this money, and what chance of success?—J. E. B.

[47687.]—**Legal.**—Will Mr. Wetherfield give me advice in the following matter?—My father having died leaving a will, bequeathing me the rents of six houses for my life, afterwards to my children. A short time before his death he borrowed £200 on note of hand, giving the deeds of my houses for security, which the executors are endeavouring to make me pay. Now, am I compelled?—as he leaves his furniture, stock-in-trade, &c., to be sold, and after paying all debts, funeral expenses, &c., the remainder to put out to interest till his grandchildren attain the age of 21 years.—A. S. B.

[47688.]—**Remelting Pig-iron.**—Supposing I melt 215½ tons of old cast-iron railway chairs, and 163½ tons of ordinary pig-iron together, and produce 348 tons of castings, may I assume I am doing this with as little loss as possible? It will be seen the loss in this case is 200lb. per ton, which seems rather heavy. What is the average waste in remelting pig-iron?—Sefton.

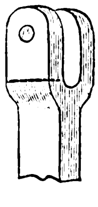
[47689.]—**Steam Tricycle.**—I am about to make a steam tricycle, and would feel obliged if any of "ours" could answer the following:—1. What dia. of cylinders would I require? 2. Size of boiler? 3. Is petroleum as fuel more economical than coal? 4. Could I carry quantity sufficient to last four hours?—Glasgow.

[47690.]—**Enamelling Photographs.**—Will any of our able photographic correspondents kindly explain the method of enamelling photographs, as I wish to try my hand at one or two which I have in my possession?—G. Fryer.

[47691.]—**Siemens Dynamo-machine.**—Will any reader oblige by giving particulars of the Siemens small shunt machine, and gauge of wires on armature, number of sections and lengths, size on field-magnets and length, to enable an amateur to construct a machine to be driven by a ¾-horse engine, to light a small workshop? Engineer.

[47692.]—**Garden Produce.**—To Mr. Wetherfield.—I am employed by the Local Board of Health at a weekly wage, with free house and garden, but have got notice to leave their service, and the crop on garden is not ripe, and I want to leave it on the garden till it is ripe. Can I claim to do so till it is ripe? If not, it will be a loss to me to take the crop up at present.—Anxious to Know.

[47693.]—**Printing Press—Fractured Staple.**—Can any one of our readers tell me the best way to repair a fracture in the staple of a printing press, in the position shown in the annexed rough sketch? The line of the fracture is shown by the dotted line. I have had it temporarily repaired, and cannot have it removed off the premises. It is a super-royal Columbian press, and the staple is in one large casting. The plan must be within the capabilities of an intelligent blacksmith with ordinary tools.—Country Johnny.



[47694.]—**Taking Top off Violin.**—I am going to fix a resonator on my violin, as described by Mr. E. Berliner in No. 882, p. 568. Would "Fiddler," or any other correspondent, kindly help me?—Cremona.

[47695.]—**Legal.**—To Mr. Wetherfield.—You will much oblige a subscriber if you will inform me the number of years a building must have been built against the gable end of a neighbour's building, and over and before a wood-shuttered opening before a right to the same by Statute can be claimed?—A closed door has been in my garden for some years in disuse, and stopped up. The owner of the property has removed the door, bricked it half up, and put a window and sliding ventilator in other part of the doorway. Has he a right to do it?—A Constant Subscriber.

[47696.]—**Wheel Cutters.**—To "Jack of All Trades."—I want two circular cutters for cutting teeth in wheels $^{5}/_{32}$in. and $^{3}/_{16}$in. pitch. Can you inform me the best way to make them?—A. T.

[47697.]—**Roundabouts.**—Would some one tell me how to contrive a set of hobby horses or roundabouts, the same, I mean, as are seen at fairs, and what wood is best suited to carve the same from?—A Constant Reader.

[47698.]—**Bunsen Battery.**—To Mr. Lancaster or Others.—I have some Bunsen cells which I put away one night without cleaning, simply emptying out the porous pots, washing the carbons, and standing out the zincs. On looking at them again, I find the acid in the outer pots evaporated, leaving behind, at the bottom of the jars, a substance of almost a white crystalline appearance about 1in. thick. This deposit is freely soluble in water. The zincs are quite rough, and covered with small white spots on the inside, and on the outside with some soft substance—both of which are insoluble in water. The p.p.'s are covered with white feathery crystals (sulphate of zinc, I presume). Will you kindly inform me what the various substances are, and how to clean the zincs and the p.p.'s? Also, whether the zincs will want reamalgamating before further use? and oblige a—NOVICE.

[47699.]—**Distillation.**—Will any correspondent kindly give the particulars of the process of distilling peppermint, and other similar herbs?—C. T., Horological House.

[47700.]—**Collimation.**—Mr. Gravatt's method for checking the line of collimation is as follows:—The line of collimation of a level is correct when $C'' - C' - (A'' - A')$ equals $2\ \{B'' - B - (A'' - A')\}$ A', B', C', being level points at equal intervals, the instrument being placed midway between the stations. A'', B'', C'', being heights taken at the same stations, respectively), the instrument being placed in front of A undisturbed for the three observations. I should feel obliged to any correspondent who would demonstrate as simply as possible in what manner this becomes a check upon the line of collimation.—T. C., Horological House.

[47701.]—**Platinum in Smee's Cell.**—Would platinised platinum be as good in a Smee form of cell as the usual platinised silver? I have a notion that mercury would not attack it so readily as it does the silver. Is it so? Can it act on it, and may I expect equal constancy and greater durability (at greater cost, of course)? Would "Sigma," or any other kind subscriber, oblige?—PLATINUM.

[47702.]—**Shoemaking.**—I have noticed of late that shoemakers are putting lapels on boots without any stitches. Can you oblige me by telling me how it is done, and what sort of cement is used?—J. C.

[47703.]—**Darkening Mahogany, &c.**—Can any correspondents inform me how to fumigate mahogany or oak wood in making furniture, which gives a deep rich colour and tone to new wood?—S. W.

[47704.]—**Hydro-Kinone.**—In the "E. M." for the 28th July last, under the heading "Recent Advances in Photography," Capt. Abney mentions hydro-kinone as a new developer, having many desirable qualities. Would the lecturer, or any other reader, kindly give instructions and formula for using same?—PHOTO.

[47705.]—**Incandescent Lamps.**—Can I light up a small room for a few hours each evening with fifty Leclanché cells (pints)? If so, what power should I get? Also, which would be best lamp, also price?—MEDICUS.

[47706.]—**Plumbing.**—Will any of your readers kindly inform an amateur plumber how he would set about making an obtuse or right-angle 4in. bend of sheet lead?—ANXIOUS TO KNOW.

[47707.] — **Cylinder and Boiler for ½-h.p. Engine.**—Would some reader of the "E. M." tell me the size of cylinder for ½-h.p. engine, and describe boiler for the same?—AMATEUR ENGINEER.

[47708.]—**Cast-iron Pipes.**—I should feel obliged if any reader of the "E.M." would kindly give a formula for calculating the thickness of cast-iron pipes for waterworks? Also, the usual commercial lengths these pipes (spigot and socket) are cast, from 3in. to 24in. internal dia., the depth of socket of each size, thickness of joint, and quantity of lead required to make such a joint, and (if possible) the mean weight of each pipe?—ETNA.

[47709.] **Compressed Lime Crucibles.**—Can any reader give information of how such crucibles are prepared, the kind of lime used, and pressure necessary? I have the use of a small hydraulic press, giving a pressure of 20 tons: Is that sufficient?—T. S. H.

[47710.]—**Tables of Spectra.**—Would some correspondent give me full titles and prices of some good tables of spectra, marked with wave-lengths, such as Capron's or Lecocq de Boisbaudran's, and state which is considered the best?—T. S. H.

[47711.] — **Electrical Measurement.** — Would "Ll.B.A." kindly inform me if the following calculations are correct?—

$$C \times E \times 0{\cdot}00134 = \text{h.p.}$$
$$C \times R = E.$$
$$E \div R = C \text{ in ampères.}$$
$$E \div C = R.$$
$$\text{c.p.} \div \text{h.p.} = \text{c.p. per h.p.}$$
$$\text{Where c.p.} = \text{candle-power.}$$

Also, what is the difference between volt-weber and volt-ampère?—STUDENT.

[47712.]—**Largest Dynamo and Coil.**—Will any reader kindly tell me which is the largest dynamo ever made, and the name of maker? Also, which is the largest induction coil? Where are they at the present time? If possible, kindly say length of spark of coil, and strength of dynamo.—ELECTRICIAN.

[47713.]—**Aniline Dyes.**—What are the usual adulterants in picric acid, naphthaline, Bismarck brown, aniline black, and Hoffman's violets? How may the same be ascertained?—PRO BONO PUBLICO.

[47714.]—**Tests.**—Will some of "ours" kindly give me a method of ascertaining, quantitatively, the amount of potash in the chromate and bichromate of potash?—PRO BONO PUBLICO.

[47715.]—**Transit of Venus at Marseilles.**—Will your correspondent, "S. G.," who has given particulars of Transit at Jamaica, be so kind as to do the same for Marseilles, which, in point of clearness of atmosphere is probably about the best part of Europe for observation?—A. K.

[47716.]—**Faint Stars.**—Can Mr. Sadler recommend a catalogue of stars which would be of use in identifying them down to the 8th or 9th Mag., at least, and can he give any hints which would be of use in making them out with an equatoreal? It would be a great convenience if the catalogue gives R.A. in time, and D., not N.P. D.—BRAIN.

[47717.]—**Problem.**—I should be pleased if you correspondent, E. J. Markham, Esq., will kindly favour me with a solution?—

given— $$\frac{1 + x^5}{(1 + x)^5} = a, \text{ to find } x.$$

—ANXIOUS.

[47718.]—**Stains in Woollen Goods.**—Can any one tell me how to remove stains of peppermint from a scarlet wool table-cover, without injury to the latter? Also, beer-stains in a light green wool table-cover?—W. H. F., Fareham.

[47719.]—**Ague.**—Will Dr. Edmunds inform me what is the best diet for a person tormented with continued ague, in spite of all quinine, strychnine, arsenic, &c., &c., &c., &c.?—UNHAPPY JACK.

[47720.]—**Oil-Stone.**—There is some kind of spirit which will soften a piece of Turkey when clogged, and gummed with oil. Will someone kindly name it? I cannot recall the name, nor the book in which I read of it.—S. P.

[47721.]—**Studying for the Medical Profession.**—I am at present engaged in a large mercantile business in a country town, but have an idea of adopting the medical profession in the course of a year or two. I wish to know how I can best prepare myself by private study, what languages are necessary, and what examinations I will have to pass. Could I get attached to the Local Infirmary, and what length of time will it be necessary to spend at the hospitals? My age is 28 I have received a fairly good education, and have a knowledge of chemistry.—DELTA.

[47722.]—**To "Sigma."**—What would be the difference between two Smee's cells (as regards E.M.F. and quantity), one with 32in. of platinised silver, and charged with dilute sulphuric acid, 1 to 8, and one with 64in. of platinised silver; and charged with dilute sulphuric acid, 1 to 16?—NOVICE.

[47723.]—**Restoring Engraving on Silver Plate.**—We have some silver articles which have been in use for many years, and we now find that the old engraved lines have been filled up and silvered over to to make a plain surface. The latter has worn off, and we wish to remove the filling, so as to restore the engraving. How can it be done?—OBLIGED.

[47724.]—**Silvering Mirrors.**—How is the heat applied in the new process of silvering looking-glasses? I believe it is done by steam, but shall be obliged for a diagram of the apparatus.—C. H.

[47725.]—**Water-glass.**—Could any reader tell me how to make water-glass, so that when an article is coated, and then baked, it would have a coating of glass?—J. G. MOON.

[47726.]—**Tin-Plate Working.**—About two years ago, I inquired in these columns how to cut out the base of a spout to be fitted to a water-can. Mr. Davies said that full instructions would be given by him under "Plumbing," but they have not yet been discovered. Will some reader kindly help me?—TIRO TIRONUM.

[47727.]—**Boot and Shoemaking.**—I want very much to have a full description of tools used by bootmakers (not machines), and the manner of their employment, with an elementary description of how to sew on soles. The books recommended by Mr. King are useless to a—TIRO TIRONUM.

[47728.]—**Electrical.**—To "E."—Can you tell me about the number of alternations in the direction of the current of the "alternating" dynamo necessary to light up an electric candle steadily?—CANDLE LIGHT.

[47729.]—**Dyeing Hose.**—I wish to die ladies' hose, &c., old gold colour. Could any of your kind readers assist me?—BLANCHE MAY.

[47730.]—**Labels for Plants.**—Can any of the "E. M." readers kindly describe the labels for plants, for which the Society of Arts have just awarded prizes?—K.

[47731.]—**Killing-Bottle.**—Can any correspondent inform me of a way to make a good killing-bottle for insects? I have one about 3in. by 3in., in which is placed 1oz. of cyanide of potassium, covered with a layer of plaster of Paris, mixed to the consistency of cream. This bottle is too slow in its action: the insects become quiet about ½min. after admission, but it requires quite 5min. to kill them, and if taken out before that time they recover. I have heard that there are bottles that kill the insect almost immediately after being placed in them. If any of the readers of the "E M." know of such, and method of making, will they kindly insert an answer?—J. MOULT.

[47732.] — **Coil for Lighting Gas by Electricity.**—To "SIGMA."—Some time since I asked a question concerning the above, but got no answer, and I now wish to repeat it, and to call Mr. Sprague's attention to it, if he will oblige me so far. There are many successful systems of lighting gas by electricity in which are used a Leclanché battery, 2 to 4 cells; an induction (resistance?) coil, on an open circuit, broken at the burner, and closed and reopened, at the burner, to light the gas, the spark at breaking the circuit being very large and bright, and, I suppose, being from the so-called "extra" current. The coils are small, but do their work well. I desire to know how the coil is wound: Is it simply a coil of fine wire, developing a spark by the mutual action of the various coils on each other (extra current); or, as I have heard, a regular induction coil, so joined up that the primary is joined to secondary to put both in the same circuit. Will Mr. Sprague satisfy my anxiety to know the facts?—ROI NE PUIS, SOUZA JE SUIS.

[47733.]—**Switch for Telephones.**—Will some of the readers of the "E. M." assist me in the following?—I have erected a pair of telephones, A and B. They consist of microphone transmitter, pair of receivers, and bell each, and they are connected in the ordinary way by a line wire about ½ mile long, with an earth at each end. They work very satisfactorily, and I am now desirous of introducing a third telephone, C, which involves, extending the line wire some 100 yards beyond B, into another house. I am at a loss how to join up the third telephone, so as to make them all intercommunicable. Will some one suggest a switch or other arrangement?—F. C. M.

[47734.]—**Microscopic.**—Being desirous of studying the infusoria, I wish to know (1) what is the form of microscope? (2) Is the binocular necessary? (3) What is the best stage for following the motions of living objects? (4) What objectives and what aperture will be best, and (5) Is it not possible, by using the deeper eyepieces, to make a good 4-10 do all the work? And if so, where can such an objective be obtained? £12 would be the utmost I could afford for the microscope stand alone.—O. O.

[47735.]—**Cataract.** — Will any kind reader give advice as to the following? My father, when 67 years of age, became perfectly blind with cataract in both eyes, and his brother also a few years earlier; grandfather also lost one eye. Is this complaint hereditary, and is there any known remedy or preventive? My eyes (age 45) up to within the last twelve months, have been very good, and I could read the "E.M." comfortably 8 or 9in. off. Now I have to hold the paper 18in. away, and soon get tired, and put on spectacles, which, I am afraid, weaken the sight if used for long together. I apparently can see a long distance as well as ever. Any advice as to what to do to retain my sight and avoid cataract will be thankfully received.—ARCHITECTUS.

[47736.]—**Legal.**—To MR. WETHERFIELD.—Will you kindly give advice on the following matter?—I own a piece of land, which I have let to a man in the following manner: I drew up agreement in writing myself, what I thought at the time would answer for a lease for seven years, which was considered good enough by both of us. It stated plainly that the rent was to be paid one-half on Lady Day, and the other half on Michaelmas Day in each year of the seven. There is no seal or stamp on the paper: it is simply signed by both of us in the presence of witnesses, with their signatures attached. He has paid some of the rent, according to agreement, and had proper half-yearly receipts; but this last 18 months he has allowed to become in arrears. He keeps promising to pay, but does not do so. Which would be the best and cheapest way to compel him to pay me? Can he, under such an agreement, defy me in this way, or relet until the seven years have expired, or can I give him six months notice if the agreement is not valid as a lease? If he has a lock on the gate, can I put another over it until it is paid? The rent of the land is £9 per annum, and he has occupied it now four years on Lady-day last.—ONE DOUBT.

[47737.]—**Black Shellac Varnish.**—Will some of "ours" kindly inform how to make shellac varnish, black? I have tried lamp-black and Prussian blue, and also aniline black; but without success. The varnish I want to make black is made of 1 part orange shellac, dissolved in 5 parts meth. spirits.—RAJ MISTRY.

[47738.]—**Analysis of Paint.**—How can I eliminate oil from paint, and at the same time estimate the amount of oil and water which a sample of paint my contain before proceeding with the rest of the analysis?—OXIDE.

[47739.]—**Tallow.**—How can adulteration in tallow be detected either by analysis or otherwise? Perhaps some of your numerous readers will kindly give me a few hints on the above.—OXIDE.

[47740.]—**Boiler Query.**—Having made a vertical steam-engine, 1¼in. stroke, mounted on a thick brass boiler, riveted and soldered, 10in. high, 5 diam., I want to heat it with an atmospheric gas burner, having made one with ¼in. pipe to the elbow, with fine vent-hole, from the elbow upwards ¼in. tube (inside diam.), terminating in a ring 3in. diameter, with 15 holes. This does not seem to get steam up any quicker than an ordinary batswing burner, and the gas escapes a little at the air-supply hole, although I have tried different size supply holes both for air and gas. Is the fault in the angle elbow, or the ¼in. tube not sufficiently large? Any information would be esteemed a favour. Also for heating it effectually where gas cannot be obtained, if possible by unscrewing gas apparatus and using that hole (⅜in.) only, as I would rather not alter stand to push a lamp in. Being a complete model and driving model machinery, I want to exhibit it publicly, therefore should be pleased with early reply. Boiler is mounted on iron bed-plate fixed to a mahogany base, having a hole clean through for air supply, &c.—STARLIGHT.

[47741.]—**Winding Engine.**—Will someone kindly help me to an explanation of the formula given on p. 596, Vol. XXI.? Say how the figures 12, 3 15, and 37·7 are obtained, and oblige—W. W. H.

[47742.]—**Tenant's Liabilities.**—Last Michaelmas I let a house. I have never yet received any rent, as my tenant says, having taken the house by the year he is not bound to pay rent more than once a year. Is this so, or can I claim the rent every half year? Also, is the tenant bound to leave the house in good repair? It was a new house, and he is the first occupier. We have no agreement.—LANDLORD IN DOUBT.

Every Workman connected with the Building Trades requiring a situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden London, W.C.

"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

Every Workman should insist on seeing "THE BUILDING NEWS" every week at his Club or Coffee House. He will find more "Lists of Tenders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Intercommunication" if he wants to know anything about his trade; to write to the Editor if he has any suggestions to make and to advertise in the paper when he wants work.

The charge for Advertisements for Situations is One Shilling or Twenty Words, and Sixpence for every Eight Words after.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Aug. 16, and unacknowledged elsewhere:—

T. Mercado.—Rev. W. J. E. Rooke.—J. Hutton.—Jas. Perry.—Rev. J. J. M. Perry.—A. Manock.—A Would-be Piper.—Galvanometer.—Disinfectant.—Chlorine.—R. Gilbert.—Tin Plate.—Indigo Planter.—Patent Plate.—A. S. L.—A. J. Smith.—Arqudante.—Boxwell.—A Subscriber.—Constant Reader.—Dolomite.—Douglas.—J Harrison.—Etna.—Caius.—A. M. R.—W. L.—H. W.—Amateur Electrician.—Grapho.—Prismatique.—A Fellow of the Royal Astronomical Society.—J. C. King.

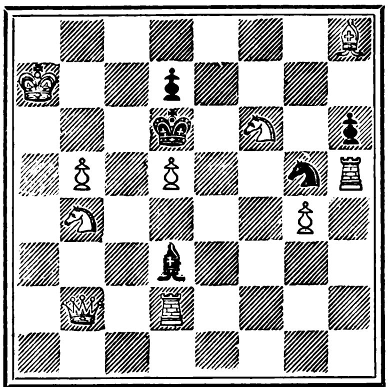
G. B. T. (How would you get the air out again? The pressure of the air would force the piston down in one cylinder, but not if that was connected to a beam and had to drag another piston up against atmospheric pressure. For you have on one side 15lb. per sq. inch less friction to pull up 15lb. plus friction.)—Paul Pry. (They are made of peroxide of manganese, carbon, and rosin, and subjected to a very heavy pressure in the moulds.)—C. H. (A solution of a tincture of the Pyrethrum roseum is said to be a protection against the bites of mosquitoes.)—An Amateur Electrician. (Put your question direct to one of the opticians who advertise in our columns; but tell him exactly what you want to do—don't bother him about a "photo-electric microscope.")—H. Hayes. (We do not know of such a work.)—J. S. (Indiarubber dissolved in bisulphide of carbon or mineral naphtha.)—Obliged. (We understand now that you wish to remove the filling so as to restore the engraving. It is most likely silver solder that has been run in, and if so could be removed by the careful application of heat, but only a practical workman could do it. Nitric acid would dissolve the silver itself. We insert a query for you.)—Young Electricity. (See reply 47496, last week. You do not say how long the coil is; but as to the spark, see p. 289, last volume.)—Unmusical Joiner. (Full instructions for making American organ were given in Vol. XXVI. Harmonium in back volumes. For prices of fittings, you must obtain the price lists from the sellers.)—Semper Fidelis. (If you had given us a description as well as a photograph, we might have been able to have determined it; but as it is, we can only suggest that it is some arrangement for drawing purposes, probably for use with the microscope.)—Round Turn. (Does it? At any rate, such questions must be put to an intelligent schoolboy.)—Sugar. (The blood was used for clarifying, but nowadays it is dispensed with, animal charcoal effecting all that is desired. The albumen was the useful part.)—Novicio. (When you write again, use an ink with less gum in it, and don't fold up the letter until dry. So far as we can understand the query, we can say that oxalic acid will remove ordinary ink.)—Questator. (Must search the records, or get some agent to do it.)—W. R. C. (We really do not know what sciences a "mackanic should chiefly study to become a member of the South Kensingention science and art department," nor "what would be is profession when leaveing"; but on application to the Secretary you can obtain the Directory, price sixpence. You can also obtain the Whitworth prospectus, free, on application to the secretary of the Science and Art Department, South Kensington.)—Finem Respice. (We cannot undertake to indicate the "best" textbook; but we think that Greenwood's "Metallurgy" (Collins), and Goodeve's "Steam-Engine" (Lockwood), would suit you.)—Was-heil. ("Model Yachts and Boats") L. Upcott Gill), is a useful book. You will find many hints in back volumes, and the lines, &c., for a schooner fully set out in p. 309, Vol. XIII.)—Learner. (If you will refer to recent back numbers you will find a series of lessons on dry-plate photography, and many replies as to developing.)—A Seven Years' Subscriber. (We quite agree with you that an answer to your questions would be interesting to many. It is for that reason we have frequently devoted considerable space to the subject during, say, the last seven years. Suppose you look at pages 237, 261, 285, 308, 381 of the last volume, and the indices of the other volumes you have.)—E. D. (Fully described in No. 849, p. 396.)—W. S. Brown. (We should be glad to give the description of the milling machine.)—Scheneider. (£2 12s. 6d., at Doctors' Commons, at the Archbishop of Canterbury's office, or of local surrogates.)—Wm. Fellows. (If the circumstances are as you state, we do not think your master can either legally or reasonably expect you to make good the damage, or refuse to pay you your wages.)—Country Architect. (A full and complete series of illustrations of the new Courts of Justice, from the drawings of the late architect, G. E. Street, R.A., are now appearing in the *Building News*. The first batch appeared in the number published June 30.)—L. L. (A good process to clarify liquors is said to be the following: To each two gallons of the liquor add 150 grains of starch, 75 grains of dry egg-albumen, and 75 grains of sugar of milk, previously macerated in a little water until the two last ingredients are dissolved. The liquors clarified by this method are said to become quite brilliant, and to acquire a pleasant taste.)—Housewife. (A solution of bichromate of potassium and glue yields a superior cement for broken glassware. Moderately strong glue or gelatine solution is mixed in a dark place or in a photographic dark room, with a small amount of concentrated solution of bichromate of potassium. The edges of the fracture, which have been thoroughly cleaned, are then coated with a thin layer of the mixture, strongly pressed together, and kept close by tying with twine, or in some other manner. The glass is then exposed to sunlight for some hours. This causes the cement to become insoluble even in hot water.)—B. J. L. (We do not know what the "original maker's" receipt is, but here are two for making eau de cologne. 1. Oil of orange flowers (Neroli), 4 parts; oil of lavender (Mitcham), 4 parts; oil of rosemary, 8 parts; oil of lemon, 8 parts; oil of bergamot, 16 parts; tincture of musk, 1 part; acetic ether, 1 part; water, 158 parts; alcohol, 800 parts. Add the oils, tincture of musk, and acetic ether to the alcohol; then add the water, and set the mixture aside in glass-stoppered bottles, until it has become perfectly clear and limpid. Draw off the clear liquid, or filter it through paper. 2. Oil of orange flowers, 3oz.; oil of rosemary, 2oz.; oil of orange, bitter, 5oz.; oil of lemon, 5oz.; oil of bergamot, 2oz.; alcohol, deodorized, 6 gal.; water, distilled, according to strength required. Dissolve the oils in the alcohol; to five gallons of the mixture add slowly and while stirring, enough distilled water to render the liquor very slightly opaque. Then add the reserved gallon, which should render the liquor clear again, and set the mixture aside for several weeks. Finally filter.)

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden. W.C.

PROBLEM DCCLXXIII.—By Frideswide Beechey and T. B. Rowland.

Black.



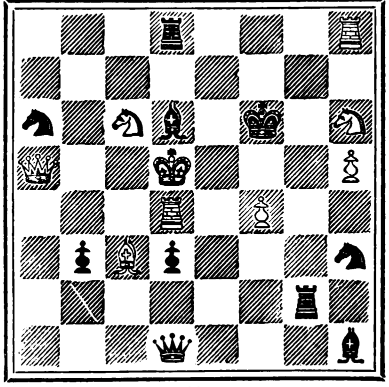
White.

White to play and mate in three moves.

PROBLEM DCCLXXIV.—By H. F. L. Meyer.

(From *Meyer's Guide to Chess.*)

Black.



White.

White to play and mate in two moves.
Maximum of checks threatened by Black 28.

Solution to 769.

White.	*Black.*
1. P to B 3	1. P to B 4 (a)
2. Kt to B 6 (ch.)	2. Moves
3. Q mates	
	(a) 1. K to Q 5 (b)
2. Q to K 4 (ch.)	2. K moves
3. Kt or B mates	
	(b) 1. P to Q 4 (c)
2. Q to B 7 (ch.)	2. K moves
3. P or Kt mates	
	(c) 1. Kt to B 3 (d)
2. Q takes B (ch.), &c.	
	(d) 1, B to B 3 or Q 6
2. Q Kt to Q 3 (ch.), &c.	

Solution to 770.

White.	*Black.*
1. K to Kt 3	1. Anything.
2. Mates accordingly.	

It is proposed to start a Correspondence Game Tourney in connection with the English Mechanic. The number of entries will be limited to eight. Entrance fee five shillings. The winner of the greatest number of games will receive £1 5s.; the second winner fifteen shillings. Names and subscriptions must be sent to Mr. J. Pierce, Bryn Rhedyn, Llandwrog, near Carnarvon, before the end of September. The winner of each game must send it to the Chess Editor for publication, if desirable, in the English Mechanic.

NOTICES TO CORRESPONDENTS.

Correct Solutions to 770 by Celsus and Schmucke; to 769 by Celsus; to 768 by W. T. Bayne.

W. A. Lee.—We believe you are right as to 763. Your solution has been submitted to the author.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

CHARGES FOR ADVERTISING.

	s.	d.
Thirty Words	**2**	**6**
Every additional eight words	**0**	**6**

Front Page Advertisements Five Shillings for the first 40 words afterwards 9d. per line. Paragraph Advertisements One Shilling per line. No front page or paragraph advertisement inserted for less than Five Shillings. Reduced terms for series of more than 6 insertions may be ascertained on application to the Publisher.

ADVERTISEMENTS in EXCHANGE COLUMN—for

	s.	d
Twenty-four words	**0**	**3**
For every succeeding Eight words	**0**	**3**

ADVERTISEMENTS in the SIXPENNY SALE COLUMN.

	s.	d.
Sixteen Words	**0**	**6**
For every succeeding Eight Words	**0**	**6**

⁂ It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions; and in cases where the amount sent exceeds One Shilling the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement and charged for.

Advertisements *must* reach the office by 3 p.m on Wednesday to insure insertion in the following Friday's number.

Holloway's Ointment and Pills.—For bad legs, gathered breasts, and scrofulous sores. these are genuine specifics. The grateful and earnest gratitude of thousands who have been raised from prostrate helplessness and a condition loathsome to themselves and others, renders it quite unnecessary to enlarge in this place upon their extraordinary virtues.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 8d. for the first 24 words, and 3d. for every succeeding 8 words.

Wanted, all the back numbers of the "**Electro**-Metallurgist and Electric Light Journal." Exchange.—J. C. T. Carter, 3, Castle-street, Reading.

Organ Bellows and Windchests (new and second-hand), in good condition, ready for wind and pipes.—Address, William Johnson, No. 12, Moxley near Wednesbury.

Splendid pair of **Horns**, 6ft. from tip to tip, and 11in. at base. Exchange for good 52in. Bicycle; or what offers?—Address, W. T. P., Poundisford, near Taunton, Somerset.

"**English Mechanic**," 114 to 557, in parts and numbers. What exchange?—A. Harris, Wavendon, Woburn, Beds.

Fret-cutting. Circular Saw, Turning, and Drilling Machine. What offers in exchange, value fifty shillings?—Webber, 34, Arundel street, Strand.

"**Imperial Gazetter, England and Wales,**" twenty two parts at 2s. 6d., bound, gilt, six volumes. Exchange Bunsen Batteries, Incandescent Lamp, offers, Electrical Light Apparatus.—J. Trackson, Norwich.

Horizontal **Engine**, new, 1½ bore, 3in stroke, link motion, reversing gear. Take 5in or 6in. slide-rests—D. Alexander, 22, Market-place, Forfar, N.B.

"**English Mechanic**" in exchange for "Graphic," "Illustrated," or "Dramatic News." Papers even a month old accepted.—E. B. Fennessy, Pallasgreen, Limerick.

Organ Pipes. Stopped diapason and flute, wood. Principal, Twelfth, and Fifteenth, metal; for what offers?—M. Rayner, Pavement-street, Cleckheaton.

Wanted, powerful **Hand Punching Machine** in exchange for one small Horizontal Engine and Boiler, complete, half horse-power.—J. Bilsborough, Alderley Edge, Cheshire.

Concertina (Anglo), 30 or more keys, or **Portable Harmonium** wanted in exchange for Violin in case, and cash.—Hewson, 12, Great Crown-court, Haymarket, W.

Violin, in case, with bow, value £5. Exchange for good Telescope on stand, or good model engine and boiler. Difference in cash.—Hewson, 12, Great Crown-court, Haymarket, W.

Magic-Lantern, mahogany bodied, Lime Light Apparatus, and quantity of Slides, cheap, or exchange. List and particulars on application.—F. B., 15. Southgate-road, Wood-green.

Piano (Cottage) Wanted, must be cheap, in exchange.—All particulars to W., 69, Norfolk-road, Essex-road, N.

48in. **Wooden Bicycle**, saddle and bell, complete, nearly new. One brass boiler on stand, 2 by 4. Useful exchange.—Samuel Baker, Robin-lane, Pudsey.

Set of Vertical **Engine Castings**, 2 by 4 cylinders, bored and turned, also copper boiler, 6 by 3½. Useful exchange.—Samuel Baker, Robin-lane, Pudsey.

Whole-plate walnut wood **Camera and Portrait Lens**. Would accept first class half-plate View Lens in part exchange.—Tanner, North Parade, Horsham.

One octave set of **Beech Pedals**, suitable for organ or piano, in frame complete. What offers?—Tanner, North Parade, Horsham.

The English Mechanic
AND
WORLD OF SCIENCE AND ART.

FRIDAY, AUGUST 25, 1882.

THE GEOMETRIC SLIDE-REST.

By J. H. Evans.

THE present forms a most interesting subject for all amateur turners, inasmuch as an unending variety of patterns may be produced, some of the most beautiful character, especially those with fine lines. This instrument was invented by Capt. Padsey Dawson, a gentleman of great mechanical ability, and a very fine ornamental turner. The slide-rest was patented in 1870, but I regret to say that, owing to its being somewhat costly, the patentee was not in any way a gainer by it. As I am about now to explain the instrument, I trust it will be an incentive to some of our amateur ornamental turners to have it added to their lathe; and if they are already possessed of the spiral apparatus, it will not be, of course, such an expensive addition after all.

FIG. 1

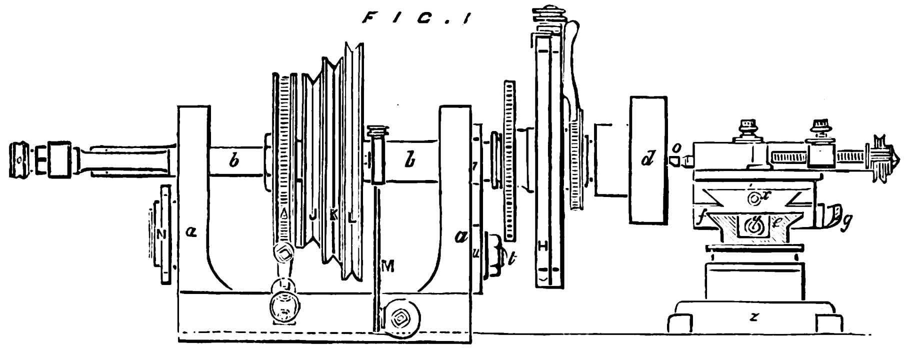


FIG. 2

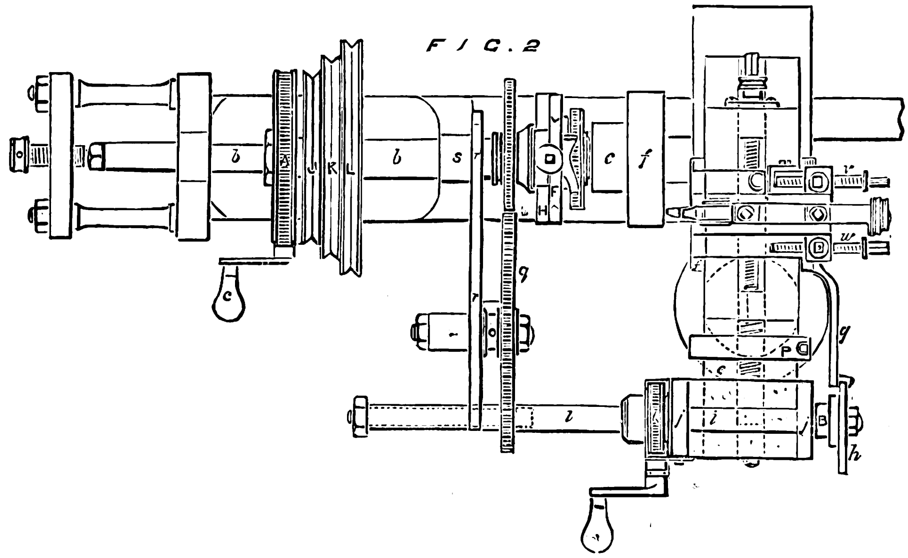


FIG. 3

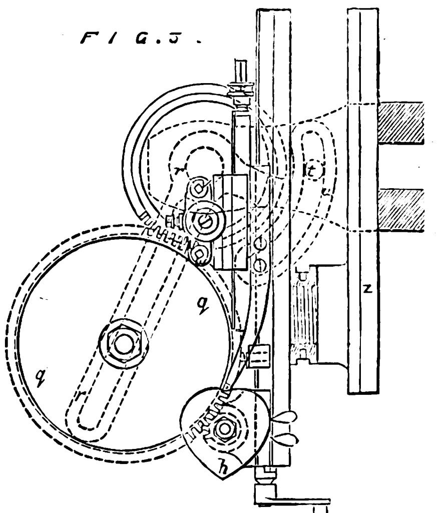
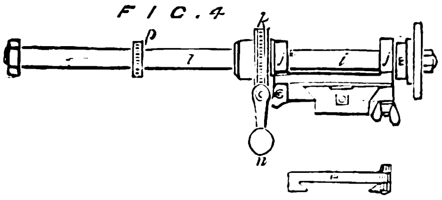


FIG. 4



The invention relates to the arrangement of apparatus for producing figures, designs, and devices of an ornamental and geometrical nature upon wood, metal, and other materials, also to the employment of cams, templates, or pattern-plates in a special manner upon a lathe, which templates, &c., effect the automatic movements of the upper slide of slide-rest, and so give motion to the cutter or tool that is being used. Although this apparatus can be readily adapted to almost any lathe, it was designed more especially for such as are generally known as ornamental turning lathes.

As will be seen, the geometric slide-rest works in connection with the spiral apparatus, and it is by the different changes of the various wheels that such a vast number of patterns can be executed; for instance, if the simple eccentric cam is placed on the transverse arm, and the wheels used are 144 on chuck, 16 and 120 on double arbor, gearing into a 24 on the spindle, the effect would be quite a different thing to using the same wheel, and either reducing or increasing the eccentricity of the cam, or to use the same eccentricity and place the 144-wheel where the 120 was used, and so on. I am quite certain that it is impossible for any one ever to work out the uses of such a tool, as they are perfectly inexhaustible.

To proceed. The apparatus is made on the same principle as the ordinary slide-rest for ornamental turning, with the exception that it has two slides; the upper one carries the tool-box or holder, in which the tools, such as eccentric cutter, drill, spindle, and universal cutter are held, also, of course, the fix tool for line patterns. The tool-holder being the ordinary standard size, any of the ornamental cutters, in fact, can be used with the apparatus. The top slide has two screws in the usual way, one to traverse the tool-carriage and the other to form the stop for the depth of cut. The lower slide has a spiral spring in the place of the ordinary screw, which is secured to the right-hand end by a steel pin; the other end of the spring passes through a small hole in the end of the lower slide, and is kept in its place by a small nut on the end of it, and when the slide is pressed against it it oscillates from the elasticity of the spring. At the back of the tool-box, under the adjusting-screws for regulating top slide there is an arm firmly fixed to the metal part of lower slide, and at the end of this arm or lever a small steel rubber is fixed, made so as to revolve freely. This when at work acts against the edge of the various templates that are used.

On the left hand of the lower slide is a transverse slide, which moves to any part of the slide, and can be fixed with a thumb nut wherever required; this slide carries a spindle, and the end nearest the lathe-head is turned down to fit any of the change-wheels and pinions, which are held on their places by a steel nut and washer; the large wheels are filled up with a loose pad with a small hole and a large washer, just in the same way as they are used on an ordinary slide-rest.

The motion is given to this spindle by a tangent-wheel and screw when the revolving-drill is being used; but when the fixed tool is in use the motion is given by a winch-handle on the end of the spindle, and the tangent-screw, of course, thrown out of gear. On the end of the spindle opposite to that which carries the wheels a metal flange is fitted, which carries the various templates, guides, &c.

In order to make the apparatus more easily understood, I have given two or three illustrations of it, and by reference to the various figures in the drawings it will, I hope, become perfectly clear to our readers as far as its application to ornamental lathes is concerned. Figs. 1 and 2 represent a face and plan-view of it respectively, A being the mandrel-frame and B the mandrel, fitted in the usual way to hardened steel collars, H, Fig. 1, being the eccentric chuck, the only difference in this part being that I now make them with tangent-wheels instead of ratched-wheels; D represents the material about to be worked upon, and is held in a cup-chuck. In front of the lathe-head, Fig. 1, is seen the slide-rest Z, being the shoe into which the socket of the lower slide is fitted; the slide C is planed up in the usual way, and on to it is fitted the metal slide F; this must be made to slide evenly and freely, in order to be acted upon by the spring; the slide L is also fitted to the one F, but this is actuated by a screw X for adjusting the tool to various positions and parts of the work.

The slide-rest is, of course fitted to a cradle in the usual way. Letters R and U, Fig. 1, show where the radial arm is fixed, T being the nut and screw to fix it in the position required. **M** is the index peg, as seen in the drawing, but this, although shown, cannot be used when the apparatus is in motion, as the pulley is constantly on the move. N shows where the eccentric action is obtained for throwing the metal conductor into gear with the steel guide for screw-cutting. J K L represent the pulley; A with a star illustrates the segment apparatus.

We now come to the plan, Fig. 2, which gives a representation of the apparatus as connected to the spiral ready to work, and it will be readily understood by careful reference to it. Fig. 4 shows the metal-piece J, which is fixed to the slide E, in whatever position it is wanted by the thumb-nut, *i* being the spindle which passes through the same, having on the one end the metal flange B, to which is again fixed the cam H, and when deep cutting is required to be done the tangent-wheel K is used in order to create a slow and more powerful motion. On the other end of the spindle *i* a nut is fitted to fix the various wheels on, the distance being made up by numerous metal washers to bring the wheels into a line with those on the radial arm. Referring to Fig. 2, they will be seen in gear. Having so far put the apparatus together, the wood D should be surfaced over with the top slide, a fixed tool being placed in the top slide; and while this is done, it is better to put a strong tension on the spring, and place the fluting stop P against the end of the slide. When the work is surfaced, over the stop P may be removed and the cam H brought to bear against the small steel roll on the arm *g*. We will take as a beginning the plain eccentric as a cam, and if this is set out to about ⅜ eccentricity, and one whole revolution of the tangent wheel taken, the action of the whole apparatus will immediately display itself, inasmuch as it will be clearly seen that, while the mandrel is making its revolution, the tool-slide is moved backwards and forwards by the cam bearing against the projecting arm G. Very beautiful patterns are thus produced, and as I have before said, the variety is unending. The cams that up to the present time have been most used are the plain eccentric, the ellipse—two of which placed across one another produce most beautiful effects—and the heart shape. I have worked considerably at these, and find that I can get a different production at almost every move; and that one of the most difficult things to obtain is a reproduction of any particular pattern, unless the settings are most accurately taken—that is, the exact wheels, precise amount of eccentricity of the cam, and the adjustment of slide of eccentric chuck, if it is used. Fig. 3 shows a face view, the dotted lines giving the position of radial arm and wheels in gear, also the heart-shape cam. When only very fine line patterns are required, the tangent-wheel K may be thrown out of gear, and a winch-handle placed upon the end of the spindle behind the cam, and the motion obtained by it. When using the plain eccentric cam, this motion is very regular; but when such cams as have undulated edges are used, the tangent-screw is quite necessary to get a smooth cut and to prevent an uneven pressure occurring through the cam slipping suddenly into a deep recess of the cam.

To cut deep mouldings round the various figures, such as 3, 4, or 5 loops, the drilling instrument O, Fig. 2, is used, and having a variety of drills fitted to it, increases its its capabilities; and it is, as I say, more essentially necessary to use the tangent-wheel when deep drilling is being done. The fixed tool, however, is used when fine-line patterns for printing from are required, and the tool should have the under side well cleared, as the work itself has to turn sharp corners, so to speak, and if the tool is at all thick, it forces it to cut away the sharp corners of the different patterns. Another way to vary the pattern is to use the fluting stop P; when this is arranged so that the slide when brought forward by the spring butts against the stop, instead of completing its movement, the end of the pattern cut becomes square, or rather of a very slight curve, according to the diameter of the pattern, but quite a different termination to what it would if the stop were removed; the top slide can also be adjusted by its screw, so that any number of cuts upon a surface may be made, each one differing from the other. If I wrote for a month upon this subject, I could tell little more, but one practical lesson would clearly illustrate what it will do; it is certainly much easier to work than the geometric chuck, and will produce an equally interesting variety of patterns. The inventor, who devoted a considerable amount of time, has, in conjunction with other apparatus, produced some most beautiful effects, and although Capt. Dawson has spent so much time upon it, I am sure he will agree with me that it is not yet half worked out. I am indebted to the Captain for my knowledge of the apparatus, and I trust that some of our readers will take advantage of it also, as it is an addition worthy of any ornamental lathe, and will afford quite as much amusement as a geometric chuck.

THE INSTITUTION OF MECHANICAL ENGINEERS.

THE summer meeting of the Institution of Mechanical Engineers was held last week in Leeds, under the presidency of Mr. Percy G. B. Westmacott, who in his address took a survey of the progress of engineering during the last half-century, and called special attention to the waste of power still going on, notably in the form of the smoke nuisance. The address, however, was mainly devoted to pointing out that just as railways had not ruined canal or road traffic, so any contrivances for cheapening the cost of transit either by land or water would act directly towards increasing the prosperity of the country. The president's address was followed by the reading of an interesting paper on the "History of Engineering in Leeds," by Mr. A. H. Meysey-Thompson. Then followed a paper which gave rise to an instructive and animated discussion, although it referred to so apparently simple a subject as the position of the tuyeres in blast furnaces. The author, Mr. Cochrane, gave a number of valuable details showing how by drawing back the tuyeres, using high temperature of blast, and increased area of hearth, considerable economy had been effected in two furnaces—the average consumption of coke per ton of iron had been reduced respectively to 18·35 and 18·45 cwt. The author has made experiments as to the temperature in the furnace, and he finds the highest at a point about 14in. from the nozzle of the tuyere, the temperature diminishing towards the centre of the hearth. Mr. Lowthian Bell opened the discussion on this paper, and commended the spirit in which Mr. Cochrane had investigated the benefits of increased capacity of furnace and blast of high temperatures; but he failed to agree as to the reality of the results alleged to be obtained, and regretted that Mr. Cochrane had not furnished analyses of the gas discharged from the furnace, which are an infallible criterion of the working of the furnace. Mr. Bell agreed with Mr. Richards as to the great importance of high-blast temperatures in low furnaces; but where the latter are high, he considers that the heat can be obtained by the combustion of coke in the usual way. He did not wish to deny that Mr. Cochrane might make iron with even less than 18cwt. of coke per ton; but to reduce the consumption to between 16cwt. and 17cwt. would involve the use of blast at a temperature of about 2,500°, and no stoves are known which can yield this temperature, and blast so heated could not be conveyed in iron pipes. The discussion extended into the second day, and the president, in closing it, pointed out that any thing that bore on the economical production of iron was of interest to mechanical engineers. It is obvious, however, that a discussion of matters which can be settled only by practical experiments is a waste of time; and if Mr. Cochrane can make iron with less coke than anybody else, it is so much to his advantage, and his rivals might either copy his practice or adopt their own in silence. Possibly, however, the discussion will serve to draw attention to the subject, and lead to other experiments having for their object the development of economy. The next paper was read by the secretary on "Mining Machinery," by Mr. Henry Davey, of Leeds, and this also led to a lively discussion, chiefly on the best means of preventing colliery explosions. Mr. Davey, writing of underground application of power, expressed the opinion that compressed air, though very convenient, was not very efficient—the useful effect being only from 25 to 33 per cent. of the power employed to compress the air. Hydraulic engines give, under suitable conditions, an efficiency of from 50 to 60 per cent., and are preferable to compressed air; but in Mr. Davey's opinion it is possible that mechanical operations underground which do not require more than small powers, may eventually be performed by means of electricity transmitted from a dynamo at the surface. He, however, thought that the gas-engine, or rather the hot-air engine, worked by quick combustion of gas, was likely to play an important part in mining, as well as in other spheres of industry. Mr. Davey's views as to the uses of compressed air were naturally criticised by several speakers, for it is obvious that in all mining operations there is a special advantage in the use of air, which, having done its work, can be discharged in a cold state into the atmoshere of the mine. In the case of water there is obviously a loss of useful effect, as the descending column is barely sufficient to force the water up again, and the effective power in the mine is consequently less than that indicated by the pumps at the surface. Several speakers advocated the use of compressed air, and Mr. Jeremiah Head drew attention to the better ventilation of mines. In two papers read at the meeting reference was made to the gradual replacement of the old furnace system of ventilation by fans, which latter are considered to leave nothing more for the engineers to do. Within the last twelve months, however, there have been at least twelve explosions attended with terrible loss of life, and Mr. Head believes that the use of the fan increases the risk of explosion. If a colliery owner learns that there is a fall in the barometer, all that he can do is to set the fan working quicker, which has the effect of still further relieving atmospheric pressure in the mine, and actually induces the exudation of gas from the coal in greater quantities. Mr. Head suggested that the proper method of ventilating mines would be to force air to the extreme ends of the workings, and allow it to flow back as it could, by which means a pressure would be kept on the face of the coal, and the dangerous gas would be prevented to a certain extent from escaping. Mr. H. Smith asked if it was not possible to discover some material possessing "chemical sponginess" which would absorb the fire-damp, and render it inert; but the suggestion was met by an expressive "shake of the head" only. The general result of the discussion may be said to be that air-engines are more convenient, but less economical, than hydraulic apparatus; and it is strange that their convenience being acknowledged, no one should have pointed out that they afford a means of working a mine by means of a pressure of air instead of by exhausting the air and creating a current which is supposed to sweep fire-damp out of the mine, but unfortunately does not. Mr. Davey thought that ultimately electricity would be utilised in mines, but some of the speakers pointed out that there must always be great risk of sparks exploding any mixture of gas and air which might happen to be near the wires. Still, we may hope with Mr. Davey that the time is not far distant when tall chimneys will cease to pour out "blackness" over the towns and fields, and that coal will eventually be consumed entirely in the shape of gas, or be burnt under pressure; but we are afraid it will be some time before he gas-engine becomes the universal prime mover, and electricity is utilised as the means of transmitting power.

A paper, by Mr. J. H. Wicksteed, of Leeds, on a "Single-Lever Testing Machine," was read by the secretary. The machine described is a fifty-ton of the steelyard type, in which the novelties are the travelling of the weight beyond the fulcrum on to the short end of the lever until a point is reached where the long end is balanced; the arrangement of a non-pendulous travelling weight of which the centre of gravity moves along a centre line drawn through the point of support and the point of attachment of the sample; and the indifferent equilibrium of the whole, which is attained by arranging the weight of the lever and all its attachments symmetrically above and below this centre line. Several members who have seen the machine at work spoke of the delicacy with which it tested and of the rapidity with which it could be operated, Mr. Head, indeed, saying that he could not conceive of anything simpler, quicker, handier, or more accurate. The other papers read were "On Governing Engines by Regulating the Expansion," by Mr. Wilson Hartnell, and on the "Fromentin Boiler-Feeder," by Mr. John Hayes. Prof. Rucker delivered an address "On Lighting and the Transmission of Power by Electricity"; Mr. Crampton lectured on his hydraulic system for excavating the Channel Tunnel automatically; and Mr. Fletcher repeated his lecture "On Flameless Combustion." Mr. Crampton's method of excavating the tunnel is, in some points, novel. The advance of one yard per hour in a tunnel 36ft. in diameter involves the removal of 170 cubic yards, or 250 tons of chalk; and a simple calculation will suffice to show that the removal of such a mass from the face of the working to the surface is no light labour. Mr. Crampton proposes to use hydraulic engines, which will work under a pressure of about 700lb. per square inch. The quantity of water used will be about three times the weight of the chalk *débris*, which will be reduced to a "sludge," that can be raised comparatively easily without interruption, telescope pipes being provided which will extend the length of the mains sufficiently to compensate for the advance made in 24 hours. A stoppage would then be made to put in another length of pipe. By this means the shaft would be left comparatively free for the lowering of the materials needed to line the tunnel. At the conversazione the electric light was exhibited, and amongst the models was one of the Forth Bridge, consisting of two spans of 1,700ft., and two of 675ft., the clear headway above high-water being 150ft. The highest part of the bridge above high-water will be 345ft., and 42,000 tons of steel will be used in the construction. A train-boat and an hydraulic hoist, as used on the Aire and Calder navigation also attracted attention, as did a creamer, the invention of Mr. G. De Laval, of Sweden, which is said to be capable of separating the cream from sixty gallons of milk in an hour, leaving only 0·3 per cent. of fat in the skim-milk. Excursions to Bradford and Hull, and visits to many of the works in the neighbourhood of Leeds, finished a well-attended meeting.

IMPROVEMENTS IN SECONDARY BATTERIES.

THE accumulator, or storage-battery, is now recognised as forming an essential portion of many installations of the electric light, especially under conditions where there is a difficulty in keeping the prime mover constantly at work. It is not surprising, therefore, that amongst the numerous applications for patents in connection with electrical matters, "inventions" of secondary batteries should form a large percentage. In one for which Mr. R. Kennedy, of Glasgow, obtained provisional protection a plate of clean lead is coated with a layer of lead dioxide or peroxide, and laid in a bath filled with dilute acid. A sheet of lead being suspended over it, current is sent through, and a deposit of close-grained, spongy lead is formed on the lower plate, which can then be cut up to suitable sizes, and covered with a coat of lead dioxide, obtained by passing chlorine through lead monoxide, and subsequently mixing the product with glycerine. The plates cut from the upper sheets of the preliminary bath are coated with a paint formed of water, glycerine, lead dioxide, and lead sulphate. Messrs. Liardet and Donnithorne have obtained a patent which covers a variety of arrangements, viz., cells packed with lead shot, cells filled with hollow balls of lead, which latter are made by coating with lead soluble substances in the form of spheres, and subsequently dissolving out the cores; cells filled with broken charcoal, coke, asbestos, &c., coated with metallic lead, lead deposited from a salt, such as the acetate, by means of zinc, lead plates attached to compressed cakes of red lead. Other cakes may be employed, obtained by mixing red oxide of lead with plaster of Paris or cement, china clay, powdered glass, &c. Fine divided porous lead, obtained by filling a cell having two compartments divided by a porous wall, with acetate of lead solution, and immersing therein as electrodes two plates of zinc in suitable jackets, and as soon as the zinc is dissolved and replaced by metallic lead, drawing off the solution and replacing it by acidified water. In cases where the cells are started with metallic lead plates peroxides of hydrogen are added to the acid to assist in the formation of peroxide of lead. In this specification it is stated that porous lead may be obtained direct from lead ore by dissolving the latter in acid and precipitating the metal by zinc. Another plan has been patented on behalf of Herr Böttcher, of Leipsic. In this case a solution of pure sulphate of zinc is decomposed by a current, and zinc is deposited on a plate of thin sheet zinc. As an anode thin lead foil is employed, after having been previously prepared by folding it lengthways from top to bottom in order to increase its surface. The lead is dipped into an aqueous paste of pure litharge prepared with the zinc solution, and is coated with a thick layer of the emulsion. The oxygen coming in contact with the lead plate forms on its surface an exceedingly thin layer of peroxide. By closing the circuit the previously-deposited zinc is re-dissolved, and the original sulphate of zinc produced, while the hydrogen reduces into finely-divided lead not only the peroxide, but also a part of the lead plate. By a new regenerative current zinc is again deposited on the zinc plate, while the recently reduced lead is oxidised to peroxide. A few repetitions will, it is said, render the cell ready for use. Yet another invention, which, at least, has some points of novelty, is described in the specification of S. Cohne, of London. In this case the patentee applies to a sheet of lead a layer of mercuric sulphide (HgS) in the form of cinnabar or vermilion. The coated lead sheet is bent into the form of a box or of a spiral, and is used as the positive electrode of the battery. A second sheet is prepared in the same way for the negative electrode. Both sheets are perforated and placed in a cell of dilute sulphuric acid. As soon as the current enters hydrogen is liberated, which reduces the mercuric sulphide, gradually causing a deposition of metallic mercury on the surface of the lead. Immediately the effects of polarisation are manifested, local action disappears, then the amalgam formed, without being destructive to the lead, decomposes the water, and in that way hydrogen is always conserved, and travels backwards and forwards as the cells are charged and discharged, and peroxide of lead is thus formed, the precipitated sulphur acting as a resistance. Sulphate of mercury (Hg_2OSO_3) may be used in place of mercuric sulphide. These are a few of many patents for secondary batteries, the value of which may be safely said to be an unknown quantity.

WINE FROM BEETROOT.

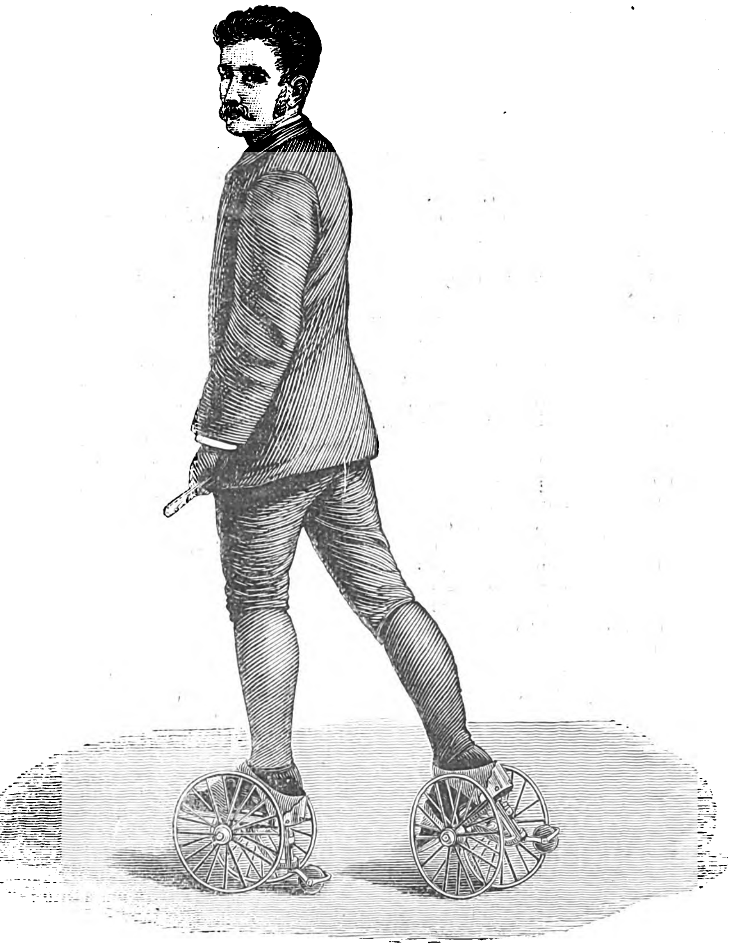
THE phylloxera has caused so great a destruction amongst the vineyards of France, that the wine trade has experienced a serious decline, and many ingenious inventors in that country have been considering how they can best meet the demand. The importation of cheap wines from Italy and Spain, to be "married" in France, is obviously too commonplace a device to satisfy the requirements, and we accordingly find that amongst British patents is one taken out by the Messrs. Brin, of Paris, for the production of red and white wine from beetroot. The inventors, when desirous of producing red wine, use the red beets, preferably cooked, in order to preserve as much as possible of the colouring matter. That beetroot should be chosen which has not the bad taste developed during fermentation; that is, it must be of very good quality and be well washed. The cooking takes place in a boiler, or with more facility, in a digester, or simply by free steam; at this stage it is reduced to pulp by means of suitable pulping apparatus, and the more completely it is pulped, the better the result will be. The pulp may at this stage be put to ferment, but it is preferred to place it in very strong linen cloths or canvas bags and then submit it to powerful pressure, in order to extract from it the greatest amount of juice possible. This juice is immediately put into vessels preferably made of wood, which are specially intended to hold it during the fermentation, carefully avoiding its coming in contact with any metal: these receivers may, however, be made of brick lined inside with a thick layer of Portland cement or other silicate. These receivers or reservoirs are internally provided with serpentine coils for steam or for hot water, or even free steam. By this means the process of fermentation may be regulated at will. The juice of the beetroot, to which may be added, if desired, a certain quantity of water, is immediately put into fermentation, so as to transform the entire mass into juice of a vinous nature; the substances are then added which are necessary to finish the work called fementation: these products are sprouting barley or malt, the yeast of beer or of grains, of slices of apple, or pearl barley. Alcohol may be added in quantity according to the strength of wine desired to be produced. As soon as the work of fermentation is finished, the whole of the liquid mass is strained by means of tannin; then it is allowed to rest one or two nights and filtered, should that be thought necessary, and is allowed to cool. The wine obtained by this process is said to possess all the qualities of grape-wine; the remainder of the treatment is the same as for wine obtained from grape-juice. These wines, owing to their sacchariferous qualities, will much improve wines poor in sweetness and rich in tannin. According to requirement, alcohol may be added and tartaric acid when more power is required to be given to it as well as colour and perfume.

Raw beetroot may be employed; but from the trials already made, it has been found preferable to cook it first, if only to force it to expand by the heat and to yield all its sugar to the mixing waters which are increased as desired. Besides, the cooked beetroot produces wines of better taste and much finer than when the beetroot is used uncooked.

To make white wine, the white beetroot is used either cooked or raw: it is treated like the red beetroot, but, at the moment of fermentation, a little nitric acid is added. Afterwards the whole of the liquid contained in the fermenting receivers is shaken and the juice of sprouting barley, or malted or natural barley roughly ground is added. It is by this process a "natural wine" is said to be produced of very great service in an alimentary point of view. The pure beetroot red wine has such a brilliant colour that it can be employed with great advantage to colour and enrich all natural wines deficient in colour as well as in condition, and for crossing or blending with glucose wines of all kinds.

THE AMERICAN TRICYCLE SKATE.

We give an illustration of the new American Tricycle Skate, said to be the fastest skate ever invented; twenty miles can be done with it. It is reported to act as well upon any ordinary surface, floor, carpet, &c., as any ice skate under the most favourable conditions, and to admit of any figure or evolutions possible in any other skate. The inventor is Mr. J. F. Walter, of 7, Queen's-road, Bayswater, W.



CART AND WHEELMAKING.—XVII.

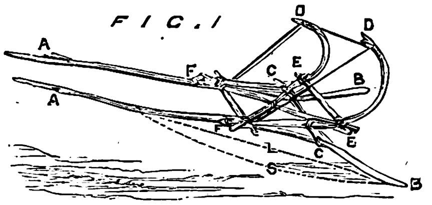
By J. Charles King.

(*Continued from page 254.*)

Having described the processes of painting and varnishing carts, which should always be done as the various parts are completed progressively, to ensure that the woodwork shall have ample coats of colour to preserve it from decay, and the ironwork bearings from rust. I continue the description of the ironwork.

Next to the axle of a cart, the chief pieces of ironwork are the springs; on these depend not only ease to riders, but lessened draught and weight, elegance of design and durability of the whole structure.

As carriage spring-making is a special craft in smiths' work, and somewhat a trade mystery in some of its processes, requiring experience and keen technical application for designing, forging, and tempering steel, to ensure sound and serviceable work. I propose briefly to illustrate and describe the principles upon which all springs of steel, or steel and leather combined, are designed, forged, and tempered, with their adjustment for carts.



The use of steel springs for vehicles does not date back more than three centuries in this country; before their use, the shafts of the vehicles of light weight were made to serve as the yielding medium, the same as the Tartar sledge of tree branches is now made to serve the same purpose.

As it may interest some persons who are making carts, an illustration of a Tartar sledge (Fig. 1) will serve to point out the initial designs of springs of steel in use in the best vehicles of the cart builder.

Here we see branches of trees and thongs of leather are all that are used in making up this sledge.

Although the branches of trees are lashed together so roughly, there is an obvious design in the form and arrangement of the bearing parts to ensure a yielding, springy structure, capable, with the aid of skins or matting, of carrying a family or merchandise, the bent ends of the upper-frame serving to support a rough canopy for shelter.

By comparing the sledge with drawings of the three forms of springs in use in modern vehicles, the resemblance will be obvious.

Fig. B is technically termed an "elbow-spring" or half-spring, such as is used at the back of broughams and on the common hand-barrow; this is seen at B on the sledge.

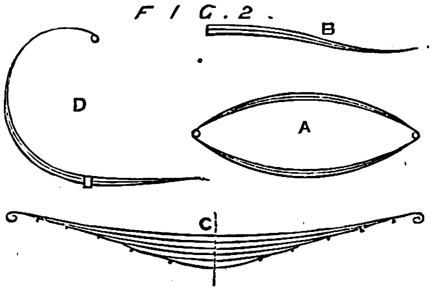


Fig. D is termed a Cee-spring, used on the best and most costly carriages, ensuring the maximum of ease without jarring vibrations; this form is on the sledge, the cross bar E being the fulcrum over which it yields.

Fig. A is an elliptic-spring, to be seen on almost every four-wheeled carriage.

It is formed of two bow-springs coupled at their ends. In the sledge, the form of one-half or the top of the elliptic spring is seen in the long shafts from A to B. In carts, the lower half or bow is used, attached to the shafts by scroll-irons, in form as marked on the illustration, Fig. 1, by the dotted line S.

Perhaps some readers may have seen the antique gig at the South Kensington Museum, about three hundred years old, the workmanship of which would put to shame by comparison many a gig or cart made now, with all our appliances of art and science; there are no springs but the long shafts which have a bow-string support, similar to the line L in the illustration, intended to resist excessive strain.

Bow-springs may be considered the most fitting springs for carts, though elliptic may be used with advantage for light pony traps.

For medium sized dog-carts, bow-springs are made about 4ft. long, 2in. wide, with six "leaves" or "plates," as they are technically termed; each plate is made to graduate in length and thickness, till the shortest plate, which rests for its bearing on the axle, is only 12in. long. Of the six plates, the longest is termed the "back-plate," the next the second plate, and so on, up to the shortest. The steel is specially made for springs, and of thicknesses varying from 3-16th to 5-16th of an inch.

The back-plate and sixth plate are best if of ¼in. thick, the rest, up to the sixth, 1-32nd of an inch less thickness.

The bow of the spring technically termed the "compass" of the spring, is usually about 6in. from a straight line before the springs have the weight of body and carriage on them.

In diagram C, Fig. 2, is shown a bow-string with the plates arranged, each one about ¾in. more span than the next larger plate above it, as far as the third plate, when the span is lessened on each shorter plate till it is only about ¼in more span on the short plate. This extra span is technically termed the force of the plates; the bolt through all the plates, about 1in. from the middle distance from each end, draws the open span-plates to a close fit.

To prevent the plates slipping edgeways beyond each other at the ends, a nib is punched on each plate, about where the dots are on the diagram, and a sunk "slit" is recessed into each other plate to receive the nib opposite to each.

As working steel is different to working iron, especially in spring-making, I propose to detail the methods adopted, and forms of tools used for spring-making, how to "draw" steel, "harden," and "temper" for springs for carts.

(*To be continued.*)

PRACTICAL NOTES ON PLUMBING.—XL.*

By P. J. Davies, H.M.A.S.P., &c.

(*Continued from page 537.*)

The New Machine.

All lead-burning machines should be of a cylindrical form, and of a size suitable to the class of work intended. A machine suitable for one job may be found very unsuitable for another. I myself have five sizes, varying from 6in. upwards. The large machines are the most profitable, and work with less attention than the smaller ones. A 6in. machine is very suitable for fixing soil pipes, burning lead on roofs, and general running about on buildings, chemical works, &c. A middle sized machine suitable for cisterns is 11in. in diameter, and a stock machine from 18in. to 24in; such a machine I have now in use for burning up all my soil-pipes. The kind of soil-pipes thus produced are the best to be had, simply because the metal of which they are formed will be of one uniform thickness throughout, and of a far better quality than is generally to be obtained. I also find that there is a considerable saving when it is requisite to bend the pipe. the lead being much softer for dummying. Fig. 228 represents a properly constructed lead-burning machine: this will be found to be light, strong, portable, self cleansing, and lasting; besides this, the material is so arranged that it is put into a stronger and more pleasing shape to meet the eye, and appears what it is, a nice piece of workmanship, a great desideratum with most plumbers, for who would care to carry an ugly square wooden box about with them when they can have a neat and compact small circular instrument quarter the size, not one sixth part of the weight, and capable of doing double the work with half the amount of acid?

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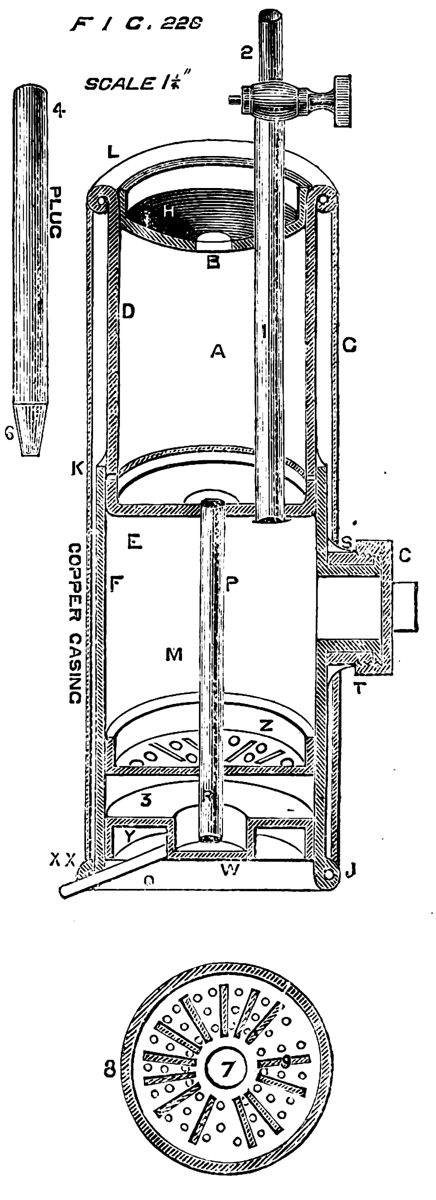
This machine is constructed as follows: With suitable sized pieces of 4lb. or 5lb. sheet-lead form the sides, or the top and bottom parts. Suppose it to be a 9in. machine these pieces will then be about 3ft. by 1ft. 6in., 3in. being taken up to form the beads JL, Fig. 228, and 2in. for lap at K, leaving the machine to stand 2ft. 7in. high; plane up the edges, and square the top and bottom, next turn the lead upon a mandrel, not necessarily the size of the machine, and get the seam burnt up. Here the first difficulty presents itself, and one that has kept hundreds of men out of the lead-burning branch of the trade.

For a trial machine instead of burning up, solder it with as coarse a solder as you can use, for it is the tin in the solder that the acid eats away, hence the reason for using coarse solder, (this will last you a month or so to practise with until you can burn one up properly); next turn the bottom bead J, and if you do not intend to case the machine, turn the top bead. Having got so far, cut three pieces of 5lb. or 6lb. lead for the bottom, middle, and top, which must be large enough for the turn-up of edge or flange, then burn the pipe P (with the bottom end cut as shown at VU, Fig. 230,) and the pipe I to the middle partition, and fix this partition as shown in the diagram to the top part of the bottom chamber of the machine. Great care should be taken in making the joints perfectly watertight, for you cannot do anything to them after the machine is put together; next shave or clean the inside and outside parts to be burned together, and slip the top chamber into the bottom, say 2in., and let it fit quite tight, then burn it together. Now form the bottom, with the well and grating, to be fixed as shown in the diagram. From the top of the grating to the bottom of the acid pipe should be 5in., the grating to have a quantity of $\frac{3}{8}$in holes. The use of this grating is that the zinc may rest upon it, so that all the acid may drain into the well of the machine, and also to keep the zinc perfectly dry when not generating gas. Care must be taken to fix the grating or strainer in such a manner that the small parts of the zinc cannot get through and into the well, otherwise the zinc would be continually acted upon by the acid, and the machine would constantly generate gas, throwing it up the pipe PR in bubbles at intervals, which of course means a waste of acid and zinc; the same thing will happen should the zinc have very rough surfaces, because the acid hangs to the zinc. If the holes in the strainer be too small, the machine will work irregularly, and cause the gas to jump, by reason of the oxide of zinc closing them up; the same effect will be produced should the oxide get into the well in large quantities to stop up the acid pipe. Now fix the top, H, by cutting a hole for the pipe I, and a 1½in. hole for the pouring in of the acid and water, burn it to the top edge of the machine, as shown. This top, should the machine throw up, prevents the acid from flying about. Next fix a 1½in. or 2in. piece of lead pipe into the side of the well, as shown at Q, this serves to empty the machine, and to drain off the oxide of zinc, &c. A 1½ or 2in. screwed plug will be best, fixed on the end of the emptying pipe for closing. Copper or lead is the best material, but for such plugs, a 2in. boss and an iron plug may be used; but this plug requires renewing about every six months, so that a lead one will be the best. Now fix, as shown at CT, a 4in., 5in., or 6in. cap and screw; the latter size is best, because it admits of large pieces of zinc being put into the machine. This cap and screw may be soldered on, as the acid is not supposed to come into contact with it; then fix a $\frac{3}{8}$ good gas cock on the pipe I as shown, but at least 4in. above the top of the machine, out of the way of the acid. Next get a 1½in. block cut to fit in the bottom to support it. The centre of the middle partition may be partly supported by the acid pipe resting upon the bottom of the well, but care must be taken in cutting this pipe, so that the end be not stopped up by resting on the bottom, otherwise it will hinder the acid water passing from one chamber to another; the bottom of the acid pipe may be cut, as shown at TV, Fig. 230 (hereafter). If the machine is to have a casing K (a thing I recommend), use copper, and keep it well blacked over with Japan black. This casing answers two purposes: it prevents the lead from being damaged, and causes the machine, by keeping the heat in, to work better. The joints or seams of the casing may be soldered up.

FIG. 228



(To be continued.)

PORTABLE engines of 8 horse-power can be obtained in New South Wales for £260, but in Victoria, owing to the duty, they cost £310 each.

BRITISH ASSOCIATION.—PRESIDENT'S ADDRESS.

AT the fifty-second meeting of the British Association for the Advancement of Science, commenced at Southampton on the 23rd of August, Dr. C. W. Siemens, the president, delivered an address as follows:

After alluding to the death of Darwin, and the untimely decease of the hon. secretary, Prof. F. M. Balfour, who recently lost his life in an attempt to ascend the Aiguille Blanche de Penteret, Dr. Siemens proceeded:—Since the days of the first meeting of the Association in York in 1831, great changes have taken place in the means at our disposal for exchanging views, either personally or through the medium of type. The creation of the railway system has enabled congenial minds to attend frequent meetings of those special societies which have sprung into existence since the foundation of the British Association, amongst which I need only name here the Physical, Geographical, Meteorological, Anthropological, and Linnean, cultivating abstract science; and the Institution of Mechanical Engineers, the Institution of Naval Architects, the Iron and Steel Institute, the Society of Telegraph Engineers and Electricians, the Gas Institute, the Sanitary Institute, and the Society of Chemical Industry, representing applied science. If we consider further the extraordinary development of scientific journalism which has taken place, it cannot surprise us when we meet with expressions of opinion to the effect that the British Association has fulfilled its mission, and should now yield its place to those special Societies it has served to call into existence. On the other hand, it may be urged that the brilliant success of last year's Anniversary Meeting, enhanced by the comprehensive address delivered on that occasion by my distinguished predecessor in office, Sir John Lubbock, has proved, at least, that the British Association is not dead in the affections of its members, and it behoves us at this, the first ordinary gathering in the second half-century, to consider what are the strong points to rely upon for the continuance of a career of success and usefulness. If the facilities brought home to our doors of acquiring scientific information have increased, the necessities for scientific inquiry have increased in a greater ratio. The time was when science was cultivated only by the few, who looked upon its application to the arts and manufactures as almost beneath their consideration; this they were content to leave in the hands of others, who, with only commercial aims in view, did not aspire to further the objects of science for its own sake, but thought only of benefiting by its teachings. Progress could not be rapid under this condition of things, because the man of pure science rarely pursued his inquiry beyond the mere enunciation of a physical or chemical principle, whilst the simple practitioner was at a loss how to harmonise the new knowledge with the stock of information which formed his mental capital in trade.

Theoretical and Applied Science.

The advancement of the last fifty years has, I venture to submit, rendered theory and practice so interdependent, that an intimate union between them is a matter of absolute necessity for our future progress. Take, for instance, the art of dyeing, and we find that the discovery of new colouring matters derived from waste products, such as coal-tar, completely changes its practice, and renders an intimate knowledge of the science of chemistry a matter of absolute necessity to the practitioner. In telegraphy and in the new arts of applying electricity to lighting, to the transmission of power, and to metallurgical operations, problems arise at every turn, requiring for their solution not only an intimate acquaintance with, but, a positive advance upon, electrical science, as established by purely theoretical research in the laboratory. In general engineering the mere practical art of constructing a machine so designed and proportioned as to produce mechanically the desired effect, would suffice no longer. Our increased knowledge of the nature of the mutual relations between the different forms of energy makes us see clearly what are the theoretical limits of effect; these, although beyond our absolute reach, may be looked upon as the asymptotes to be approached indefinitely by the hyperbolic course of practical progress, of which we should never lose sight. Cases arise, moreover, where the introduction of new materials of construction, or the call for new effects, renders former rules wholly insufficient. In all these cases practical knowledge has to go hand in hand with advanced science in order to accomplish the desired end. Far be it from me to think lightly of the ardent students of nature, who, in their devotion to research, do not allow their minds to travel into the regions of utilitarianism and of self-interest. These, the high priests of science, command our utmost admiration; but it is not to them that we can look for our current progress in practical science, much less can we look for it to the "rule of thumb" practitioner, who is guided by what comes nearer to instinct than to reason. It is to the man of science, who also gives attention to practical questions, and to the practitioner, who devotes part of his time to the prosecution of strictly scientific investigations, that we owe the rapid progress of the present day, both merging more and more into one class, that of pioneers in the domain of nature. It is such men that Archimedes must have desired when he refused to teach his disciples the art of constructing his powerful ballistic engines, exhorting them to give their attention to the principles involved in their construction, and that Telford, the founder of the Institution of Civil Engineers, must have had in his mind's eye, when he defined civil engineering as "the art of directing the great sources of power in nature."

These considerations may serve to show that although we see the men of both abstract and applied science group themselves in minor bodies for the better prosecution of special objects, the points of contact between the different branches of knowledge are ever multiplying, all tending to form part of a mighty tree—the tree of modern science—under whose ample shadow its cultivators will find it both profitable and pleasant to meet, at least once a year; and considering that this tree is not the growth of one country only, but spreads both its roots and branches far and wide, it appears desirable that at these yearly gatherings other nations should be more fully represented than has hitherto been the case. The subjects discussed at our meetings are without exception of general interest, but many of them bear an international character, such as the systematic collection of magnetic, astronomical, meteorological, and geodetical observations, the formation of a universal code for signalling at sea, and for distinguishing lighthouses, and especially the settlement of scientific nomenclatures and units of measurement, regarding all of which an international accord is a matter of the utmost practical importance.

As regards the measures of length and weight it is to be regretted that this country still stands aloof from the movement initiated in France towards the close of last century; but considering that in scientific work metrical measure is now almost universally adopted, and that its use has been already legalised in this country, I venture to hope that its universal adoption for commercial purposes will soon follow as a matter of course. The practical advantages of such a measure to the trade of this country would, I am convinced, be very great, for English goods, such as machinery or metal rolled to current sections, are now almost excluded from the continental market, owing to the unit measure employed in their production. The principal impediment to the adoption of the metre consists in the strange anomaly that although it is legal to use that measure in commerce, and although a copy of the standard metre is kept in the Standards' Department of the Board of Trade, it is impossible to procure legalised rods representing it, and to use a non-legalised copy of a standard in commerce is deemed fraudulent. Would it not be desirable that the British Association should endeavour to bring about the use in this country of the metre and kilogramme, and, as a preliminary step, petition the Government to be represented on the International Metrical Commission, whose admirable establishment at Sèvres possesses, independently of its practical work, considerable scientific interest, as a well-found laboratory for developing methods of precise measurement?

Electrical Measures.

Next in importance to accurate measures of length, weight, and time, stand, for the purposes of modern science, those of electricity. The remarkably clear lines separating conductors from non-conductors of electricity, and magnetic from non-magnetic substances, enable us to measure electrical quantities and effects with almost mathematical precision; and although the ultimate nature of this, the youngest scientifically investigated form of energy, is yet wrapped in mystery, its laws are the most clearly established, and its measuring instruments (galvanometers, electrometers, and magnetometers) are amongst the most accurate in physical science. Nor could any branch of science or industry be named in which electrical phenomena do not occur to exercise their direct and important influence. If, then, electricity stands foremost amongst the exact sciences, it follows that its unit measures should be determined with the utmost accuracy. Yet, 20 years ago, very little advance had been made towards the adoption of a rational system. Ohm had, it is true, given us the fixed relations existing between electromotive force, resistance, and quantity of current; Joule had established the dynamical equivalent of heat and electricity; and Gauss and Weber had proposed their elaborate system of absolute magnetic measurement. But these invaluable researches appeared only as isolated efforts, when, in 1862, the Electric Unit Committee was appointed by the British Association, at the instance of Sir William Thomson; and it is to the long-continued activity of this committee that the world is indebted for a consistent and practical system of measurement, which, after being modified in details, received universal sanction last year by the International Electrical Congress assembled at Paris. At that Congress, which was attended officially by the leading physicists of all civilised countries, the attempt was successfully made to bring about a union between the statical system of measurement that had been followed in Germany and some other countries, and the magnetic, or dynamical, system developed by the British Association, also, between the geometrical measure of resistance, the (Werner) Siemens unit, that had been generally adopted abroad, and the British Association unit intended as a multiple of Weber's absolute unit, though not entirely fulfilling that condition. The Congress, while adopting the absolute system of the British Association, referred the final determination of the unit measure of resistance to an International Committee, to be appointed by the representatives of the several Governments; they decided to retain the mercury standard for reproduction and comparison, by which means the advantages of both systems are happily combined, and much valuable labour is utilised; only, instead of expressing electrical quantities directly in absolute measure, the Congress has embodied a consistent system, based on the Ohm, in which the units are of a value convenient for practical measurements. In this, which we must hereafter know as the "practical system," as distinguished from the "absolute system," the units are named after leading physicists, the Ohm, Ampère, Volt, Coulomb, and Farad.

I would venture to suggest that two further units might, with advantage, be added to the system decided on by the International Congress at Paris. The first of these is the unit of magnetic quantity or pole. It is of much importance, and few will regard otherwise than with satisfaction the suggestion of Clausius that the unit should be called a "Weber," thus retaining a name most closely connected with electrical measurements, and only omitted by the Congress in order to avoid the risk of confusion in the magnitude of the unit current with which his name had been formerly associated.

The other unit I should suggest adding to the list is that of power. The power conveyed by a current of an Ampère through the difference of potential of a Volt is the unit consistent with the practical system. It might be appropriately called a Watt, in honour of that master-mind in mechanical science, James Watt. He it was who first had a clear physical conception of power, and gave a rational method of measuring it. A Watt, then, expresses the rate of an Ampère multiplied by a Volt, whilst a horse-power is 746 Watts, and a Cheval de Vapeur 735.

The system of electro-magnetic units would then be :—

					C.G.S. Units.
(1)	Weber,	the unit of	magnetic	quantity	$= 10^8$
(2)	Ohm.	,,	,,	resistance	$= 10^9$
(3)	Volt	,,	,,	electromotive force	$= 10^8$
(4)	Ampère	,,	,,	current	$= 10^{-1}$
(5)	Coulomb	,,	,,	quantity	$= 10^{-1}$
(6)	Watt	,,	,,	power	$= 10^7$
(7)	Farad	,,	,,	capacity	$= 10^{-9}$

The word energy was first used by Young in a scientific sense, and represents a conception of recent date, being the outcome of the labours of Carnot, Mayer, Joule, Grove, Clausius, Clerk-Maxwell, Thomson, Stokes, Helmholtz, Macquorn-Rankine, and other labourers, who have accomplished for the science regarding the forces in nature what we owe to Lavoisier, Dalton, Berzelius, Liebig, and others, as regards chemistry. In this short word energy we find all the efforts in nature, including electricity, heat, light, chemical action, and dynamics, equally represented, forming, to use Dr. Tyndall's apt expression, so many "modes of motion." It will readily be conceived that when we have established a fixed numerical relation between these different modes of motion, we know beforehand what is the utmost result we can possibly attain in converting one form of energy into another, and to what extent our apparatus for effecting the conversion falls short of realising it. The difference between ultimate theoretical effect and that actually obtained is commonly called loss; but, considering that energy is indestructible, represents really secondary effect which we obtain without desiring it. Thus friction in the working parts of a machine represents a loss of mechanical effect, but is a gain of heat, and in like manner the loss sustained in transferring electrical energy from one point to another is accounted for by heat generated in the conductor. It sometimes suits our purpose to augment the transformation of electrical into heat energy at certain points of the circuit when the heat rays become visible, and we have the incandescence electric light. In effecting a complete severance of the conductor for a short distance, after the current has been established, a very great local resistance is occasioned, giving rise to the electric arc, the highest development of heat ever attained. Vibration is another form of lost energy in mechanism; but who would call it a loss if it proceeded from the violin of a Joachim or a Norman-Neruda?

The Transmission of Energy.

Electricity is the form of energy best suited for transmitting an effect from one place to another; the electric current passes through certain substances—the metals—with a velocity limited only by the retarding influence caused by electric charge of the surrounding dielectric, but approaching probably under favourable conditions that of radiant heat and light, or 300,000 kilometres per second; it refuses, however, to pass through oxidised substances, glass, gums, or through gases except when in a highly rarefied condition. It is easy therefore to confine the electric current within bounds, and to direct it through narrow channels of extraordinary length. The conducting wire of an Atlantic cable is such a narrow channel; it consists of a copper wire, or strand of wires, 5mm. in diameter, by nearly 5,000 kilometres in length, confined electrically by a coating of guttapercha about 4mm. in thickness. The electricity from a small galvanic battery passing into this channel prefers the long journey to America in the good conductor, and back through the earth, to the shorter journey across the 4mm. in thickness of insulating material. By an improved arrangement the alternating currents employed to work long submarine cables do not actually complete the circuit, but are merged in a condenser at the receiving station after having produced their extremely slight but certain effect on the receiving instrument So perfect is the channel and so precise the action of both the transmitting and receiving instruments employed, that two systems of electric signals may be passed simultaneously through the same cable in opposite directions, producing independent records at either end. By the application of this duplex mode of working to the Direct United States cable under the superintendence of Dr. Muirhead, its transmitting power was increased from 25 to 60 words a minute, being equivalent to about 12 currents or primary impulses per second.

The minute currents here employed are far surpassed as regards delicacy and frequency by those revealed to us by that marvel of the present day, the telephone. The electric currents caused by the vibrations of a diaphragm acted upon by the human voice, naturally vary in frequency and intensity according to the number and degree of those vibrations, and each motor current in exciting the electro-magnet forming part of the receiving instrument, deflects the iron diaphragm occupying the position of an armature to a greater or smaller extent according to its strength. Savart found that the fundamental *la* springs from 440 complete vibrations in a second; but what must be the frequency and modulations of the motor current and of magnetic variations necessary to convey to the ear through the medium of a vibrating armature, such a complex of human voices and of musical instruments as constitutes an opera performance. And yet such performances could be distinctly heard and even enjoyed as an artistic treat by applying to the ears a pair of the double telephonic receivers at the Paris Electrical Exhibition, when connected with a pair of transmitting instruments in front of the footlights of the Grand Opera. In connection with the telephone, and with its equally remarkable adjunct the microphone, the names of Riess, Graham Bell, Edison, and Hughes will ever be remembered.

Regarding the transmission of power to a distance the electrical current has now entered the lists in competition with compressed air, the hydraulic accumulator, and the quick running rope as used at Schaffhausen to utilise the power of the Rhine fall. The transformation of electrical into mechanical energy can be accomplished with no further loss than is due to such incidental causes as friction and the heating of wires; these in a properly designed dynamo-electric machine do not exceed 10 per cent., as shown by Dr. John Hopkinson, and, judging from recent experiments of my own, a still nearer approach to ultimate perfection is attainable. Adhering, however, to Dr. Hopkinson's determination, for safety sake, and assuming the same percentage in reconverting the current into mechanical effect, a total loss of 19 per cent. results; to this loss must be added that through electrical resistance in the connecting line wires, which depends upon their length and conductivity, and that due to heating by friction of the working parts of the machine. Taking these as being equal to the internal losses incurred in the double process of conversion, there remains a useful effect of $100 - 38 = 62$ per cent., attainable at a distance, which agrees with experimental results, although in actual practice it would not be safe at present to expect more than 50 per cent. of ultimate useful effect, to allow for all mechanical losses.

In using compressed air or water for the transmission of power the loss cannot be taken at less than 50 per cent., and as it depends upon fluid resistance it increases with distance more rapidly than in the case of electricity. Taking the loss of effect in all cases as 50 per cent., electric transmission presents the advantage that an insulated wire does the work of a pipe capable of withstanding high internal pressure, which latter must be more costly to put down and to maintain. A second metallic conductor is required, however, to complete the electrical circuit, as the conducting power of the earth alone is found unreliable for passing quantity currents, owing to the effects of polarisation; but as this second conductor need not be insulated, water or gas pipes, railway metals or fencing wire, may be called into requisition for the purpose. The small space occupied by the electromotor, its high working speed, and the absence of waste products, render it specially available for the general distribution of power to cranes and light machinery of every description. A loss of effect of 50 per cent. does not stand in the way of such applications, for it must be remembered that a powerful central engine of best construction produces motive power with a consumption of 2lb. of coal per horse-power per hour, whereas small engines distributed over a district would consume not less than 5lb.; we thus see that there is an advantage in favour of electric transmission as regards fuel, independently of the saving of labour and other collateral benefits.

To agriculture, electric transmission of power seems well adapted for effecting the various operations of the farm and fields from one centre. Having worked such a system myself in combination with electric lighting and horticulture for upwards of two years, I can speak with confidence of its economy, and of the facility with which the work is accomplished in charge of untrained persons.

As regards the effect of the electric light upon vegetation, there is little to add to what was stated in my paper read before section A last year, and ordered to be printed with the report, except that in experimenting upon wheat, barley, oats, and other cereals sown in the open air, there a marked difference between the growth of the plants influenced and those uninfluenced by the electric light. This was not very apparent till towards the end of February, when, with the first appearance of mild weather, the plants, under the influence of an electric lamp of 4,000 candle-power placed about five metres above the surface, developed with extreme rapidity, so that by the end of May they stood about 4ft. high, with the ears in full bloom, when those not under its influence were under 2ft. in height, and showed no sign of the ear.

In the electric railway first constructed by Dr. Werner Siemens, at Berlin, in 1879, electric energy was transmitted to the moving carriage or train of carriages through the two rails upon which it moved, these being sufficiently insulated from each other by being placed upon well creosoted cross sleepers. At the Paris Electrical Exhibition the current was conveyed through two separate conductors making sliding or rolling contact with the carriage, whereas in the electric railway now in course of construction in the north of Ireland (which when completed will have a length of twelve miles) a separate conductor will be provided by the side of the railway, and the return circuit completed through the rails themselves, which in that case need not be insulated; secondary batteries will be used to store the surplus energy created in running downhill, to be restored in ascending steep inclines, and for passing roadways where the separate insulated conductor is not practicable. The electric railway possesses gread advantages over horse or steam-power for towns, in tunnels, and in all cases where natural sources of energy, such as waterfalls, are available; but it would not be reasonable to suppose that it will in its present condition compete with steam propulsion upon ordinary railways.

Electric energy may also be employed for heating purposes, but in this case it would obviously be impossible for it to compete in point of economy with the direct combustion of fuel for the attainment of ordinary degrees of heat. Bunsen and St. Claire De Ville have taught us, however, that combustion becomes extremely sluggish when a temperature of 1,800° C. has been reached, and for effects at temperatures exceeding that limit the electric furnace will probably find advantageous applications. Its specific advantage consists in being apparently unlimited in the degree of heat attainable, thus opening out a new field of investigation to the chemist and metallurgist. Tungsten has been melted in such a furnace, and 8 pounds of platinum have been reduced from the cold to the liquid condition in 20 minutes.

Electric Lighting.

The largest and most extensive application of electric energy at the present time is to lighting, but, considering how much has of late been said and written for and against this new illuminant, I shall here confine myself to a few general remarks. Joule has shown that if an electric current is passed through a conductor the whole of the energy lost by the current is converted into heat; or, if the resistance be localised, into radiant energy comprising heat, light, and actinic rays. Neither the low heat rays nor the ultra-violet of highest refrangibility affect the retina, and may be regarded as lost energy, the effective rays being those between the red and violet of the spectrum, which in their combination produce the effect of white light. Regarding the proportion of luminous to non-luminous rays proceeding from an electric arc or incandescent wire, we have a most valuable investigation by Dr. Tyndall, recorded in his work on "Radiant Heat." Dr. Tyndall shows that the luminous rays from a platinum wire heated to its highest point of incandescence, which may be taken at 1,700° C., formed 1-24th part of the total radiant energy emitted, and 1-10th part in the case of an arc light worked by a battery of 50 Grove's elements. In order to apply these valuable data to the case of electric lighting by means of dynamo-currents, it is necessary in the first place to determine what is the power of 50 Grove's elements of the size used by Dr. Tyndall, expressed in the practical scale of units as now established. From a few experiments lately undertaken for myself, it would appear that 50 such cells have an electro-motive force of 98·5 volts, and an internal resistance of 13·5 ohms, giving a current of 7·3 ampères when the cells are short-circuited. The resistance of a regulator such as Dr. Tyndall used in his experiments may be taken at 10 ohms, the current produced in the arc would be 4 ampères (allowing one ohm for the leads), and the power consumed 160 watts: the light power of such an arc would be about 150 candles, and, comparing this with an arc of 3,308 candles produced by 1,162 watts, we find that 7·3 times the electric energy produce 22 times the amount of light measured horizontally. If, therefore, in Dr. Tyndall's arc 1-10th of the radiant energy emitted was visible as light, it follows that in a powerful arc of 3,300 candles, fully $\frac{1}{3}$ are luminous rays. In the case of the incandescence light (say a Swan light of 20 candle power) we find in practice that 9 times as much power has to be expended as in the case of the arc light; hence, 1-27 part of the power is given out as luminous rays, as against 1-24th in Dr. Tyndall's incandescent platinum—a result sufficiently approximate, considering the wide difference of conditions under which the two are compared.

These results are not only of obvious practical value, but they seem to establish a fixed relation between current, temperature, and light produced, which may serve as a means to determine temperatures exceeding the melting point of platinum with greater accuracy than has hitherto been possible by actinimetric methods in which the thickness of the luminous atmosphere must necessarily exercise a disturbing influence. It is probably owing to this circumstance that the temperature of the electric arc as well as that of the solar photosphere has frequently been greatly over-estimated.

The principal argument in favour of the electric light is furnished by its immunity from products of combustion, which not only heat the lighted apartments, but substitute carbonic acid and deleterious sulphur compounds for the oxygen upon which respiration depends; the electric light is white instead of yellow, and thus enables us to see pictures, furniture, and flowers as by daylight; it supports growing plants instead of poisoning them, and by its means we can carry on photography and many other industries at night as well as during the day. The objection frequently urged against the electric light, that it depends upon the continuous motion of steam or gas-engines, which are liable to accidental stoppage, has been removed by the introduction into practical use of the secondary battery; this, although not embodying a new conception, has lately been greatly improved in power and constancy by Planté, Faure, Volckmar, Sellon, and others, and promises to accomplish for electricity what the gas-holder has done for the supply of gas and the accumulator for hydraulic transmission of power.

It can no longer be a matter of reasonable doubt, therefore, that electric lighting will take its place as a public illuminant, and that even though its cost should be found greater than that of gas, it will be preferred for the lighting of drawing-rooms and dining-rooms, theatres, and concert-rooms, museums, churches, warehouses, show-rooms, printing establishments and factories, and also the cabins and engine-rooms of passenger steamers. In the cheaper and more powerful form of the arc light, it has proved itself superior to any other illuminant for spreading artificial daylight over the large areas of harbours, railway stations, and the sites of public works. When placed within a holophote the electric lamp has already become a powerful auxiliary in effecting military operations both by sea and land.

The electric light may be worked by natural sources of power such as waterfalls, the tidal wave, or the wind, and it is conceivable that these may be utilised at considerable distances by means of metallic conductors. Some five years ago I called attention to the vastness of those sources of energy, and the facility offered by electrical conduction in rendering them available for lighting and power-supply, while Sir William Thomson made this important matter the subject of his admirable address to Section A last year at York, and dealt with it in an exhaustive manner. The advantages of the electric light and of the distribution of power by electricity have lately been recognised by the British Government, who have just passed a Bill through Parliament to facilitate the establishment of electrical conductors in towns, subject to certain regulating clauses to protect the interests of the public and of local authorities. Assuming the cost of electric light to be practically the same as gas, the preference for one or other will in each application be decided upon grounds of relative convenience, but I venture to think that gas-lighting will hold its own as the poor man's friend.

Improvements in the Use of Gas.

Gas is an institution of the utmost value to the artisan; it requires hardly any attention, is supplied upon regulated terms, and gives with what should be a cheerful light a genial warmth, which often saves the lighting of a fire. The time is moreover not far distant, I venture to think, when both rich and poor will largely resort to gas as the most convenient, the cleanest, and the cheapest of heating agents, and when raw coal will be seen only at the colliery or the gasworks. In all cases where the town to be supplied is within say 30 miles of the colliery, the gasworks may with advantage be planted at the mouth, or still better at the bottom of the pit, whereby all haulage of fuel would be avoided, and the gas, in its ascent from the bottom of the colliery, would acquire an onward pressure sufficient probably to impel it to its destination. The possibility of transporting combustible gas through pipes for such a distance has been proved at Pittsburg, where natural gas from the oil district is used in large quantities.

The quasi-monopoly so long enjoyed by gas companies has had the inevitable effect of checking progress. The gas being supplied by meter, it has been seemingly to the advantage of the companies to give merely the prescribed illuminating power, and to discourage the invention of economical burners, in order that the consumption might reach a maximum. The application of gas for heating purposes has not been encouraged, and is still made difficult in consequence of the objectionable practice of reducing the pressure in the mains during daytime to the lowest possible point consistent with prevention of atmospheric indraught. The introduction of the electric light has convinced gas managers and directors that such a policy is no longer tenable, but must give way to one of technical progress; new processes for cheapening the production and increasing the purity and illuminating power of gas are being fully discussed before the Gas Institute; and improved burners, rivalling the electric light in brilliancy, greet our eyes as we pass along our principal thoroughfares.

Previous to the year 1856—that is to say, before Mr. W. H. Perkin had invented his practical process, based chiefly upon the theoretical investigations of Hoffman, regarding the coal-tar bases and the chemical constitution of indigo—the value of coal-tar in London was scarcely a halfpenny a gallon, and in country places gasmakers were glad to give it away. Up to that time the coal-tar industry had consisted chiefly in separating the tar by distillation into naphtha, creosote, oils, and pitch. A few distillers, however, made small quantities of benzene, which had been first shown —by Mansfield, in 1849—to exist in coal-tar naphtha mixed with toluene, cumene, &c. The discovery, in 1856, of the mauve or aniline purple gave a great impetus to the coal-tar trade, inasmuch as it necessitated the separation of large quantities of benzene, or a mixture of benzene and toluene, from the naphtha. The trade was further increased by the discovery of the magenta or rosaniline dye, which required the same products for its preparation. In the mean time, carbolic acid was gradually introduced into commerce, chiefly as a disinfectant, but also for the production of colouring matter.

The colour industry utilises even now practically all the benzene, a large proportion of the solvent naphtha, all the anthracene, and a portion of the naphthaline resulting from the distillation of coal-tar; and the value of the colouring matter thus produced is estimated by Mr. Perkin at £3,350,000. The demand for ammonia may be taken as unlimited, on account of its high agricultural value as a manure; and, considering the failing supply of guano and the growing necessity for stimulating the fertility of our soil, an increased production of ammonia may be regarded as a matter of national importance, for the supply of which we have to look almost exclusively to our gasworks. The present production of 1,000,000 tons of liquor yields 95,000 tons of sulphate of ammonia; which, taken at £20 10s. a ton, represents an annual value of £1,947,000.

The total annual value of the gasworks by-products may be estimated as follows:—

Colouring matter	£3,350,000
Sulphate of ammonia	1,947,600
Pitch (325,000 tons)	365,000
Creosote (25,000,000 gallons) ..	208,000
Crude carbolic acid (1,000,000 gallons)	100,000
Gas coke, 4,000,000 tons (after allowing 2,000,000 tons consumption in working the retorts) at 12s.	2,400,000
Total	£8,370,000

Taking the coal used, 9,000,000 tons, at 12s., equal £5,400,000, it follows that the by-products exceed in value the coal used by very nearly £3,000,000. In using raw coal for heating purposes these valuable products are not only absolutely lost to us, but in their stead we are favoured with those semi-gaseous by-products in the atmosphere too well known to the denizens of London and other large towns as smoke. Professor Roberts has calculated that the soot in the pall hanging over London on a winter's day amounts to fifty tons, and that the carbonic oxide, a poisonous compound, resulting from the imperfect combustion of coal, may be taken as at least five times that amount. Mr. Aitken has shown, moreover, in an interesting paper communicated to the Royal Society of Edinburgh, last year, that the fine dust resulting from the imperfect combustion of coal is mainly instrumental in the formation of fog; each particle of solid matter attracting to itself aqueous vapour; these globules of fog are rendered particularly tenacious and disagreeable by the presence of tar vapour, another result of imperfect combustion of raw fuel, which might be turned to much better account at the dye-works. The hurtful influence of smoke upon public health, the great personal discomfort to which it gives rise, and the vast expense it indirectly causes through the destruction of our monuments, pictures, furniture, and apparel, are now being recognised, as is evinced by the success of recent Smoke Abatement Exhibitions. The most effectual remedy would result from a general recognition of the fact that wherever smoke is produced, fuel is being consumed watefully, and that all our calorific effects, from the largest down to the domestic fire, can be realised as completely and more economically, without allowing any of the fuel employed to reach the atmosphere unburnt. This most desirable result may be effected by the use of gas for all heating purposes with or without the addition of coke or anthracite.

The cheapest form of gas is that obtained through the entire distillation of fuel in such gas producers as are now largely used in working the furnaces of glass, iron, and steel works; but gas of this description would not be available for the supply of towns owing to its bulk, about two-thirds of its volume being nitrogen. The use of water-gas, resulting from the decomposition of steam in passing through a hot chamber filled with coke, has been suggested, but this gas also is objectionable, because it contains, besides hydrogen, the poisonous and inodorous gas carbolic oxide, the introduction of which into dwelling-houses could not be effected without considerable danger. A more satisfactory mode of supplying heating separately from illuminating gas would consist in connecting the retort at different periods of the distillation with two separate systems of mains for the delivery of the respective gases.

The greater efficiency of gas as a fuel results chiefly from the circumstance that a pound of gas yields in combustion, 22,000 heat-units, or exactly double the heat produced in the combustion of a pound of ordinary coal. This extra heating power is due, partly to the freedom of the gas from earthy constituents, but chiefly to the heat imparted to it in effecting its distillation. Recent experiments with gas-burners have shown that in this direction also there is much room for improvement. The amount of light given out by a gas-flame depends upon the temperature to which the particles of solid carbon in the flame are raised, and Dr. Tyndall has shown that of the radient energy set up in such a flame, only the 1·25th part is luminous; the hot products of combustion carry off at least four times as much energy as is radiated, so that not more than one hundredth part of the heat evolved in combustion is converted into light. This proportion could be improved, however, by increasing the temperature of combustion, which may be effected either by intensified air currents or by regenerative action. Supposing that the heat of the products of combustion could be communicated to metallic surfaces, and be transferred by conduction or otherwise to the atmospheric air supporting combustion in the flame, we should be able to increase the temperature accumulatively to any point within the limit of dissociation; this limit may be fixed at about 2,300° C., and cannot be very much below that of the electric arc. At such a temperature the proportion of luminous rays to the total heat produced in combustion would be more than doubled, and the brilliancy of the light would at the same time be greatly increased. Thus improved, gas-lighting may continue its rivalry with electric lighting both as regards economy and brilliancy, and such rivalry must necessarily result in great public advantage.

Utilisation of Gaseous Fuel.

In the production of mechanical effect from heat, gaseous fuel also presents most striking advantages, as will appear from the following consideration. When we have to deal with the question of converting mechanical into electrical effect, or vice versâ, by means of a dynamo-electrical machine, we have only to consider what are the equivalent values of the two forms of energy, and what precautions are necessary to avoid losses by the electrical resistance of conductors and by friction. The transformation of mechanical effect into heat involves no losses except those resulting from imperfect installation, and these may be so completely avoided that Dr. Joule was able, by this method, to determine the equivalent values of the two forms of energy. But in attempting the inverse operation of effecting the conversion of heat into mechanical energy, we find ourselves confronted by the second law of thermo-dynamics, which says that whenever a given amount of heat is converted into mechanical effect, another but variable amount descends from a higher to a lower potential, and is thus rendered unavailable. In the condensing steam-engine this waste heat comprises that communicated to the condensing water, whilst the useful heat, or that converted into mechanical effect, depends upon the difference of temperature between the boiler and condenser. The boiler pressure is limited, however, by considerations of safety and convenience of construction, and the range of working temperature rarely exceeds 120° C. except in the engines constructed by Mr. Perkins, in which a range of 160° C., or an expansive action commencing at 14 atmospheres, has been adopted with considerable promise of success, as appears from an able report on this engine by Sir Frederick Bramwell.

Before many years have elapsed we shall find in our factories and on board our ships engines with a fuel consumption not exceeding 1lb. of coal per effective horse-power per hour, in which the gas producer takes the place of the somewhat complex and dangerous steam-boiler. The advent of such an engine and of the dynamo-machine must mark a new era of material progress at least equal to that produced by the introduction of steam power in the early part of our century. Let us consider what would be the probable effect of such an engine upon that most important interest of this country—the merchant navy.

The Gas-engine for Marine Purposes.

According to returns kindly furnished me by the Board of Trade and "Lloyds' Register of Shipping," the total value of the merchant shipping of the United Kingdom may be estimated at £126,000,000, of which £90,000,000 represent steamers having a net tonnage of 3,003,988 tons; and £36,000,000 sailing vessels, of 3,688,008 tons. The safety of this vast amount of shipping, carrying about five-sevenths of our total imports and exports, or £500,000,000 of goods in the year, and of the more precious lives connected with it, is a question of paramount importance. It involves considerations of the most varied kind: comprising the construction of the vessel itself, and the material employed in building it: its furniture of engines, pumps, sails, tackle, compass, sextant, and sounding apparatus, the preparation of reliable charts for the guidance of the navigator, and the construction of harbours of refuge, lighthouses, beacons, bells, and buoys, for channel navigation. Yet notwithstanding the combined efforts of science, inventive skill, and practical experience—the accumulation of centuries—we are startled with statements to the effect that during last year as many as 1,007 British-owned ships were lost, of which fully two-thirds were wrecked upon our shores, representing a total value of nearly £10,000,000. Of these ships 870 were sailing vessels and 137 steamers, the loss of the latter being in a fourth of the cases attributable to collision. The number of sailing vessels included in these returns being 19,325, and of steamers 5,505, it appears that the steamer is the safer vessel, in the proportion of 4·43 to 3·46; but the steamer makes on an average three voyages for one of the sailing ship taken over the year, which reduces the relative risk of the steamer as compared with the sailing ship per voyage in the proportion of 13·29 to 3·46. Commercially speaking, this factor of safety in favour of steam-shipping is to a great extent counterbalanced by the value of the steamship, which bears to that of the sailing vessel per net carrying ton the proportion of 3 : 1, thus reducing the ratio in savour of steam shipping as 13·29 to 10·38, or in round numbers as 4 : 3.

In considering the question how the advantages thus established in favour of steam-shipping could be further improved, attention should be called in the first place to the material employed in their construction. A new material was introduced for this purpose by the Admiralty in 1876-78, when they constructed at Pembroke dockyard the two steam corvettes, the *Iris* and *Mercury*, of mild steel. The peculiar qualities of this material are such as to have enabled shipbuilders to save 20 per cent. in the weight of the ship's hull, and to increase to that extent its carrying capacity. It combines with a strength 30 per cent. superior to that of iron such extreme toughness, that in the case of collision the side of the vessel has been found to yield or bulge several feet without showing any signs of rupture, a quality affecting the question of sea risk very favourably. When to the use of this material there are added the advantages derived from a double bottom, and from the division of the ship's hold by means of bulkheads of solid construction, it is difficult to conceive how such a vessel could perish by collision either with another vessel or with a sunken rock. The spaces between the two bottoms are not lost, because they form convenient chambers for water ballast, but powerful pumps should in all cases be added to meet emergencies.

If to the improvements already achieved could be added an engine of half the weight of the present steam-engine and boilers, and working with only half the present expenditure of fuel, a further addition of 30 per cent. could be made to the cargo of an Atlantic propeller vessel—no longer to be called a steamer—and the balance of advantages in favour of such vessels would be sufficient to restrict the use of sailing craft chiefly to the regattas of this and neighbouring ports.

Maritime Improvements.

The progressive views perceptible in the construction of the navy are further evidenced in a remarkable degree in the hydrographic department. Captain Sir Frederick Evans, the hydrographer, and vice-president of the British Association, gave us at York last year a very interesting account of the progress made in that department, which, while dealing chiefly with the preparation of charts showing the depth of water, the direction and force of currents, and the rise of tides near our shores, contains also valuable statistical information regarding the more general questions of the physical conditions of the sea, its temperature at various depths, it flora and fauna, as also the rainfall and the nature and force of prevailing winds. In connection with this subject the American Naval Department has taken an important part, under the guidance of Captain Maury and the Agassiz father and son, whilst in this country the persistent labours of Dr. William Carpenter deserve the highest consideration. Our knowledge of tidal action has received a most powerful impulse through the invention of a self-recording gauge and tide-predicter, which will form the subject of one of the discourses to be delivered at our present meeting by its principal originator, Sir William Thomson. The application of iron and steel in naval construction rendered the use of the compass for some time illusory, but in 1839 Sir George Airy showed how the errors of the compass, due to the influence experienced from the iron of the ship, may be perfectly corrected by magnets and soft iron placed in the neighbourhood of the binnacle; but the great size of the needles in the ordinary compasses rendered the correction of the quadrantal errors practically unattainable. In 1876, Sir William Thomson invented a compass with much smaller needles than those previously used, which allows Sir George Airy's principles to be applied completely. Sir William Thomson has also enriched the art of navigation by the invention of two sounding machines; the one being devised for ascertaining great depths very accurately in less than one-quarter the time formerly necessary, and the other for taking depths up to 130 fathoms without stopping the ship in its onward course. In both these instruments steel pianoforte wire is used instead of the hempen and silken lines formerly employed; in the latter machine, the record of depth is obtained, not by the quantity of wire run over its counter and brake-wheel, but through the indications produced upon a simple pressure gauge consisting of an inverted glass tube, whose internal surface is covered beforehand with a preparation of chromate of silver, rendered colourless by the sea-water up to the height to which it penetrates. The value of this instrument for guiding the navigator within what he calls "soundings" can hardly be exaggerated; with the sounding-machine and a good chart he can generally make out his position correctly by a succession of three or four casts in a given direction at given intervals, and thus in foggy weather is made independent of astronomical observations and of the sight of lighthouses or the shore. By the proper use of this apparatus, such accidents as happened to the mail steamer *Mosel* not a fortnight ago would not be possible. As regards the value of the deep-sea instrument, I can speak from personal experience, as on one occasion it enabled those in charge of the Cable s.s. *Faraday* to find the end of an Atlantic cable, which had parted in a gale of wind, with no other indication of the locality than a single sounding, giving a depth of 950 fathoms. To recover the cable a number of soundings in the supposed neighbourhood of the broken end were taken, the 950 fathom contour line was then traced upon a chart, and the vessel thereupon trailed its grapnel two miles to the eastward of this line, when it soon engaged the cable 20 miles away from the point where dead reckoning had placed the ruptured end.

Modern Engineering Enterprises.

The great success, both technically and commercially, of the Suez Canal, has stimulated M. de Lesseps to undertake a similar work of even more gigantic proportions, namely, the piercing of the Isthmus of Panama by a ship canal, 40 miles long, 50 yards wide on the surface, and 20 yards at the bottom, upon a dead level from sea to sea. The estimated cost of this work is £20,000,000, and more than this sum having been subscribed, it appears unlikely that political or climatic difficulties will stop M. de Lesseps in its speedy accomplishment. Through it, China, Japan, and the whole of the Pacific Ocean will be brought to half their present distance, as measured by the length of voyage, and an impulse to navigation and to progress will thus be given which it will be difficult to over-estimate. Side by side with this gigantic work, Captain Eads, the successful improver of the Mississippi navigation, intends to erect his ship-railway to take the largest vessels, fully laden and equipped, from sea to sea, over a gigantic railway across the Isthmus of Tehuantepec, a distance of 95 miles. Mr. Barnaby, the chief constructor of the navy, and Mr. John Fowler, have expressed a favourable opinion regarding this enterprise, and it is to be hoped that both the canal and the ship-railway will be accomplished, as it may be safely anticipated that the traffic will be amply sufficient to support both these undertakings.

Whether or not M. de Lesseps will be successful also in carrying into effect the third great enterprise with which his name has been prominently connected, the flooding of the Tunis-Algerian Chotts, thereby re-establishing the Lake Tritonis of the ancients, with its verdure-clad shores, is a question which could only be decided upon the evidence of accurate surveys; but the beneficial influence of a large sheet of water within the African desert could hardly be matter of doubt.

It is with a feeling not unmixed with regret that I have to record the completion of a new Eddystone lighthouse in substitution for the *chef-d'œuvre* of engineering erected by John Smeaton more than 100 years ago. The condemnation of that structure was not, however, the consequence of any fault of construction, but was caused by inroads of the sea upon the rock supporting it. The new lighthouse, designed and executed by Mr. (now Sir James Douglass), engineer of Trinity House, has been erected in the incredibly short time of less than two years, and bids fair to be worthy of its famed predecessor. Its height above high water is 130ft., as compared with 72ft., the height of Telford's structure, which gives its powerful light a considerably 'increased range. The system originally suggested by Sir William Thomson some years ago, of distinguishing one light from another by flashes following at varied intervals, has been adopted by the Elder Brethren in this as in other recent lights in the modified form introduced by Dr. John Hopkinson, in which the principle is applied to revolving lights, so as to obtain a greater amount of light in the flash.

The geological difficulties which for some time threathened the accomplishment of the St. Gothard Tunnel have been happily overcome, and this second and most important sub-Alpine thoroughfare now connects the Italian railway system with that of Switzerland and the South of Germany, whereby Genoa will be constituted the shipping port for those parts.

Whether we shall be able to connect the English with the French railway system by means of a tunnel below the English Channel is a question that appears dependent at this moment rather upon military and political than technical and financial considerations. The occurrence of a stratum of impervious grey chalk, at a convenient depth below the bed of the Channel, minimises the engineering difficulties in the way, and must influence the financial question involved. The protest lately raised against its accomplishment can hardly be looked upon as a public verdict, but seems to be result of a natural desire to pause pending the institution of careful inquiries. These inquiries have been made by a Royal scientific commission, and will be referred for further consideration to a mixed Parliamentary Committee, upon whose report it must depend whether the natural spirit of commercial enterprise has to yield in this instance to political and military considerations. Whether the Channel Tunnel is constructed or not, the plan proposed some years ago by Mr. John Fowler of connecting England and France by means of a ferry boat capable of taking railway trains would be a desideratum justified by the ever-increasing intercommunication between this and Continental countries.

The public inconvenience arising through the obstruction to traffic by a sheet of water is well illustrated by the circumstance that both the estuaries of the Severn and of the Mersey are being undermined in order to connect the railway systems on the two sides, and that the Frith of Forth is about to be spanned by a bridge exceeding in grandeur anything as yet attempted by the engineer. The roadway of this bridge will stand 150ft. above high-water mark, and its two principal spans will measure a third of a statute mile each. Messrs. Fowler and Baker, the engineers to whom this great work has been entrusted, could hardly have accomplished their task without having recourse to steel for their material of construction, nor need the steel used be of the extra mild quality particularly applicable for naval structures to withstand collision, for, when such extreme toughness is not required, steel of very homogeneous quality can be produced, bearing a tensile strain double that of iron.

Improvements of Explosives.

When the British Association met at Southampton on a former occasion, Schönbein announced to the world his discovery of gun-cotton. This discovery has led the way to many valuable researches on explosives generally, in which Mr. Abel has taken a leading part. Recent investigations by him, in connection with Captain Noble, upon the explosive action of gun-cotton and gunpowder confined in a strong chamber, which have not yet been published, deserve particular attention. They show that while by the method of investigation pursued about twenty years ago by Karolye (of exploding gunpowder in very small charges in shells confined within a large shell partially exhausted of air), the composition of the gaseous products was found to be complicated and liable to variation, the chemical metamorphosis which gun-cotton sustains, when exploded under conditions such as obtain in its practical application, is simple and very uniform. Among other interesting points noticed in this direction was the fact that, as in the case of gunpowder, the proportion of carbonic acid increases, while that of carbonic oxide diminishes with the density of the charge.

Messrs. Noble and Abel are also continuing their researches upon fired gunpowder, being at present occupied with an inquiry into the influence exerted upon the chemical metamorphosis and ballistic effects of fired gunpowder by variation in its composition, their attention being directed especially to the discovery of the cause of the more or less considerable erosion of the interior surface of guns produced by the exploding charge—an effect which, notwithstanding the application of devices in the building up of the charge specially directed to the preservation of the gun's bore, have become so serious that, with the enormous charges now used in our heavy guns, the erosive action on the surface of the bore produced by a single round is distinctly perceptible. As there appeared to be *primâ facie* reasons why the erosive action of powder upon the surface of the bore at the high temperatures developed should be, at any rate, in part due to its one component, sulphur, Noble and Abel have made comparative experiments with powders of usual composition, and with others in which the proportion of sulphur was considerably increased, the extent of erosive action of the products escaping from the explosion vessel under high tension being carefully determined. With small charges, a particular powder containing no sulphur was found to exert very little erosive action as compared with ordinary cannon powder; but another powder containing the maximum proportion of sulphur tried (15 per cent.), was found equal to it under these conditions, and exerted very decidedly less erosive action than it, when larger charges were reached. Other important contributions to our knowledge of the action of fired gunpowder in guns, as well as decided improvements in the gunpowder manufactured for the very heavy ordnance of the present day, may be expected to result from a continuance of these investigations. Professor Carl Himly, of Kiel, having been engaged upon investigations of a similar nature, has lately proposed a gunpowder in which hydrocarbons precipitated from solution in naphtha take the place of the charcoal and sulphur of ordinary powder. This powder has amongst others the peculiar property of completely resisting the action of water, so that the old caution, "Keep your powder dry," may hereafter be unecessary.

The extraordinary difference of condition, before and after its ignition, of such matter as constitutes an explosive agent leads us up to a consideration of the aggregate state of matter under other circumstances. As early as 1776 Alexander Volta observed that the volume of glass was changed under the influence of electrification, by what he termed electrical pressure. Dr. Kerr, Govi, and others have followed up the same inquiry, which is at present continued chiefly by Dr. George Quincke, of Heidelberg, who finds that temperature, as well as chemical constitution of the dielectric under examination, exercises a determining influence upon the amount and character of the change of volume effected by electrification; that the change of volume may under certain circumstances be effected instantaneously as in flint glass, or only slowly as in crown glass, and that the elastic limit of both is diminished by electrification, whereas in the case of mica and of guttapercha an increase of elasticity takes place.

Phenomena of Electrical Discharge.

Still greater strides are being made at the present time towards a clearer perception of the condition of matter when particles are left some liberty to obey individually the forces brought to bear upon them. By the discharge of high tension electricity through tubes containing highly rarefied gases (Geissler's tubes), phenomena of discharge were produced which were at once most striking and suggestive. The Sprengel pump afforded a means of pushing the exhaustion to limits which had formerly been scarcely reached by the imagination. At each step, the condition of attenuated matter revealed varying properties when acted upon by electrical discharge and magnetic force. The radiometer of Crookes imported a new feature into these inquiries, which at the present time occupy the attention of leading physicists in all countries.

The means usually employed to produce electrical discharge in vacuum tubes was Ruhmkorff's coil; but Mr. Gassiot first succeeded in obtaining the phenomena by means of a galvanic battery of 3,000 Leclanché cells. Dr. De La Rue, in conjunction with his friend, Dr. Hugo Müller, has gone far beyond his predecessors in the production of batteries of high potential. At his lecture, "On the Phenomena of Electric Discharge," delivered at the Royal Institution in January, 1881, he employed a battery of his invention, consisting of 14,400 cells (14,832 volts), which gave a current of 0·054 ampère, and produced a discharge at a distance of 0·71in. between the terminals. During last year he increased the number of cells to 15,000 (15,450 volts), and increased the current to 0·4 ampère, or eight times that of the battery he used at the Royal Institution.

The President of the Royal Society has made the phenomena of electrical discharge his study for several years, and resorted in his important experiments to a special source of electric power. In a note addressed to me, Dr. Spottiswoode describes the nature of his investigations much more clearly than I could venture to give them. He says: "It had long been my opinion that the dissymmetry shown in electrical discharges through rarefied gases must be an essential element of every disruptive discharge, and that the phenomena of stratification might be regarded as magnified images of features always present, but concealed under ordinary circumstances. It was with a view to the study of this question that the researches by Moulton and myself were undertaken. The method chiefly used consisted in introducing into the circuit intermittence of a particular kind, whereby one luminous discharge was rendered sensitive to the approach of a conductor outside the tube. The application of this method enabled us to produce artificially a variety of phenomena, including that of stratification. We were thus led to a series of conclusions relating to the mechanism of the discharge, among which the following may be mentioned:—"1. That a stria, with its attendant dark space, forms a physical unit of a striated discharge. 2. That the origin of the luminous column is to be sought for at its negative end; that the luminosity is an expression of a demand for negative electricity. 3. That the time occupied by electricity of either name in traversing a tube is greater than that occupied in traversing an equal length of wire, but less than that occupied by molecular streams (Crooke's radiations) in traversing the tubes. 4. That the brilliancy of the light with so little heat may be due in part to brevity in the duration of the discharge. 5. That striæ are not merely loci in which electrical is converted into luminous energy, but are actual aggregations of matter.

"This last conclusion was based mainly upon experiments made with an induction coil excited in a new way—viz., directly by an alternating machine, without the intervention of a commutator or condenser. This mode of excitement promises to be one of great importance in spectroscopic work, as well as in the study of the discharge in a magnetic field, partly on account of the simplification which it permits in the construction of induction coils, but mainly on account of the very great increase of strength in the secondary currents to which it gives rise."

Solar Physics.

These investigations assume additional importance when we view them in connection with solar—I may even say stellar—physics, for evidence is augmenting in favour of the view that interstellar space is not empty, but is filled with highly attenuated matter of a nature such as may be put into our vacuum tubes. Nor can the matter occupying stellar space be said any longer to be beyond our reach for chemical and physical test. The spectroscope has already thrown a flood of light upon the chemical constitution and physical condition of the sun, the stars, the comets, and the far distant nebulæ, which have yielded spectroscopic photographs under the skilful management of Dr. Huggins, and Dr. Draper of New York. Armed with greatly improved apparatus the physical astronomer has been able to reap a rich harvest of scientific information during the short periods of the last two solar eclipses; that of 1879, visible in America, and that of May last, observed in Egypt by Lockyer, Schuster, and by Continental observers of high standing. The result of this last eclipse expedition has been summed up as follows: "Different temperature levels have been discovered in the solar atmosphere; the constitution of the corona has now the possibility of being determined, and it is proved to shine with its own light. A suspicion has been aroused once more as to the existence of a lunar atmosphere, and the position of an important line has been discovered. Hydrocarbons do not exist close to the sun, but may in space between us and it.

To me personally these reported results possess peculiar interest, for in March last I ventured to bring before the Royal Society a speculation regarding the conservation of solar energy, which was based upon the three following postulates, viz.:—

1. That aqueous vapour and carbon compounds are present in stellar or interplanetary space.

2. That these gaseous compounds are capable of being dissociated by radiant solar energy while in a state of extreme attenuation.

3. That the effect of solar rotation is to draw in dissociated vapours upon the polar surfaces, and to eject them after combustion has taken place back into space equatorially.

It is therefore a matter of peculiar gratification to me that the results of observation here recorded give considerable support to that speculation. The luminous equatorial extensions of the sun which the American observations revealed in such a striking manner (with which I was not acquainted when writing my paper) were absent in Egypt; but the outflowing equatorial streams I suppose to exist could only be rendered visible by reflected sunlight, when mixed with dust produced by exceptional solar disturbances or by electric discharge; and the occasional appearance of such luminous extensions would serve only to disprove the hypothesis entertained by some, that they are divided planetary matter, in which case their appearance should be permanent. Professor Langley, of Pittsburg, has shown, by means of his Bolometer, that the solar actinic rays are absorbed chiefly in the solar instead of in the terrestrial atmosphere, and Captain Abney has found by his new photometric method that absorption due to hydro-carbons takes place somewhere between the solar and terrestrial atmosphere; in order to test this interesting result still further, he has lately taken his apparatus to the top of the Riffel, with a view of diminishing the amount of terrestrial atmospheric air between it and the sun, and intends to bring a paper on this subject before Section A. Stellar space filled with such matter as hydrocarbon and aqueous vapour would establish a material continuity between the sun and his planets, and between the innumerable solar systems of which the universe is composed. If chemical action and reaction can further be admitted, we may be able to trace certain conditions of thermal dependence and maintenance, in which we may recognise principles of high perfection, applicable also to comparatively humble purposes of human life. We shall thus find that in the great workshop of nature there are no lines of demarcation to be drawn between the most exalted speculation and commonplace practice, and that all knowledge must lead up to one great result, that of an intelligent recognition of the Creator through His works.

HOW TO FIND THE MERIDIAN LINE.

THE following method of finding the meridian is described in a paper read recently by Mr. R. W. McFarland before the Association of County Surveyors of Ohio, who has used it for many years and finds that the true meridian can be ascertained within one minute of arc. Nail a slat to the north side of an upper window—the higher the better. Let it be 25ft. from the ground or more. Let it project 3ft. Near the end suspend a plumb-bob, and have it swing in a bucket of water. A lamp set in the window will render the upper part of the string visible. Place a small table or stand about 20ft. south of the plumb-bob, and on its south edge stick the small blade of a pocket knife; place the eye close to the blade, and move the stand so as to bring the blade, string, and polar star into line. Place the table so that the star shall be seen very near the slat in the window. Let this be done half an hour before the greatest elongation of the star. Within four or five minutes after the first alignment the star will have moved to the east or west of the string. Slip the table or the knife a little to one side, and align carefully as before. After a few alignments the star will move along the string—down, if the elongation is west; up, if east. On the first of June the eastern elongation occurs about half-past two in the morning, and as daylight comes on shortly after the observation is completed, I prefer that time of year. The time of meridian passage or of the elongation can be found in almost any work on surveying. Of course the observer should choose a calm night. In the morning the transit can be ranged with the knife blade and string, and the the proper angle turned off to the left, if the elongation is east; to the right, if west. Instead of turning off the angle, as above described, I measure 200 or 300ft. northward, in the direction of the string, and compute the offset in feet and inches, set a stake in the ground, and drive a tack in the usual way. Suppose the distance 250ft. and the angle 1° 40′, then the offset will be 7·271ft. or 7ft. 3¼in. A minute of are at the distance of 250ft. is seven-eighths of an inch; and this is the most accurate way, for the vernier will not mark so small a pace accurately.

The angle of elongation should be computed by the surveyor for each observation. The distance between the star and the pole is continually diminishing, and on January 1, 1882, was 1° 18′ 48″. There is a slight annual variation in the distance. July 1, 1882, it will be 1° 19′ 20″. If from this latter quantity the observer will subtract 16″ for 1883, and the same quantity for each succeeding year for the next four or five years, no error so great as one-quarter of a minute will be made in the position of the meridian as determined in the summer months. If winter observations are made, the distance in January should be used. The formula for computing the angle of elongation is easily made by any one understanding spherical trigonometry, and is this: $\frac{R \times \text{sin. Polar dist.}}{\text{cos. lat.}}$ = sin. of angle of elongation.

As an example, suppose the time is July, 1882, and the latitude 40°. Then the computation being made, the angle will be found to be 1° 43′ 34″. A difference of six minutes in the latitude will make less than 10″ difference in the angle, as one can see by trial. Any good map will give the latitude to within one or two miles—or minutes.

The facts being as here stated, the absurdity of the Ohio law, concering the establishment of county meridians, becomes apparent. The longitude has nothing at all to do with the meridian; and a difference of six miles in latitude makes no appreciable error in the meridian established as here suggested, whereas the statute requires the latitude within one half a second, which is fifty feet. There are some other things, besides the ways of Providence, which may be said to be "past finding out." It is not probable that a surveyor would err so much as three miles in his latitude; but should he do so, then the error in his meridian line, resulting from the mistake, will be five seconds, and a line one mile long, run on a course 5″ out of the way, will vary but an inch and a half from the true position. Surveyors well know that no such accuracy is attainable.

THE FUTURE OF THE BRITISH RACES.

IN an inaugural address at the Welsh National Eisteddfod, on Monday, Dr. Richardson observed that the races of men form the fractional surfaces by which, in natural collision, the knowledge and wisdom which make life worth having struck out. If one race, having the same tastes, desires, hopes, traditions, language, arts, literature, and aptitudes were to become the exclusive inhabitants of the planet, it would become a Babel, and fall, probably, a prey to the lower untamed forms of animal life. The speaker next described in detail the races which occupy this country—the Saxon, the Keltic, the Jewish, and the Gipsy. The vitality of these races formed the second portion of the address. The Saxon was described as the most powerful, physically, but not always so tenacious of life as the Kelt and the Jew. He suffered much from the constitutional disease called struma, or scrofula; from consumption, and from the mechanical shocks and strains incidental to his active physical life. The Kelt was more subject to affections of the emotional and nervous class. The Jew, though very liable to one fatal constitutional disease—cancer, was most of all tenacious of life, suffered less than others from contagious diseases, and from the danger of luxury, was the longest-lived of all, and that under privations and persecutions, which would at first sight seem actually destructive to any people. The Gipsy was formed naturally to live a long life, but in his nomadic state was subject to vicissitudes of climate, privation, and neglect, which often caused his early death. In the third part of his address Dr. Richardson dwelt on the question of the future of these great races, and concluded as follows:—"The three races, Saxon, Keltic, Semitic, in this day strive together, re-act on each other, and, on the whole, beneficially. The Saxon goes to the fringe of some new continent, carrying with him his other self, his lever, his mattock, spade, plough, axe, and other tool or engine. He cuts into the forest, he digs into the earth, he levels the roads, he builds rude houses, warm and comfortable enough for him if he be let alone; he sets up earthworks and forts; he plans docks, builds and mans ships, and does it all often out of what he finds on the spot, taking everything as if it were his own, and fighting the owner if the owner dares to interfere; crushing out all that comes in his way, yet not quarrelsome if he be allowed his own way. When he has made a rough holding he lets the Kelt join him on terms which he keeps the key of, and the Kelt, with light heart and elastic mind, beautifies the place, and makes it more human; builds the temple, the theatre, the mansion; lays out the garden; introduces the picture, the sculpture; improves and lightens the literature; lets in the light, the art, the beauty; in fact, furnishes the place and makes it happy. When Saxon and Kelt have in their ways thus installed the community in comfort and position, in glides the Jew with his money bags, and 'will you buy?' becomes the ring of the street and the market, so commerce completes the whole. The Jew does more than this· he brings music also, enterprise, and, until he feels his way, long-sufferance and stability. In these combinations the three races help each other. Will the partnership survive? The danger underlying the Saxon is physical power. The danger of the Jew is money; heaps of gold are the Goodwood Sands of the Jewish race. The Kelt is safer on these grounds. The Jew may amass wealth, may hold the capital; may dispense and equalise the capital; he is safe at that so long as he does not show his wealth, too feebly hidden, and does not attempt to dominate or put his hand into the works of the mighty Saxon engine. Let him expose his wealth, display himself on it, try to rule by it, and he is under that iron heel of Saxon power again as sure as ever he was before. This is his danger, and, as events elsewhere have shown, it is ever imminent. The danger to the Saxon is with himself of himself. Saxon and Saxon in conflict and other races oppressed by Saxon wrongs, waiting till they can be the dictators and masters of the sullen power, and he, making for himself domains and empires beyond his control, sinking under the burden, and not daring to retract or recede until the resistance is overwhelming. The danger of the Keltic race lies in irritability and sudden action without due forethought, under excitement or impulse. This controlled, the Kelt, under fostering influence of knowledge, is equal to any of his social peers. The hope of all advanced scholars must be that these conflicts may be avoided; that men may learn to know each other socially as well as individually; that they may understand the natural requirements of each race, and let those requirements have legitimate play; that while they do not assume to change the foundations of nature, in which they will most assuredly fail if they try, they learn of her how her courses may be so naturally diverted that they shall progress without injury to anyone; that, as the philosopher who defied not the lightning, nor attempted to stop it by his skill, gleaned from nature herself how to direct it at will, and by a mere line of wire to bring it harmlessly to the earth, its destination, so they, in dealing with vital forces, mental and physical, may let them all have their vent and reach their destinations, directed in their course in such a manner that not a chance of evil shall ensue; that they shall comprehend that the greatness of the world will be best realised when all races shall join to produce the greatness; that for this end all races have some peculiar gifts which will add to the whole; and that, as in the orchestra each one has a part, which, in itself perfectly distinct, combines with the rest to make up the harmonious result, so in the world that is to come, even on this planet, the harmony for which the whole creation yearns can be secured when every social part is brought by its best and wisest, and, according to its own conscience, holiest disposition, into communion and universal concord."

Coal in China.—According to a paper in the *Comptes Rendus* "On the Coal Basins of Tong-King," by M. Fuchs, the workable coal in this district, at not more than 330ft. below the sea level, is estimated to be over five million tons. There are four different species in distinct groups of beds.

SCRAPS of india rubber-coated fabrics have hitherto been useless because the rubber could not be profitably extracted. An American inventor finds that strong hot sulphuric or muriatic acid has no effect on the rubber, but a strong corrosive action on the textile fabrics, and he has taken out patents for a process of recovery in which he eats away the textile fabrics with these acids, preferring hydrochloric.

SCIENTIFIC NEWS.

THE *Eira* relief expedition has accomplished its work, and Mr. Leigh Smith's party are safely home again; but the results of his expedition are practically nil, as everything of value was lost in his yacht. Full details of the expedition have appeared in the daily papers.

A telegram from the Swedish Arctic expedition has been received in Stockholm viâ Tromsö, from which it appears that the party were unable to reach Mossel Bay, Spitzbergen, and had returned to the Norse Islands, where the observatory had been erected, and the party would winter.

At the meeting of the British Association Prof. Sollas, of the University College, Bristol, will describe a scheme for publishing a complete record of the scientific work of the year. Each nation will supply a record of its work, and receive in return a copy of the records of the other nations. The work properly carried out would be of great benefit to science; but there are obvious difficulties which even the British Association may not be able to overcome.

In the expectation of the British Association being invited to visit Canada either in 1883 or at some subsequent period, a private circular has been issued to the members of the General Council, requesting to know whether they could be present, and, if so, what year would suit their convenience most. Last year it was arranged that Oxford should be the place of meeting in 1883, but unforseen circumstances have arisen, which we believe will upset that arrangement, and it is thought that the opportunity will be a good one for visiting Canada, and probably meeting the American Association.

With the object of stimulating the students of King's College, London, to a high standard of proficiency in metallurgical science, Dr. Siemens has founded a medal (value 10 guineas) and a prize of 10 guineas (in books,) open to those who have, as matriculated students, studied in the applied science department for two years, and who, either in their third year, or, if they remain in the department for three years, in the succeeding year, make metallurgy a special study. The first award will be made at the end of June, 1883, and will depend partly on an essay on some particular subject, partly on a written examination on the metallurgical lectures, and partly on actual work done in the laboratory. The subject for the essay for 1883 will be the "Manufacture of Steel suitable for Ship and Boiler Plates." The essays are to be illustrated by free-hand sketches and mechanical drawings to scale, and must be sent in to Prof. Huntington on or before June 30 next year.

The "press" department of the telegraph office in St. Martin's-le-Grand was illuminated on Monday night by the Edison system, the wires being led from Holborn Viaduct to the building—a distance altogether of nearly 2,000ft. There are 59 incandescent-lamps in the department, which occupies the whole upper floor of the building, and gives accommodation to no fewer than 1,200 employés it is said. The gas had previously been alight for a time sufficiently long to render the atmosphere warm, and when the gas was extinguished and the electricity turned on, the effect was marked. A safety link of lead-wire at each lamp is employed to avoid risk of fire, but as it would melt on a given increase of current, the department might suddenly be deprived of light at a very busy time.

A consular report from Sweden gives a description of a new explosive called sebastine, or virite, which, it is said, has competed most favourably with dynamite. Sebastine appears to be an explosive based upon nitro-glycerine, but safer to handle than the ordinary dynamite, while more powerful in effect and cheaper to purchase. The greater safety of sebastine depends on two circumstances—first that the explosive oil is more completely absorbed and bound by a specially prepared kind of charcoal and other ingredients, and secondly that in ordinary cases it requires no percussion cap to explode.

Experiments were made the other day at the Wharncliffe Collieries with the new compressed lime cartridges employed for breaking down coal. The seam is undercut in the usual way, and then, near the roof, holes about three inches in diameter are bored, into which cartridges of highly caustic and compressed lime are inserted. The cartridges have a groove which admits a perforated iron tube through which water is forced; and when properly tamped the steam and the swelling of the lime when water is forced in brings down the coal in about half an hour. In the experiment made at the Parkgate Seam on Monday, about 10 tons of coal were brought down in an almost unbroken mass, while the percentage of small made in the operations was much less than in the more dangerous operation of blasting.

Zorgite, an ore from La Plata, is found to be very rich in selenium; it is a lead selenide containing 30 per cent. of selenium. M. P. Kienlen also states that the deposit found in Wolff's bottles used for the condensation of hydrochloric acid is rich in selenium. There is a considerable demand for that element, and with the increase the price has fallen considerably, many new sources of supply having been discovered.

The Sydney Technological, Industrial, and Sanitary Museum is progressing steadily, the Government of New South Wales being anxious that the colonists should be made acquainted with the improved apparatus and appliances for building and domestic purposes.

A pamphlet describing Binko's electric railway at the Crystal Palace has been issued by the International Electric Railway Company. The pamphlet contains an historical sketch of early roads, tramways, railways, and means of locomotion, by W. Grist.

An exhibition "projected for the purpose of bringing together a display of apparatus and products illustrative of the modes of working and esults attained in the various departments of Science and Industry," is announced to take place in the Public Buildings, Penzance, during the week embracing the 25th to 30th September. This time has been fixed in order that exhibitors at the Cornwall Polytechnic at Falmouth may have opportunity of sending their exhibits on to Penzance. The Falmouth Exhibition opens on the 5th and closes on the 16th September. The arrangements for the Penzance exhibitions are being carried out by an Executive Committee of thirty, including a Chairman and two Hon. Secs; there are also President and Vice-President. The Committee seeks the co-operation of inventors, manufacturers, skilled workers, amateurs, and private individuals, from whom objects for exhibition will be gladly received. "Examples, models, digrams, or descriptions of obsolete or disused machines or processes, possessing historic interest, will be eligible; but the committee more particularly desire a collection of the most approved modern appliances in use at the present time." Exhibits may be for sale if the owners so desire, the secretaries being authorised to receive things for that purpose. The profits, if any, will be devoted to the advancement of Penzance Science Classes. All communications should be addressed to the Hon. Secs., Exhibition Committee, Public Buildings, Penzance.

According to M. D'Arsonval, there is reason to believe that in the telephones with both poles utilised, the really active part of the wire is that between the poles, the rest being mere useless resistance. He has constructed a telephone accordingly; it is formed of a bar-magnet, bent round so as to bring the poles near each other; one polar end is a short cylinder having the coil round it, the other is of ring-shape, and encloses the coil. Both poles are in one plane, and they are brought very near the plate. The instrument, though very small and light, transmits the voice with remarkable distinctness and force. If a trumpet mouthpiece be added, one can hear easily in any part of a room.

There are now several buildings in Paris, in which one may read on all the floors, "Eau, gaz, telephone."

An instructive paper (largely illustrated), on the subject of dynamometers, by M. Richard, has been appearing in *La Lumière Electrique*. We may also note that in *Carl's Repertorium*, Dr. Hammerl deals in a comprehensive manner with the large variety of thermostats that have been constructed.

It has been observed by M. Slouginoff, of St. Petersburg, that just as by action of high temperature in a metal a liquid brought to the metal is repelled, so liquid is repelled from metal when a strong galvanic current passes through; in other words, both heat and electricity may throw a liquid into the spheroidal state; sometimes both act together. The electro-spheroidal state is accompanied by a weak, luminous phenomenon. Besides this electrolytic light-phenomenon, there is luminosity of another sort; and when it occurs at the cathode, particles of platinum are detached from this electrode. In the case of the light-phenomenon in a solution of platina-chloride in hydrochloric acid, and at the cathode, the intensity of the luminous effect depends on the heating of the powdered platina that is detached. (See *Carl's Rep.*)

With reference to a "small illusion," lately indicated by M. Plateau (a system of capillary siphons which, one might think, should give perpetual motion), M. Fougerat has recalled, in *La Nature*, a proposal with the same object made by the famous mathematician, Jean Bernouilli. A U tube with unequal arms has in its shorter arm a mixture of two liquids of different specific gravity, and at the lower part a filter letting only the lighter liquid through to the longer arm, which is filled with the latter, and is a little shorter than for equilibrium of the liquids. A small tube or trough connects the ends of the system, bringing the overflow of the larger arm into the shorter in a continuous manner. It would be interesting, M. Fougerat remarks, if some one were to make the experiment (though it would no doubt fail to give perpetual motion), and communicate the result.

Experiments have been recently made by Dr. Troitzky with a view to ascertain the influence of tobacco-smoking on temperature and pulse. He made some 600 observations on 25 persons grouped in three categories, according to constitution. The main result is, that tobacco-smoking has a stronger influence on the pulse than on the temperature. Taking all the classes of persons together, the mean temperature on smoking, as against non-smoking days, showed an increase in the ratio 1,008 : 1,000; while the ratio for the pulse was 1,180 : 1,000.

While malaria is an old acquaintance among Italian peoples, it appears from old texts that the Agro Romano was at one time comparatively healthy and populous. A professor of Velletri, S. Tucci, believes the cause to have been the system of deep drainage practised by the Romans. One finds in the district numerous conduits known as *cuniculi* (unwalled), having a height of 1·50m., and a mean width of 1·70m. Cuttings for roads have solved the problem of their origin and function. These *cuniculi* have a constant slope, which brings them sometimes 15 metres (50ft.) below the soil. S. Tucci is preparing a memoir in which he means to show (1) that this old system rendered the country very healthy, (2) that the surface-flow now existing is little better than stagnation of the waters, and (3) that the unhealthiness therewith connected is mainly due to the combined action of the water and the atmosphere on the tufa and pozzuolana at the surface of the ground. Encouraging results, it may here be mentioned, have been gained by the Trappist monks of the monastery of Tre Fontane (a short distance out of Rome, on the way to Ostia), in reclamation of marsh land and improvement of a very unhealthy climate by planting of eucalyptus trees, which are known to be efficient agents of sanitation, and by drainage. This work has been engaged in by contingents of the monks that were recently expelled from France.

A dry galvanic element recently patented in Germany by Herr Scrivener consists of three parts: a plate of compressed carbon or graphite, a carefully amalgamated zinc plate, and a depolarising plate applied to the carbon plate, this latter being the essential part, and made from a mass consisting of 10 parts by weight of ammonium-mercury-chloride, 3 of chloride of sodium, and ¼ of chloride of silver. To this mixture is added a weak acid solution of zinc chloride (of 50°) till it forms a consistent paste, with which the previously-paraffined carbon plate is then coated, in a comparatively thick layer. The layer is covered with five or six layers of Swedish filter-paper saturated with a solution of equal parts of chloride of zinc and and sulphide of sodium. By connection of this plate with the zinc plate, a constant element of about 1·3 volt difference of potential is formed. In the case of house telegraphs, the element is placed directly behind the knob to be pressed.

The following (according to *La Nature*) is the way in which those glass plates are prepared, which show an image, or writing, only when breathed upon. The piece of glass should be of the kind used for mirrors, and may be either transparent or silvered, and a little powdered fluor-spar is put in a porcelain capsule and moistened with ordinary sulphuric acid, to an extent which will allow of using it to write with, by means of a quill pen, on the carefully-cleaned glass. The drawing, or writing, is then traced, and allowed to stand five or ten minutes. Then the plate is washed with ordinary water, and dried with a cloth, after which it is ready for use.

Doubts have been raised within recent years, by M. Heckel and others, as to the *rôle* of insects in cross fertilisation of flowers: they have been based especially on the supposed absence, or, at least, great rarity of these auxiliary animals on the flowery summits of high mountains. The results of four years observations at Grenoble, by M. Masset, in a region with all altitudes from 200m. to 3,000m., and amidst an herbaceous flora the richest in the world, are here instructive. He finds (1), that all orders of insects have representatives up to 2,300m.; (2), that beyond 2,300m. lepidoptera, diptera, and certain hymenoptera preponderate in number; (3), that the number of genera, species, and individuals of nectar-loving insects is proportional to that of the flowers, sometimes incalculable; (4), that the hours of sleep and waking of flowers, and those of insects, are synchronous; (5), that the apparent number of nectar-loving insects is in relation with the number of their favourite flowers, and the state of the atmosphere and sky. M. Masset concludes that, as flowers and insects are never simultaneously and mutually wanting, the objection referred to against cross-fertilisation loses weight.

The "Sherwood Forester" Tricycle.—The "Sherwood Forester" made by Messrs. Kirkham and Mallatratt, of the Wellbeck Works, Mansfield, is a rear steering, open fronted tricycle, with the framework of the pattern of the "hay-fork" style. The "Sherwood Forester" is driven by the rotary action, same as a bicycle, and has two equal size driving wheels of 42in. to 50in. diameter, and a 20in. steering wheel. The wheels run on two independent steel axles, and the whole power of the rider is transmitted direct from the cranks to the driving wheels by means of an improved and patented endless chain. A special feature of the "Sherwood Forester" Tricycle is the makers' new patented automatic double driving clutch fixed in the chain wheels on each end of the crank axle. The patent double driving clutch is entirely self-acting, and instantaneous, and no obstacles, irregularities of road, or ground resistance will relieve it, whilst it instantly relieves itself on taking pressure off the treadles, and in turning circles of any size. By the use of this patent double driving clutch the pedals instantly form foot rests by simply ceasing to move the cranks, and allowing the two driving wheels to run on of themselves. It will be thus seen that no power of the rider is wasted; as when the going is easy, the machine may be propelled by intermittent strokes, and the pedals between the strokes form most comfortable foot rests. A new pattern double band brake fitted and applied in the most complete manner entirely removes all objections to brakes acting on the hubs. It can be adjusted perfectly, and by the simple motion of one hand-lever, a powerful brake is applied in the same instant on each driving wheel.

Black Ink.—Peltz in *Pharm. Zeitschr. f. Russl.*, recommends the following for making a good ink:

	Parts.
Extract of logwood	100
Lime-water	800
Carbolic acid	3
Common hydrochloric acid	25
Distilled water	600
Gum arabic	30
Bichromate of potassium	3
Distilled water enough to make	1800

Dissolve the extract in the lime-water, in a porcelain or well-enamelled iron vessel, over a steam-bath, with frequent stirring. Add the carbolic and hydrochloric acids, which change the solution from a red to a brownish yellow colour. After half an hour's heating over the steam-bath, set the mixture aside until cold, then strain or filter. Now add the bichromate of potassium and the gum, each separately dissolved in a considerable quantity of distilled water, and finally add enough water to make 1800 parts. This ink is a fine red colour which quickly turns black. It does not corrode steel pens, and, if it dries up, needs only the addition of water.

LETTERS TO THE EDITOR.

[*We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.*]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

"I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
—*Montaigne's Essays.*

BROMPTON AND THE PATENT OFFICE—RAILWAY SIGNALLING—ACKNOWLEDGMENT OF QUOTATIONS—THE LATE PROFESSOR JEVONS—TELESCOPIC APERTURE AND SEPARATING POWER—TABLES OF SPECTRA—STEINHEIL'S ACHROMATIC EYEPIECES.

[20405.]—Readers of the Parliamentary Reports will have noted how, on the evening of the 10th instant, Mr. Hinde Palmer put a question in the House with reference to the Patent Museum. That the present building is crowded to an extent which renders the examination of any special portion of its contents inconvenient in the highest degree is too notorious to need any insisting on here; and the honourable Member for Lincoln not unnaturally urged that the time had at last arrived for the redemption of a promise made by Sir Austen Layard (when, years ago, as Mr. Layard, he was First Commissioner of Works) that a suitable building should be erected for the reception of a collection of such incalculable value. Mr. Palmer went on to suggest that the large quantity of waste and unused land in the neighbourhood of the Northumberland-avenue might be utilised to provide a most accessible site, and an amply commodious building for this purpose. It would seem, however, that Mr. Chamberlain has been "got at," as well as Mr. Mundella, by the Brompton Ring, for, in his reply to Mr. Palmer, the President of the Board of Trade is reported to have said that "it had been suggested that the exhibition could be best arranged if it were transferred to the Science and Art Department." Of course! To transfer the Patent Museum to the horde of leeches at South Kensington means the creation of Directorships, Curatorships, Registrarships, Keeperships, Cleaner and Deputy-Cleanerships *et id genus omne*, and other devices for adding to the offices of the clique of pluralists there, and further plundering the public in a genteel way. My admiration for Mr. Chamberlain scarcely assumes the form of idolatry; but he has always enjoyed the credit of having a very determined will of his own. Mr. Mundella, unhappily, is a mere tool in the hands of the wire-pullers at Brompton, who manipulate his strings and use him as a mere puppet. I did hope, though, that the President of the Board of Trade was not quite so easily to be imposed upon; albeit his answer on which I am commenting suggests to me the line in Phœdrus (I think it was Phœdrus) which I used to construe as a small boy: "Delusa ne spes ad querelam recidat."

Mr. Stooke (letter 20367, p. 523) must forgive me if I demur to his description of my comment on his system of signalling as "hypercriticism." Reverting to his original letter (20267, p. 427), I find that *Clear* is signified by "Arm-in-arm position between 45° and 85°," and that "From 5° to 45° is to be treated as a 'Doubtful signal,' and worked on as 'Danger.'" Now my contention was—and is—that an angle of 44° (*Danger*) sufficiently resembles one of 46° (*Clear*) as seen from a distance, on a rapidly moving engine, to render discrimination between them, in the last degree doubtful; and I can quite conceive the effect of a driver reading an angle of 44° as 46° or 47°, and so crashing merrily into the rear of a train ahead of him.

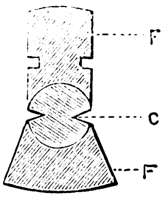
"S. G." (reply 47468, p. 529) repeats, verbatim et literatim, the answer given to the same query on p. 506, with this very important difference: that whereas "J. R. H." (in whose initials I seem to recognise those of a very eminent astronomer) tells us that he quotes from *Nature*, "S. G." leaves it to be inferred that his reply is original. For myself, I regard it as a breach of literary etiquette to extract a whole passage from any work, without the slightest acknowledgment of its origin. Very different indeed is the succeeding reply on the same page, which is so obviously the outcome of personal experience.

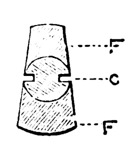
Having, on more than one occasion, expressed a very definite opinion indeed on the monomaniacal craze of the late Professor Jevons concerning sun-spots and commercial panics, I am the more anxious to give utterance to the sincere regret with which I (in common, I imagine, with all scientific men) have learned of the very great loss that English thought has sustained in his lamentable death. Mr. Jevons was, in no legitimate sense, a physicist. As, in the case of his greater predecessor, Bacon, his contributions to the establishment of a sound scientific method were of great and enduring value; although, like those of Lord Verulam, his attempts to apply such method to concrete investigations in physical science were failures. Of this no better illustration could be found than the notorious one of which I have spoken above. As a logician, however, he will leave a gap which it will be very hard to fill. He was an original and independent thinker, and his works on logic and political economy are among the most useful to the student of any extant. I can say sincerely that there are few books in my own library that I have read with more pleasure and profit than those of the great thinker whose loss will be so widely mourned.

If Mr. Gardiner (letter 20382, p. 516) will consult Airy's treatise "On the Undulatory Theory of Optics," he will find it demonstrated that if e be the radius of the aperture of a telescope in inches, the extreme diameter of a star disc in seconds to the first black ring $= 2{\cdot}76$ divided by e. That I may be mistaken in my own estimate of the present distance of the components of ζ Herculis is possible; but that a well determined law of nature suffers an absolute change in four or five hours of longitude certainly does tax my powers of belief very seriously indeed. Perhaps I may add that Dallmeyer's formula gives 1·08″ as the separating limit of a 4in. object-glass, and 0·962″ as that of a 4·5in. objective.

The book that "T. S. H." (query 47710, p. 557) requires is "An Index of Spectra, by W. M. Watts, D.Sc., with preface by Prof. Roscoe, F.R.S., with eight lithographic plates, and a chromo-lithograph, price 7s. 6d.

"Zeta" (query 47420, p. 436), asked for a diagram of the new achromatic eyepieces constructed by Steinheil. "O. V." described them in the next number, but without giving any illustration. I have, therefore, copied the accompanying diagrams from the current number of the *Journal of the Royal Microscopical Society*, in hope that they may supply "Zeta's" want. They represent two of these eyepieces (as constructed for the telescope), of $\frac{3}{4}$in. and $\frac{1}{3}$in. focus respectively. C is the crown-glass convex lens; F and F the flint-glass menisci. The grooves cut in the edges of the lenses are filled in with black cement to form diaphragms, as in the Coddington lens. The definition is stated to be exceptionally sharp and brilliant.





A Fellow of the Royal Astronomical Society.

OBSERVING-WEATHER IN NORTHUMBERLAND—ζ HERCULIS—σ CORONÆ, A. B—λ OPHIUCHI—μ DRACONIS—Σ 2215—μ^2 HERCULIS—τ OPHIUCHI—70 OPHIUCHI—73 OPHIUCHI—ε^1 AND ε^2 LYRÆ.

[20406.]—Since my last letter (Vol. XXXV., No. 900, letter 20181), the weather here for observational purposes has been of the most wretched description, there not having been one night in which the finest work could be done. It seems to me that there is little to choose between the heat of summer and the cold of winter. The atmosphere is nearly always in a state of great disturbance, the stars, when viewed through a telescope, twist and twirl, flutter and jump, wriggle and writhe, as if they had a very particular objection to being measured, and strongly resented the impertinence of terrestrial mortals in prying into their secrets. I hardly ever find them in such good humour that they will stand still to be looked at, and consequently the materials at hand for contributing to your columns information as to the doings of close and difficult binaries are somewhat scanty. However, such as they are, I will give them, hoping still for that "good time" which is always "coming."

ζ Herculis, R.A., 16·36, Mags. 3, 6·5.

My latest measures of this rapid binary are as follows:—

P = 106°·0	D = 1″·2	Ep. 1882·49
P = 101·5	D = 1·32	·55
P = 103·5	D = 1·44	·57

σ Coronæ. R.A. 16·10. Mags. A, 5; B, 6·1.

Chambers tells us that "several computers have investigated the orbit of σ Coronæ, but the results are very discordant. Whilst Jacob found a period of only 195 years, Doberck, in 1875, fixed it at 843 years. The other results are all intermediate between these." The following measures will serve for comparison:—

		°	″	
Herschel$_2$ and South	AB, P =	71·5	D = 1·44	Ep. 1822·83
Smyth	AB, P =	107 6	D = 1·3	,, 1830 76
Dawes	AB, P =	147 8	D = 1·65	,, 1840·57
Mädler	AB, P =	173·0	D = 2·23	,, 1850·70
O Σ	AB, P =	186 8	D = 2·72	,, 1860·74
Dembowski	AB, P =	196·9	D = 3·09	,, 1870 43
Perry	AB, P =	206·8	D = 3·5	,, 1882·54

λ Ophiuchi. R.A. 16·25. Mags. 4, 6·1.

Smyth says that this object is very beautiful and close, and that the measures are attended with great difficulty, except when, as H_1 expresses it, "the star will be quiet." Chambers remarks that "Mädler found the period to be 88 years, and Hind made it 95 years; but Doberck has arrived at a much higher value—viz., 233 years, and there can be no doubt that this is much nearer the mark." H_1 says that it "requires a most excellent telescope to see it well."

The following are some of the measures:—

Σ W.	P = 331°·8	D = 0″·84	Ep. 1825 51
Smyth	P = 351·2	D = 1·0	,, 1834·48
Dawes	P = 358·3	D = 1·07	,, 1840·54
Mädler	P = 12 9	D = 1·05	,, 1850·58
Σ O	P = 18·6	D = 1·35	,, 1861·63
Dembowski	P = 28·6	D = 1·51	,, 1870·45
Doberck	P = 33·5	D = 1·59	,, 1878·47
β	P = 37·7	D = 1·45	,, 1880·46
Perry	P = 37·6	D = 1·34	,, 1882 52

μ Draconis. R.A. 17·2. Mags. 5, 5·1.

A slowly moving binary, with a period said to be about 600 years, and considered by Herschel$_2$ to be a miniature of Castor.

Herschel$_1$	P = 232°·4	D = 4″·35	Ep. 1781·73
Σ	P = 205·1	D = 3·23	,, 1832·22
O Σ	P = 191·1	D = 2·82	,, 1851·74
Doberck	P = 171·0	D = 2·49	,, 1877·64
Perry	P = 165·0	D = 2·20	,, 1882·53

Σ 2215. R.A. 17·40. Mags. 5·9, 7·9.

Gledhill says that the change in angle is uncertain.

	°	″	
Σ	P = 310·6	D = 0·74	Ep. 1831·53
Dembowski	P = 304·6	D = 0·67	,, 1855·92
Spörer	P = 300·7	D = 0·70	,, 1875 54
Perry	P = 294·0	D = 0·93	,, 1882·57

μ^2 Herculis. R.A. 17·41. Mags. 9·5, 10·5.

This very rapid and interesting binary was discovered in 1856 by Alvan Clark. "In 1860," says O Σ, quoted by Gledhill, "the measures of this star presented no difficulty; but in 1873 its separation could not be effected on any but the finest nights." "Doberck," says Chambers, "finds a period of 54·2 years." The following are some of the measures:—

	°	″	
Dawes	P = 59·2	D = 1·81	Ep. 1857·50
O Σ	P = 93·7	D = 0·88	,, 1868·50
O Σ	P = 185·5	D = 0·63	,, 1873·50
β	P = 245·9	D = 0·96	,, 1880 47
Perry	P = 259·1	D = 0 79	,, 1882 58

τ Ophiuchi. R.A. 17·56. Mags. 5, 5·7.

H_1 April 28th, 1783, found it to be "the closest of all his double stars." In 1825 and 1827 Σ could not see the companion. In 1835, however, with a power of 1000, and in moments of best definition, he saw the stars separated. Hind finds the period about 120 years, and Doberck about 217 years. I find this star an easy object now.

O Σ	P = 223°·1	D = 0″·94	Ep. 1840 51
Secchi	P = 245·8	D = 1·30	,, 1860·77
Dembowski	P = 247·8	D = 1·42	,, 1870 50
Jedrzejewicz	P = 252·2	D = 1·89	,, 1880·67
Perry	P = 252·2	D = 1·34	,, 1882·52

70 *Ophiuchi*. R.A. 17·59. Mags. 4·1, 6·1

Dawes says that this is, "One of the most interesting and beautiful of the binary systems;" and there is a very fair agreement amongst computers as to its period, which seems to be somewhere between 73 and 88 years. Sir John Herschel noted that the rings round the telescopic image of this star "seem to have something peculiar about them; they are thin, and extend further than in general."

We have the following measures:—

Σ	P = 168°·4	D = 4″ 66	Ep. 1819·63
Dawes	P = 124·8	D = 6·62	,, 1840·59
Auwers	P = 107 9	D = 6·49	,, 1860·74
Doberck	P = 75·4	D = 3 03	,, 1878·54
Jedrzejewicz	P = 62 8	D = 2·74	,, 1880·65
Perry	P = 51·3	D = 2·58	,, 1882·56

73 *Ophiuchi*, R.A., 18 3. Mag. 5·7, 7·2.

The binary character of this close double star seems to be not yet fully determined, although, as Chambers points out, there is evidently a diminution in both angle and distance, as the following measures will show:—

Σ	P = 259°·7	D = 1″·54	Ep. 1831·05
Mädler	P = 252 8	D = 1·17	,, 1861·89
Doberck	P = 250 0	D = 1·03	,, 1876 61
Perry	P = 247 0	D = 1·03	,, 1882·61

ε^1 Lyræ. R.A. 18·40. Mags. 4·6, 6·3.

This, with the following pair, form the celebrated "double-double," the separation of which with the naked eye, is a remarkable and somewhat unusual feat. Webb, in his charming and most useful "Celestial Objects," says there is "little doubt of the rotation of each pair; ε^1 perhaps in about 2,000 years, ε^2 in half that time; and possibly both pairs round their common centre of gravity is something less than a million years." We have the following measures:—

Herschel$_1$	P = 33°·9	D = 3″·44	Ep. 1779·83
O Σ	P = 22·5	D = 3·52	,, 1840·74
Doberck	P = 16·3	D = 3·04	,, 1878·56
Perry	P = 17 0	D = 3·62	,, 1882·60

ε^2 Lyræ. R.A. 18·40. Mags. 4·9, 5·2.

Herschel$_1$	P = 173°·5	D = 3″·50	Ep. 1779·83
O Σ	P = 151·1	D = 2·73	,, 1840 83
Doberck	P = 139·1	D = 2·24	,, 1878·56
Perry	P = 131·5	D = 2·69	,, 1882·60

I shall be very happy to look up the stars mentioned by your valued correspondent, Mr. Herbert Sadler, when an opportunity occurs of dealing with them successfully.

The above measures were made with the 18¼in. Calver reflector.

Jevon J. Muschamp Perry.

St. Paul's Vicarage Observatory, Alnwick.

MARKINGS ON JUPITER.

[20407.]—Another observation of the red spot on Jupiter was obtained on August 19th, the *p.* end being on the C. M. at 16h. 20m., and the centre at 16h. 47m. The spot was very well defined, with power 186 on my 5¼in. Calver, and but little fainter than last year. A delicate streak extended from the *p.* end for some distance south preceding; but otherwise it appeared perfectly regular. In letter 20380, p. 546, Mr. W. F. Denning both delineates and refers to the narrow streak seen following the red spot last year as being continuous now with the south equatorial belt; but on August 19th, it was just possible, though with very great difficulty, to separate this streak. It has, however, increased immensely in size and prominence. On the same night, a spot was seen similar to the new one, figured on p. 546, in the northern hemisphere, and in the same position. It was much shorter than this spot, not being much more than half as long as the red spot. It was noted on the centre at 13h. 55m.

The south equatorial dark belt is now in an extremely interesting condition, numerous dark patches and spots being visible. One of these, of unusual size and darkness, and very well defined, was observed on the C. M. as under:—

August 19th	....	14h. 28m., *p.* end.
,,	....	14h. 43m., centre.
,,	....	14h. 58·5m., *f.* end.

A fainter spot of the same kind was visible a little *p.* the *p.* end of the red spot. It projected a little way south of the belt, and formed, with the dark streak following, a shallow bay, which conformed to the curve of the north edge of the red spot. This patch was noted central at 15h. 55m.

A. Stanley Williams.

Brighton, August 19.

P.S.—In letter 20360, p. 520, I stated that the white equatorial spot was on the centre on August 5th at 15h. 35m. This observation, however, really refers to another spot, very similar in appearance, a little following.—A. S. W.

ζ HERCULIS—4·56in. / APERTURE.

[20408.]—In justice to myself allow me to say that I did not supply the eyepieces Mr. Gardiner, of Newburgh, N.Y., refers to in letter 20382. Had I been allowed to do so, my own eyepieces would have done every justice to a really fine object-glass.

W. Wray.

Laurel House, North-hill, Highgate, Aug. 18.

HOW TO MAKE A FLAT FOR A NEWTONIAN REFLECTOR.

[20409.]—As by some mistake on my part or the printer's, the sketches did not appear in letter 20370, I have sent others. I also wish to correct another error of my own or the printer's, occuring in the 12th line from top, of letter 20370. This should read, "For if the discs are slipped (or slid) together, there is a chance of scratching." The dotted lines in Fig. 1. show the sections of major axis when edged. As this will conclude my letters on this subject, I will here say that I shall be glad to answer any questions concerning the matter that may crop up.

FIG. 1.

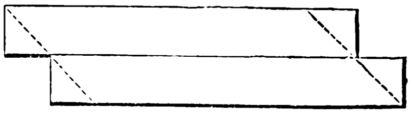
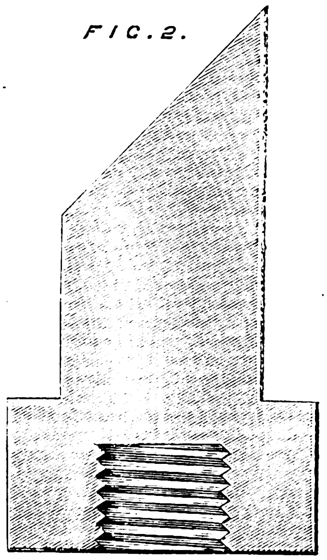


FIG. 2.



Prismatique.

FOCAL IMAGES, CASSEGRAIN TELESCOPES, &c.—TO "F.R.A.S.," "ORDERIC VITAL," "W. G. P."

[20410.]—May I ask "F.R.A.S." to kindly turn to his letter of May 19th last, in which he gave me what I had not before seen—a rule for the diameter of star disc, and supplement the rule by informing me what is the lowest power per inch of object-glass that is necessary to raise a disc on a star. "Old Kitchener" refers to the point, but his remarks are not very accordant *inter se*. The answer which "F.R.A.S." favoured me with was not really a reply to my original query (addressed to "Orderic Vital," and by him referred to "F.R.A.S."), and as, so far, no reply has appeared, I venture to re-state the question, or rather questions.

The first is this: With a given lens of known focus (and aperture?) what will be the diameter of the light-spot as received on a card at the focus of such lens. As regards the insertion of "aperture" in the query, a letter of mine on p. 156, April 21st, will explain why I do so.

The other question refers to the effect on the rays of light of the length of focus in a lens or mirror.

Let there be two lenses of the same diameter, but one of them having twice the focal length of the other, and let them be so placed that their foci are on the two sides of a photometer screen, what will be the proportionate illumination of one to the other when thus measured? For the Cassegrain telescope, I will (in order to save engraving a fresh block), ask your correspondents above referred to to insert in the diagram on page 217, May 12th, a small x between E and F, and a large X behind the concave mirror to the left of D, both letters referring to points on the axial line D H. Then let the bent line, D C E, turn about the point C till C E passes through x, then we may assume that C D produced will pass through X. This gives a geometrical method of finding what alteration in the focus of the small mirror will throw back the point D at vertex of large mirror to any given point X behind it, since x and X will be the conjugate foci of the new mirror, just as E and D are the conjugate foci of the original one, and F x will be the required focus. In this case the distance apart of the mirrors remains unaltered, but I do not quite see how to throw back D to X by any rule which allows the distance apart to be varied, but retains the same focus for the mirrors. Can a *rule* be given for this, which is the *practical* state of the case, the point D being always in reality considerably behind the vertex of the large mirror. Also for the Gregorian. Lens.

TESTING MIRRORS, &c.

[20411.] It appears from our private correspondence that the method of zone-testing occurred independently to both Mr. Wassell and myself, and I need hardly therefore say that I have been reading up the back numbers since my return with special interest in Mr. W.'s articles. I would now like to explain that I fancy some such method was used by Short, and for this reason. I have an old Gregorian made by him, in which the sliding block, which carries the small mirror, is graduated to serve as the vernier of a fixed scale attached to the body-tube, the graduation being such as to read to 1-200 (one two-hundredth) of an inch. It is the only instance which I have seen, or heard of, in which such an attachment occurs. Unfortunately, the mirror has been rendered practically useless by amateur attempts at refiguring it, or it would have been interesting to subject it to careful testing. There is one point in connection with this question, zone-testing, which I hope Mr. Wassall will not omit to notice, as I think it is not an uncommon difficulty in obtaining a good figure. In all the descriptions or sketches of the "rings" and "mounts," these are shown as symmetrical and concentric, but in certain cases a kind of "lop-sidedness" (if I may use such a term) seems to occur; in fact, the axis of the mirror is not at its centre, and is also out of square with the chord of the curve. If such a curve were accurate and producible at pleasure, I presume it would be exactly suitable for a Herschelian telescope; but as it is practically neither one thing nor the other it can only be looked on as a very bad Newtonian mirror.

In running over the different letters I see some correspondence has taken place about eyepieces, but I have not noticed any reference to the fact (?) that the Huyghenian is in one respect less fitted for reflectors. There is in this form of eyepiece, with the lenses proportioned as usual, a power of correcting to a certain degree, the spherical and chromatic aberrations of an object-glass or microscope objective, but since with the reflector the image is colourless, what is in other respects an advantage must become a defect. What says our friend, "O. V."?

A. S. L.

FAURE'S ACCUMULATORS.

[20412.]—If "Caloric" (p. 549) had looked on the opposite page to that from which he quotes the statement about 24 Swan lamps being worked by 24 Faure accumulators, he would have found a wise Frenchman saying, "I would have everyone write what he knows, and as much as he knows, and no more," and a further perusal might have induced him to cross out that passage from his letter in which he says, "It is a pity that people write about what they know little about, causing such absurd and misleading statements to be made." That is a dreadfully stale platitude, but it looks simply awful in "Caloric's" letter, which is as beautiful a specimen of the genus mare's-nest as has been recently seen. "Caloric" has actually been to the office of the Faure Accumulator Company, and learnt from the obliging attendant that one Swan lamp requires four accumulators, and thereupon he jumps to the conclusion that your correspondent "E.," who has contributed some really valuable notes on dynamos, "knows nothing about it." Go to, "Caloric"; return to the obliging attendant, and ask him what sort of a Swan lamp he meant that requires only four accumulators to work it. Then let him refer to Mr. Swan's Royal Institution lecture, and read, "When I pass through the filament one unit of current, light equal to two candles is produced. If now I increase the current by one-half, making it one unit and a half, the limit is increased to thirty candles." Having digested that, "Caloric" may multiply 24 accumulators by two volts, and he will find the E.M.F. comes out as 48 volts, and as the E.M.F. required for a Swan lamp is 45 volts, he will find that the French watchmaker knows just as much and no more than the correspondent "Caloric" has criticised, without knowing anything about it. Presumably, "Caloric" is the same gentleman who, on p. 556, has carefully examined the "Lampe Soleil," and has arrived at the conclusion that "it is not approached by any other form of arc light." Verily "It is a pity that people write about what they know [nothing] about." What amount of energy is expended over that solitary Lampe-Soleil, which has produced so valuable a testimonial from so high an authority? Does "Caloric" know, and has he ever seen more than one Lampe-Soleil in his life? Finally, why does he not study his English Mechanic, and learn what E.M.F. really means? **Calorimeter.**

[20413.]—"Caloric" (letter 20394) gives three statements, gathered from different sources, which appear to him contradictory. As a matter of fact all three are true. A 16-candle Swan lamp has a resistance of about 40 ohms! and since we require over 1 ampère current, the minimum number of Faure cells is about 24 or 26. If this number of cells be obtained, provided they are large and thus do not offer any great resistance, we may light 24 or even more lamps with the same number. As to the statement of the Faure Co. attendant, he no doubt referred to a small 2 or 5-candle lamp. The small 2-candle Swan can be worked with 2 or 3 Faure cells, so that 4 would do it well.

"Caloric" would do well to inquire more closely into facts before stating that "E." "knows nothing about it." **Ll.B.A.**

[20414.]—With reference to my remarks on the above in "Notes on Dynamo-Machines," "Caloric" has ventured to express an opinion that I am ignorant of the subject, and his conclusion is based on two facts. 1st. A watchmaker in Paris lights his shop with 24 Swan lamps worked with 24 accumulators. 2nd. On page 523, I write: "The E.M.F. of a Faure accumulator is 2 volts, and the E.M.F. required for a Swan lamp is 45 volts." I have observed sundry good-natured criticisms of my Notes from time to time, and have taken no notice; but there is a limit to human endurance, and that limit is reached when one sees a man strutting through the columns of a scientific journal evidently under the impression that he is writing jokes for a weekly comic. I say emphatically that a Swan lamp of the ordinary construction will not give 20 candles with an E.M.F. of 45 volts. I have also to remark that I did not fit up the lamp in the watchmaker's shop at Paris; it is consequently not my business if he does not work his lamps up to their full power. It is easy to calculate the E.M.F. at the terminals of his lamps. E.M.F. of each accumulator 2 volts; resistance ·01ohm; number of accumulators 24. Resistance of each lamp 33·6 ohms; number of lamps, 24. If V = E.M.F. at terminals of lamps, then

$$\frac{2 \times 24}{V} = \frac{\frac{33{\cdot}6}{24} + {\cdot}01 \times 24}{\frac{33{\cdot}6}{24}}$$

$$1{\cdot}4\,V + {\cdot}24\,V = 67{\cdot}2$$

$$1{\cdot}64\,V = 67{\cdot}2$$

$$V = \frac{67{\cdot}2}{1{\cdot}64} = 41 \text{ volts nearly.}$$

Does "Caloric" suppose that reducing the E.M.F. at the terminals of the lamp causes it to strike on the spot and refuse to give a light, or is he aware that decreased E.M.F. simply means diminished light? The obliging attendant to whom "Caloric" refers certainly did not mean a Swan lamp, as understood in the ordinary sense by electrical engineers. The Swan lamp is a well-known standard lamp employed to give an illuminating power of 16 to 20 candles, and if "Caloric" will read over the paragraph of mine with which he finds fault, he will see that I specially mention lamps lately constructed of small candle-power to light with six volts—i.e., three accumulators. The attendant evidently had one of these in his mind. I have no intention to be hard on a critic whose knowledge is of schoolboy order. It is really very kind of "Caloric" to furbish up a newspaper report, and interview the attendant at Faure's for the purpose of administering an antidote to readers of the "E.M." who may have been unfortunate enough to come under the baneful influence of my pernicious writing; but attendants are not *generally* considered scientific authorities, and newspaper reports are not *wholly* reliable. It may be true that four accumulators will light a small Swan lamp, although not the ordinary Swan lamp; it may be a truthful report about the Paris watchmaker; it is certainly a fact that a 20-candle Swan lamp requires at the least 45 volts, while it is abundantly manifest and beyond the shadow of a doubt that "Caloric" is profoundly ignorant of the very foundation of the subject, and glad to pin his faith to Faure's attendant or anything else. Had "Caloric" asked civilly for the explanation of a seeming paradox, one might have been disposed to clear away the mists for him; but that *he*, knowing nothing whatever of the matter—as shown by his letter—should step to the front with all the dignity of a savant, and tell another correspondent that he knows nothing of what he is writing, only shows that his ignorance is equalled by his unapproachable presumption. Alas! fools rush in where angels fear to tread. **E.**

SMALL DYNAMOS.

[20415.]—Will you permit me to join with Mr. Lancaster in warning amateurs and others from laying out money in small dynamos, persuaded by the extremely low price charged? There is no commercially valid reason why a maker of a really good machine should be satisfied with the cost of the materials used, and charge nothing for designing, mounting, &c. A few years ago a series of articles appeared in these columns, written with great authority, giving amateurs advice and instructions how to build small dynamos. I do not know whether any were ever built; but the writer simultaneously advertised that he made dynamos for industrial purposes. I was foolish enough to order and pay for one—£25 was the cost; but in repairs, fares for sending to and from Scotland, telegrams, &c., it stands in between £30 and £40. It never did any work, is a monster in ugliness, and a paragon of bad finish. It will not realise £5, if I was going to sell it. Such was my experience of cheap dynamos; let others take warning.

I built a machine myself, partly according to the instructions published, partly after own observations. It never did so much work as any other dynamo with the same weight of iron and copper wire. But it did afford me great instruction, and as a commercial concern has earned its cost ten times over, and will turn out many hundred pounds' worth of good work. For general work I have bought one of Elmore's splendid machines, which is all any man can desire.

As I have built a dynamo which does, and has done, useful work for more than nine months, I think I am right in saying that small laboratory machines can be made—in fact, both Weston and Elmore make such—but I should think magneto machines would be the handiest where power is not available. A machine for supplying one small arc or a few incandescent lamps need not be either large or expensive, and with the excellent opportunity we had in the Crystal Palace of examining machines, combined with the articles in *Engineering* and elsewhere, I think that any amateur with some knowledge of electricity might construct a machine that will suit him. Any one who does not knows the laws of electricity I would strongly advise to master these first before building a dynamo. **Anglo-Dane.**

[20416.]—To show that I believe I can satisfy all as to the strict veracity of my statements, I will notice a few of Mr. Lancaster's otherwise welcome criticisms on my letter. First, then, he is informed that the speed (in my note) for four to six ten-candle lamps was 2,000 revolutions per minute, not 1,700, and this was done by *one* man for a little over that space of time. It is not to be supposed that a man could exert all his strength like this for many minutes, but he could certainly do so for this short time. But what is the question at issue? What I spoke of was a small dynamo, and not by any means limiting it to the power of one man: especially when trying, as I did, to get the best possible results out of the machine. I think if it took half-horse power to work it, the results obtained are very favourable. The quarter-horse that I judged was put into the machine was when it was going at the rate of 4,000 revolutions per minute. The engine I worked it by was very powerful, and it was extremely hard to tell the exact amount of power used. However, I have nearly got a half-horse power engine finished, and I expect this will drive my machine very easily.

I cannot understand how a quarter horse-power is four times that of a man, for I have always been under the impression that one horse-power was equal to eight men. This is what some gas-engine makers take, and what I intended our readers to understand. Then the case stands thus:—One man (for short time) five ten-candle power lights at 2,000 revs., $\frac{1}{4}$ horse-power (two men) four five-candle power, two ten-candle power, and six twenty-candle power (half-lighted) at 4,000 revs.

I need scarcely add that it was straining the machine to run it at 4,000 revolutions, but I did so to *get all I could out of it*. For continuous running, of course, these results would be lessened 30 or 40 per cent., but for short experiments all I have said could be got out of the machine.

I think it would have been far better for me to have waited until I could give in proper language the power of the machine; but I really could not let such an attack on my veracity go by unnoticed.

To show that I feel certain my results are as near as possible correct, I make the offer to Mr. Lancaster, as I have already to another gentleman, to give him every facility in my power for testing the machine, and I shall be glad for him to report on it himself.

I must add, before closing, the best results when driving by hand-power were obtained by separately exciting the field-magnets with a bichromate cell, but when using steam I did not use that.

I must add, too, that I am in no way connected with the makers of this machine; but I am with a company supplying largely Swan lamps, so that I know their power when I see it.

I am sorry I cannot give my own name, but solely on business grounds I must again subscribe myself **Tried.**

SMALL DYNAMOS.

[20417.]—As Mr. Lancaster (20403) has taken upon himself to say that "Tried" (29394) states "what must be absolutely false," I feel it my duty to corroborate "Tried's" statements. I presume that the machine "Tried" referred to is Mr. Patrick's; if so, I may state that I also went to his shop and asked to see the capabilities of his machine; but, as it happened, he only had four 10-candle incandescent lamps in the shop, and it was found that when the machine was driven from the foot-lathe there was not sufficient resistance in the lamps for them to give their full light; but after introducing a piece of thin iron wire, about 1ft. long, between the terminals of the machine, which I imagine would be equal to about two lamps (making up the six) it was found that with a little of my assistance with the treadle of the lathe, they gave, as "Tried" states, as much light as they should. **Fred. W. Ball.**

Queen's-road, Battersea.

[20418.]—I was very much pleased to see the letter of "Tried" in the "E.M." of Aug. 4, clearing up a lot of doubts concerning small dynamos, upon which so much cold water has been thrown.

Amateurs desiring to construct small dynamos have not known what to do in the matter, as one person in one number of the "E.M." would say it was useless to make such a machine, and in perhaps the very next number another person would say the contrary.

I think "Tried" would oblige others besides myself if he would state what kind of armature the machine has, and if Siemens', whether the cylindrical or H girder.

I have an idea that I could drive a small dynamo by means of a small water-motor, No. 3 Empress for instance, which runs 1,500 revolutions per minute, as we have here a pressure of 90lb. per square inch. If in this idea I am mistaken, I shall be very glad to be told so. **W. L.**

VOSS' ELECTRICAL MACHINE.

[20419.]—In damp and rainy weather it is often found that this machine requires a small initial charge of electricity to start it into action. This may be supplied, I find, in the following simple manner:—Take a small camel-hair brush, costing a penny; hold it lightly against the revolving plate; the slight friction thus produced will almost instantly give the needful charge. The sparks, too, may be increased both in length and frequency by another simple device. Take a piece of wire, say No. 20, and 6in. long; sharpen one end and bend the other into a hook; insert the pointed end into a cork, previously fastened on the top of the vertical comb; bend the wire forward till the hooked end projects over the two knobs of the conductors. From this hook suspend a worsted thread, or one of thick cotton, long enough to reach to the base board nearly. Now, on turning the crank-handle and withdrawing the knobs of the conductors the sparks will be found to come faster and grow longer through the influence of this simple thread which wriggles about in a curious and life-like manner. Another device I have adopted is this: To the base-board, near the front edge, I have fixed two binding posts—one near to and in connection with one condenser, and the other near to and in connection with the other condenser. To these posts may be attached two chains, one to each. On laying the chains on the table in two heaps—say, an inch apart—and then separating the two conductor-knobs to the same distance, two bright sparks will be produced simultaneously—one between the knobs, and the other between the chains. Vacuum tubes, laid on the table between the chains, will be bautifully lit up, and shocks can be taken from the chains in various ways. If one chain be laid, say, over one shoulder, and the other chain over the other, the shocks will be felt smartly through the clothes; the strength of which can be regulated to the greatest nicety by increasing or decreasing the distance between the knobs of the conductors.

I consider the machine a most interesting and beautiful invention; for by its means, Static Electricity may be produced at any time, in large or small quantities, for charging Leyden batteries, lighting up vacuum tubes, giving shocks, &c., &c. It is always ready—no amalgam or other preparation being required; the mere turning of a small crank handle, which may be done by a child three years old, is all the power required to develop copious streams of electricity. I am surprised so little has appeared in your valuable paper on this *the best* of electrical machines.

August 21. **John C. Frank.**

STRAIGHTENING CROOKED CASTINGS.

[20420.]—Thomas D. West, whose article you have reproduced from the *American Machinist*, is incorrect in many things, according to my judgment. He says truly, that the foreman of a foundry is puzzled to tell how a casting will go, when looking at a complicated pattern for the first time; and in order to keep it straight the great question is, how so to manage that all parts will cool equally. T. D. W. says "There are two reasons for castings warping. The first is ill-proportioned thickness, the second the allowing of some parts to cool before the others." This is very misleading; for what he states as the first reason is only the cause of the second, and so there is only one reason—viz., *one part cooling before the others*. Again, he says, "When the thickness of metal in a column is not equal, the thin side will cool first, and draw the thick side towards it, thereby making the thin side of the column concave and the thick side convex." The very opposite of this is the result of an unequal column; the *concave side* is the *thick side*, the cause being that the thin side in cooling becomes rigid, while the thick side being still plastic, and subject to compression, is, therefore, not liable to bend by the contraction of the thin side; and after *that* contraction is passed, the thick side has *its* shrinkage to undergo, and that force acting like a bow-string, draws the ends of the casting nearer to each other on that side, and *it* therefore becomes *concave*.

T. D. W. seems to me to be more of a practical man than a theorist. He says: "*Cool the thick parts and keep the thin parts hot* is about all that can be said as regards keeping ill-proportioned castings straight." This is correct. He further says: "Try to keep all parts of the same temperature, so that their contraction will be equal." He should have added *as to time*, as contraction in all parts of a casting (thick and thin) is alike in amount, not as T. D. W. has it, *i.e.*, "a thin body of iron will contract more in cooling than a thick body."

Again, he says, "Often moulders will . . . shovel the sand from the top in the middle of a casting, in order to keep the ends of it from coming up. This is wrong; for by cooling the middle on the top side this part is contracted quicker than the under side, which will naturally cause the ends to come up." I say this will not be the case if cooling is done early enough—all along the top side—for the under side being still plastic will compress by the action of the cooling side, therefore will not be affected from the straight, and, when the under side comes to contract, *it* will act like a bowstring and draw the *ends down*—just the reverse of what T. D. W. states. Again, "The part that cools first will generally keep the casting in the shape it was bent when hot." No, it won't; the part that is cold is rigid, while the part that is warm has still to shrink a bit, and will either cause bending or break *itself* in cooling down.

At the close of his article, T. D. W. gives an instance of gates and runners drawing a casting crooked, "The casting of a small toothed rack was run from a runner parallel with it, by a series of sprues entering the rack mould from the runner at equal distances all along, and when the casting was taken from the sand, it was bent sideways, *concave side next runners*. This," he says, "was caused by the runner being lighter than the casting, and in cooling and contracting quickest it drew the casting crooked. To remedy this runners were made on both sides, &c." This is another instance of T. D. W.'s practice being correct, but of his theory being fallacious; having a runner on both sides was right, but the cause he assigns for the casting being crooked the first time—with the runner on one side—is most certainly wrong. The side of the casting next the runner being concave shows that the runner must have been plastic while the casting was cooling, and the runner having its shrinkage to undergo afterwards, acted as a bow-string along that side of the casting and drew the ends towards it. **Patternmaker.**

Bonnybridge, August 16th, 1882.

BREAD.

[20421.]—Some time ago, I inquired through your columns why English bread was so wretchedly underbaked. I elicited no satisfactory reply. I have now found out the reason. A baker frankly avowed to me to-day that it would *not pay* to bake bread thoroughly, on account of the attendant loss of weight. It appears, therefore, that the less you bake the bread the better for the baker,—but the worse for the stomach, I fancy. For my part, I would rather pay more and get bread that can be assimilated. **Disgusted Foreigner.**

SCREW PROPELLERS.

[20422.]—The arrangement described by "C. T. E." on p. 551, letter 20402, does not appear to me to possess any theoretical advantage as a mode of propulsion over the paddle or screw methods. If the plate be supposed to be parallel to the vessel's side when first put in motion, a considerable part of the stroke, and that also being the part where the plate offers the greatest resistance to motion, will be comparatively ineffective to drive the vessel forwards, the greatest effect being only attained towards the end of the stroke, one of the great advantages possessed by the screw being, I conceive, that it keeps up a continuous as well as a uniform thrust forward. It would be fatal to the speed of any vessel to have four rods sufficiently strong enough to work such a pair of "fins," projecting from the sides at right angles to the line of motion; then there would be the complication of stuffing boxes, as well as several additional joints necessary to connect the fin to the two rods, which I presume are to slide in and out parallel to each other.

Moral.—This plan is much more complicated in its arrangements than a screw propeller; possesses no advantage in theory over that means of propulsion, and won't do. **J. J. A. (Liverpool).**

STONEHENGE AND SUN-WORSHIP.

[20423.]—If "Neo" can come across a book entitled "The Druidical Temples of the County of Wilts," by the Rev. E. Duke, M.A., &c., 1846, he will find some interesting chapters on Stonehenge and other stone circles.

A Would-be Piper.

RAILWAY SIGNALS.

[20424.]—My patent automatic apparatus is a mechanical contrivance placed at, or near, the signal itself, being capable of various modifications. A straight or segmental bar of novel construction, slotted at one end, is actuated from the signal-box by means of the usual interlocking lever, and a latch passing along the bar by means of the slot, is in connection with the signal. When this latch is in position, with the shoulder on the bar, the signal can be taken off by the signalman, or kept on, as per requirement; but should the signal be off, the train on passing the mechanism releases the latch from its point of detention, and the weighted arm in connection with the signal places it in the danger position. Electrical contact apparatus may be applied in various ways, and it is not unfrequently that the distant signal is taken off after the train has run within it, in consequence of the same not being seen from the signal-box.

I desire to retain the signal at danger until the train has cleared the section; but I do not interfere with any systems now in use.

Hackney. **J. Harrison.**

[20425.]—I ought to be much obliged to those correspondents who have kindly noticed my suggestion *re* railway signals; but owing, I suppose, to the heat or the holiday season, they have scarcely paid me the compliment of understanding what I meant. Perhaps, however, I did not make matters clear. One gentleman (p. 523) does not see "any advantages," and thinks a semaphore much better than a disc, by which I learn for the first time that I have suggested a disc instead of a semaphore. Another (p. 548) says the suggested alteration is a "mechanical disadvantage"—which is extraordinary, too, considering that the alteration is only in the meaning to be attributed to a signal, let that signal be what it may. This gentleman, having set up the skittle, proceeds to knock it down in a variety of ways until at last he is satisfied that it is really down. Probably twenty years' hence the mechanical disadvantages of the present signalling arrangements will be generally recognised as out of place in these times, but until then I can agree with "Tittesworth," that "both for the sake of uniformity and clearness an angle of 45° for a 'go-ahead' signal would be the best to adopt universally." The chairman of the London and North-Western (p. 548), commenting on my assertion that by the present system a driver proceeds unless obstructed, says "so he would if the system was changed as proposed." On the contrary, I put it the other way, and say the driver would be perpetually "obstructed" except when he had a positive signal to come on. Mr. Moon says the "all-right is a positive order to come on," and Mr. Stooke says "we *do* give a positive signal to come on," both statements being positive enough. But if it really is so, permit me to ask what was Mr. Stooke's original question, accompanied by a beautiful little engraving (p. 427)? It seemed to me, so far from being a positive signal, that "when we come to examine the arms at different places, we find many different angles are shown for what is intended to be the same signal"—and drivers are occasionally in doubt as to whether the signal is "off" or "on." Mr. Stooke is the only correspondent who has really begun a reply to my letter, and he gives no argument, but simply says "we want a conspicuous signal for danger, and to obtain such we must keep the arm in a horizontal position." Allow me to ask why? Why should any signal at all be wanted to block the line? I grant that circumstances may arise when a danger signal is necessary, but that should be of so special a character that no mistake could possibly be made, like the fearful blunder at Canonbury. But for all ordinary purposes, the *absence* of the signal "line clear," should, could, and would indicate "danger," which should be considered the normal condition of any railway. What is done at present? A driver starts by a signal which gives him permission to go, and he runs on, passing the signals one by one until he finds one against him; then he pulls up if he can. If it should have been put on suddenly, the margin of safety is, as Sir H. Tyler put it, the "thickness of a signal-post." What is the objection to taking a bare pole as a stop signal? or, to put it the other way, what is the objection to making a rule that an engine should be in motion only when the signal in front ordered the driver to come on? If the present arrangements of semaphores and posts are retained, there will be no questions of angles, for when the line is not clear the semaphores will be within the post, and the signal to come on will be given by putting the semaphore at whatever angle may be found most convenient. There will, certainly, be no necessity to make it 90°. The drivers will thus, technically, be perpetually "obstructed," and will proceed only when a signal is given to do so. I should like to hear what objections the drivers have to the suggestion. I think they will see that there is nothing very puzzling in the change. **Nun. Dor.**

[20426.]—Mr. Stooke, 20367, p. 523, says, "There is not likely to be any confusion or misunderstanding of any kind whatever, if a rule of strict uniformity is established, never mind what the angles determined on may be." This sentence requires a modification, and certain conditions must be fulfilled before it is said to be true. In the first place it implies that the driver is capable of estimating the angle made between the signal and the post to the utmost *nicety* (which, by the way, is a qualification Mr. Stooke does not expect), or he will cause great confusion. According to Mr Stooke's arrangement, 20267, the angles from 45° to 85° are allowed as clear; but immediately the arm falls to 86° it must be treated as danger. I am inclined to think that there are very few drivers who are capable of distinguishing in this case between the clear signal and the one for danger. In fact, we may venture to state that there is not one driver in a dozen who, at a hundred yards' distance, could estimate such a nicety, let alone when he is on the engine and travelling at the rate of 40 to 50 miles an hour. The same objection applies to the doubtful signal, because from 5° to 45° has to be treated as danger; but should the arm indicate 46°, then, according to the rule, it is strictly clear. Secondly, the angles determined upon must be such that one cannot be taken for another.

Although Mr. Stooke cannot agree to the angles suggested in letter 20296, we do not see but what they can be made to fulfil the conditions which he requires. For instance, suppose, as suggested in letter 20296, the danger signal be from zero to 30°, and the first fall of the arm be to 15°, then there is a margin of 15° to allow for wear and tear of axles and axle bearings, and also expansion before it reaches the clear signal. The same principle applies all through; but, of course, if the suggestion is barren, let it pass as such. It was tendered in response to the following sentence: 20267, "If anyone disapproves of these angles will he be so good as to say so, as by doing this assistance will be rendered in settling a somewhat important question?"

A. Manock.

WAGGON COUPLINGS AND RAILWAY ACCIDENTS.

[20427.]—A large number of the needless casualties which occur to railway servants are directly due to the use of chain or link couplings now universally used on railway trucks and waggons. The operation of "coupling" and "uncoupling" with the present appliances necessitates that the operator should place himself in a position of personal risk, and it will readily be seen that the risk should, if possible, be obviated. In the five years ending 1880, no fewer than 206 railway servants were killed outright, and 1,614 others lost limbs, were crushed, or otherwise injured, whilst engaged in coupling or uncoupling trucks and waggons. I estimate that from 12,000 to 14,000 men represent the total of those whose regular duty it is to marshal and distribute trains; and it is amongst this number that the foregoing casualties occurred. After making every allowance for incautiousness on the part of workmen, the list of killed and wounded deserves serious consideration from those responsible for the continued use of an appliance in great part the cause of so much human destruction.

In consequence of a communication from the Amalgamated Society of Railway Servants, the Board of Trade, in February last, addressed a circular to the railway companies calling their serious attention to the matter, and asking for suggestions calculated to obviate the constant risk now incurred under the present system of coupling waggons. I do not know what effect the circular has had, but there are no apparent signs of improvement.

A great many improved waggon couplings have been invented, and not a few have, by practical tests, proved efficient. All those I have seen or read of, provided, 1st, against personal risks to the operator, by enabling him to manipulate them without going between the waggons; and 2nd, for greater despatch in forming and distributing the component parts of a train. In a word, they aim at greater safety and economy in time. Hitherto, however, no company has adopted an improved coupling. The objections urged are the cost involved and the desirability of maintaining uniformity for the convenience of through traffic. The objections prevail, and the work of death and mutilation goes on at its usual average.

In the hope of assisting in promoting the adoption of improved appliances by the spread of information, the Amalgamated Society of Railway Servants respectfully invite the proprietors of improved waggon couplings to send working models of their appliances to an exhibition to be held at the Mechanics' Institute, Darlington, on October 3rd and four following days. Arrangements will be made to explain to visitors the merits of the several exhibits, and to contrast them with the dangerous and time-wasting appliance now used on all railways. Any communication that may be addressed to me will receive prompt attention.

In the interest of my fellow workers I beg the insertion of this letter.

Fred W. Evans.
Gen. Sec. Amalgamated Society
of Railway Servants.

306, City-road, London, August 14th.

VEGETARIANISM AND SLEEPLESSNESS.

[20428.]—Having read with much interest Dr. James Edmunds' letter in your issue of the 11th inst., may I—as a vegetarian of eight years' standing—be allowed to say, with regard to the remark about vegetarians suffering from sleeplessness, that such was my experience when I first left off eating meat. I did not, however, think it necessary to abandon vegetarianism on that account, although strongly urged to do so. I attributed the sleeplessness to my brains having felt so clear and vigorous on the new diet, that I greatly overtaxed their powers at the outset.

I am working hard now, and find that dropping all study at nine, and then taking a light supper of cooked onions or celery, with a cup of cocoa, and getting, if possible, a little "turn" in the open air afterwards, are pretty sure to secure me a good night's sleep. **Spes.**

Chislehurst, 16th August.

STRING VIBRATIONS.

[20429.]—"Nur ein Geiger" says:—"I have been given to understand that a string vibrates in sections $\frac{1}{2}$, $\frac{1}{3}$, &c., of the whole length, and that this secondary vibration goes on at the same time that the string moves as a whole." Yes, this is the old formula—easy to say, difficult to prove. But let anyone take a strained string (a piece of thread will do) and they will see it does not vibrate in parts; but as a whole, forming a bow-shape, the widest part being in the middle of the string. Of course the whole string moves, but not in sections, and pulls each end in the same plane as the directions of the vibrations. This must be sufficient without any further explanation. "N." says: "A solid body touching a vibrating string produces a point of no vibration—i.e., a node." I answer that the contact, if close enough, will produce another fundamental or full tone, but if lightly applied will produce an harmonic node only at certain parts of the string, and not at any other part; in fact, there it will have no node at all, but simply a blurr. I wonder what kind of harmonic node is formed between a violin-bridge and post, and what tone it represents? Please permit an illustration, showing the directions and formation of vibrations. Take a wineglass filled with tea or dark liquor that will reflect the light, and vibrate the edge with a well-rosined violin bow. You will see a pattern formed on the surface of liquor much the same as that shown on the back of a lever watch. The circles begin at the edge furthest from the bow, and are reduplicated till they cross each other almost infinitely. Now, the edge of the glass is the centre of these vibrations, and the furthest away from the bow is the primary circle; therefore, where the sound commences is where the harmonics are produced all together; hence the harmonics are inclosed in the diameter of the vibration, and not in the length of the string, as is generally supposed. Then you say, Why are harmonics formed *on* the length of the string? Because, by lightly interfering with the vibrations, you reduce their diameter or size as springing from the middle of the string, and thus only produce a *part* of the fundamental or open tone. Why can't we form harmonics on a length of free reed? Because there is not sufficient control or weight at the free end to allow a reaction; but fix two free reeds together, *à la* violin string, and harmonics can be obtained. Sound is always produced from a centre, like light; and only in its centre can it be analysed. The sound of a string begins in its middle or centre, and from thence arise the phenomena of nodes forming part of the whole. The node of an harmonic does vibrate, as any one can feel when playing the violin, because it depends on the middle of the string. Now, granting, what is true that the soundboard and string sound together, I fail to see why a node, and so small a node, formed between bridge and soundpost, can affect the tone. Besides, such a node would be formed in so small relation to any tone or tones, that its effect would not exceed the addition of a slight harmonic. Drums can be tuned to pitch, and are, therefore, musical—side kettle-drums in some of Handel's choruses. I don't mind "N.'s" closing remarks about adding soundposts; but he can do it if he likes to his Klotz and piano or banjo; the result will be the same—very bad, indeed. I acknowledge that the new violin is in the process of perfection, and, like all other sublunary things, not perfection itself.

"N. E. G." desires less gas; so now for the daylight. He says, "I agree with 'Fiddler' in thinking the post unnecessary, if the soundboard be moved the right way." Now this is professional blarney; because it is well known that no violin other than my own has been made without a soundpost, to be any way efficient, and I tell "N. E. G." that if he tries for twenty years, on his so-called scientific and universally accepted plan, he will not succeed in making a violin without a post, worth the hearing. Take the finest Strad, remove the post, and it is worth nothing; its wood "may be cut in such a way as to give ascendency to the favoured harmony," or any other high-art style, and the effect will be *nil*. If, then, I can produce a new violin in two or three days without hurry, and without a post, for a nominal sum in shillings, that shall far surpass any other violin without a post, that cost the same in pounds, I consider the victory mine. I shall not paste old labels on my violins, or daub them with dirt, or play any other professional games; but in the daylight, and in the open, my work shall tell its own tale—please or displease whom it may. But to follow "N. E. G.'s" reasoning, where he says:—"To sum up, the soundpost acts by transmitting a certain number of vibrations to the back; an action of slight importance." Then why have any back at all? Let the transverse vibrations of the strings act on the soundboard across the grain; go the hardest way to work, and let the violin remain in its present mysterious condition another 700 years. There may be half a dozen *bonâ fide* makers of violins in England—perhaps not so many; and the reason there are so few is because of the difficulty in making a good instrument, and the high price consequent thereon. At the same time, we have it on record in these pages that a fiddle thrown together in a hurry by one of our mechanics, sounded louder than a violin made the ordinary way. **Fiddler.**

SCIENCE AT SOUTH KENSINGTON.

[20430.]—I begin to feel quite interested in Mr. Jackson's friends; so much so, that I should like to know what it is they really do. In his first letter (p. 498), he mentions four who would have been in the workshop, &c., and as he specially noted that one was a "teacher of science," and another a "science master," the conclusion seemed obvious that the other two were not science teachers. It appears now that they are all engaged in science teaching, and we will hope that the results of their labours are more gratifying than those mentioned in your article, Sir. I observe that Mr. Jackson carefully avoids the question as to the responsibility for the ignorance displayed by the candidates, which is, after all, of rather more importance than a question as to whether or not he and his friends still "teach." His example of the "medulla oblongata" question does not touch it, however absurd the answer may have appeared to him. The fact is, as your article plainly intimated, that many of the so-called teachers have crammed themselves to pass, and now, to earn the grants, cram candidates in turn; for, take the answers given on p. 463, and it is obvious that those who gave them were crassly ignorant, not to say stupid, and could only have been sent by "teachers" who hoped the papers would contain just such questions as their "students" had been coached to answer. If the teachers are not responsible, once again it may be asked, who is? It does not at all follow that, because a man enters at South Kensington, passes the examinations, and gets sent out by the department as a "teacher," that he is really qualified to teach, which is an art *sui generis*, and is not to be acquired. Given a class of fairly intelligent pupils, anyone who has passed the examinations can insure the passing of a good percentage; but to really educate the masses, born teachers are required, and it is clear that those who sent the candidate who believes that the "increase of civilisation of the British Island is rectified by the many indentations in the coast," &c., must have lost whatever faculty for teaching he once possessed. Science teachers there are, I know, who work honestly and laboriously for small pay, having a love for the labour, and an earnest desire to do their duty; but such as these never send crammed candidates to be examined, on the chance that they may pass and obtain a "science certificate."

Nun. Dor.

LEGAL REPLIES.

[20431.]—BANKRUPTCY (47686). In this extraordinary case it seems as if the bankrupt's estate had in the end realised more than the debts owing. If this be so, then the bankrupt or his personal representatives would be legally entitled to the surplus. If the querist knows who was the trustee in the matter, or if it was in the hands of the official assignee, he would certainly consult a solicitor with a view to recovering this surplus. I have known of cases where money has been obtained in much the same way after a long lapse of time.

WILL (47687).—There is no doubt whatever that a devise of houses which are mortgaged, only passes the property to the devisee, subject to the mortgage debt. In this case, therefore, and, as I presume, the will does not expressly provide for paying off the mortgage out of the personal estate; the executors are quite right. The querist takes the house and must arrange with the mortgagee, notwithstanding the curious disposition of the testator's personal property.

WINDOW LIGHT (47695).—I am afraid I cannot understand this question, which I would gladly answer upon having the facts more fully and clearly stated. But I may say that twenty years'-user is required to establish a right to a window light, under the Prescription Act; and I may add that one man has a perfect right to open windows overlooking the land of his neighbour; but, on the other hand, that neighbour has a perfect right to block them up, if he can do so, by building upon his own land, unless the right to their enjoyment has been acquired by twenty years' enjoyment or given by deed of grant.

VOID LEASE (47736).—In this case the writing being without seal or stamp is void as a lease for seven years, and it could not so be used in any Court. But as the tenant has entered and paid rent under it, he has become a yearly tenant at the rent thereby reserved. The landlord can, therefore, sue for the rent in arrear as use and occupation, and he can also give six months' notice to quit, expiring at the quarter-day at which the tenancy commenced, while he might, perhaps, bring an action for ejectment. He can, however, have no right to put a lock upon the gate, or in any other way take the law into his own hands. But I could advise much more fully if I saw the writing, which though void as a lease, may in some respects regulate the position of the parties.

TENANTS' LIABILITIES (47742).—If a landlord lets his house at a yearly rent, without any agreement whatever as to the time of payment, I think, unless there is some clear custom of the country that it should be paid half-yearly, he can only claim the rent at the end of the year. Of course, if the tenant had paid, even once, at the quarter or half-year, this would become part of the contract, and he must so continue. A yearly tenant is only bound to leave the house in the same state as it was when he commenced, fair wear and tear excepted. **Fred Wetherfield.**

2, Gresham-buildings, Guildhall.

COLOUR.

[20432.]—IN reply to "X. N. X." (20372), I must ask him to kindly tell me what oxide of copper is used for staining glass blue, and also if he has tried the experiment? I ask this because I have taken great pains to study what colours can be obtained in glass with the various metallic oxides. I have been to one of the first assayers in London, whose business it is to prepare these oxides, but they do not know of the one in question. I should be glad to know where I can obtain a specimen of *blue* glass, guaranteed to be coloured with oxide of copper only. (If there is any modern work, treating specially and practically upon the oxides available for staining glass, I should be glad to know of it).

"X. N. X." writes: "The light transmitted by cobalt glass, though very far indeed from pure blue, does not contain sufficient green for our purpose." This statement is very misleading, the fact being that cobalt glass is unsuitable for making green, *on account* of its impurity, it being a rich blue purple; that is to say, it contains a considerable percentage of red.

I note "X. N. X.'s" experiment with sodium carbonate "in the dark." If he wishes to have a green effect, he should first have sufficient light to be able to distinctly recognise the blue, and then illuminate with his sodium. In fact the blue should have as much light upon its surface as the strength of the yellow light.

I am not at all suprised at "X. N. X." failing to see the green in this, or in any of the other experiments he mentions, even if he were entirely without bias upon the subject. Under such misleading conditions, it is probable I should not be able to form a fair opinion, although I have had so much practice with colour.

"X. N. X." writes: "The light seen on blue and yellow being added together is brighter than the yellow light alone, and not darker, as Mr Caltón supposes." "X. N. X." appears to misunderstand me. I stated that a yellow light thrown upon the screen would show a stronger light than if it were only thrown upon the screen alternately with a blue light. Of course two lights added together will be brighter than either individual light, but lights flashed alternately upon the same spot are not added together. Would "X. N. X." call it adding to a man's account at his bankers if he drew out £100 and paid in £80, or even £90, directly afterwards? (I am here taking it for granted that the blue light is less powerful than the yellow, as this is pretty certain to be the case.) A banking account that varies between £80 and £100 can hardly be said to exceed the latter amount.

As for the so-called blue glass that transmits a considerable quantity of green, it is strangely miscalled.

"X. N. X.'s" prediction that pure blue and yellow pigments would produce black, is a great advance upon the philosopher's-white theory, as the green produced would certainly be much nearer black than white; but he goes from one extreme to the other: his prediction is entirely contrary to practice, for it is an invariable rule that the purer the blue and yellow, the more intense the green.

"X. N. X." endeavours to discredit my experiment of throwing a yellow shadow upon a blue surface by saying "the blue paper is able to reflect green, although it absorbs yellow and red, and therefore the light reflected from the paper is green."

Here, I contend, he is mistaken, and maintain that a blue surface does not absorb either red or yellow. If a red light be thrown upon a blue surface, the combined light reflected to the eye is purple, and with a yellow light the combined effect is green. Neither the red nor yellow is absorbed, but are, in each case, reflected back to the eye, combined with the original colour of the surface. In fact, a blue surface reflects any hue that is thrown upon it, and has no special partiality for green.

I really must protest against the self-assurance of people who calmly designate all their own ideas as "science." "Sigma" writes (20324), "From a purely scientific point of view, the discussion about which colours are primary, and which secondary, is quite meaningless." If he had said, from his own (limited) point of view, it would have been more modest. I consider the latter part of his statement entirely erroneous, and, therefore, unscientific. It strongly reminds me of a remark made during last year's discussion—viz., "What we (the scientists) state with regard to colour is as demonstrable to a colour-blind man as to one who is not." I should say that, to a colour-blind scientist, the whole of this discussion may be "quite meaningless." "Sigma" continues: "The whole question has two aspects—the scientific and the artistic, which have no point in union." While the scientists' view of the question is kept forcibly apart from the artistic, it is likely to remain in its present unsatisfactory condition.

I was much struck with "Sigma's" remark about "the production of music from a violin." Do his theories differ as widely from practice in sound as in colour?

Again, he writes, "a so-called blue glass transmits blue and green, and a yellow glass yellow and green; the resulting hue should be white, *with an excess of green.*"

Here, I maintain, he is at fault. It might as reasonably be argued that, upon combining blue and red, the blue glass transmits blue and purple, and the red glass red and purple, and the resulting hue should be white, with an excess of purple; or, on combining red and yellow, the red might be said to transmit red and orange, and the yellow yellow and orange, and the resulting hue should be white, with an excess of orange; so that we find that blue glass, when it is combined with yellow, transmits blue and green, but when it is combined with red, transmits blue and purple, while yellow glass transmits yellow and green, or yellow and orange, according as it is combined with blue or red; and yet these people would claim the monopoly of science.

What astonishes me the most is that anyone (not colour-blind) can look at a vivid green and not be able to see the blue and yellow in it. A good illustration of the effect of combining blue and yellow is seen in a piece of shot silk, in which the green effect is produced by separate threads of blue and yellow. Last year I suggested the experiment of ruling parallel lines of blue and yellow, ⅛in. wide by 6in. long. If they are made two or three times as long the effect is plainer; but I find the green is easier seen in a room if yellow and pale blue lines are ruled with a pen, about forty to an inch, over a surface of about 6in. or 8in. square. In these two experiments we get a good green without the blue and yellow being in any sense lost to the eye, and they cannot, therefore, be said to absorb one another's colours.

Take Tyndall's statement as quoted by Mr. Smith, viz., "that with a mixture of blue and yellow powders, white light plunges into the powders to a certain depth, and is discharged by external reflection, minus its yellow and blue (he omits to mention anything about the red), the green alone remains." Now I should like to know where the line is drawn at which "green alone remains" without blue and yellow being visible, for we can have green that is nearly all yellow, or green that is nearly all blue, with endless varieties between. Surely, even a scientist would not say that in either of these two extreme cases the reflection was green "minus its yellow and its blue;" therefore, they must draw a line somewhere. I can inform Mr. Tyndall that there is no necessity for the blue and yellow to overlap to produce green. The powders can be carefully arranged so that the colours are simply alongside one another, and yet the effect is green, and this reflected colour is certainly not "minus its blue and yellow."

If we take a saucer and rub some gamboge and water in it, and then add a small percentage of (say, Prussian) blue, it immediately shows green exactly to the extent of the blue added. To this pale yellow green we add more and more blue, and observe the effect. We see it changes from yellow green gradually to a deep blue-green. Now what right have we to say that the blue and yellow have neutralised one another, and are lost? We find in every combination of these two colours the same effect is invariably produced, and I maintain that it is their joint visible presence that we recognise as green, exactly the same as we call the joint effect of red and blue purple. What do the scientists understand by blue-green and yellow-green? Surely, it can only mean that these two colours predominate!

Most of "X. N. X.'s" remarks are met by my letter, to which his is a reply. It simply rests to prove who is mistaken, as one of us most certainly is. I would call his attention to "Sigma's" letter. That gentleman is coming much nearer to my views than any other opponent, as he candidly admits "an excess of green" on combining blue and yellow lights. What is the difference between "an excess of green" and "a pale green"? His term is very singular, he might as well say that in mixing black and white an excess of grey was obtained, or that a mixture of copper and zinc gave a vacuum, with an excess of brass. Then "X. N. X." admits that the white produced by his experiment has "perhaps a yellow tinge." I predicted the result would be a very pale yellow green. So we are not so very far apart, after all, and if "X. N. X." will kindly compare his "yellow tinge" with a strong white light, perhaps he may admit a greenish-yellow tinge.

Upon careful examination it is satisfactory to find how nearly we agree; and yet how much we differ in explaining the same result; but I think it is a considerable advance to have it acknowledged by anyone who calls himself a scientist, or at least defends their cause, that a combination of blue and yellow lights produces a green effect, even though it is called "an excess."

"E. H." in his letter, 20329, mentions some apparently extraordinary effects, seen upon looking through various coloured mediums at other colours. I have observed something the same effects, and if I had not prepared the glasses myself should probably have been at a loss to account for them.

I was preparing some green glasses with aniline dyes and gelatine (to show that any colour may be rendered visible upon superimposing various red and green glasses, and that yellow is only visible when that colour is in excess) as I found the only green glass I could purchase was of a very yellow hue, being, in fact, nearly all yellow. I, therefore, made some green by mixing various yellows and a blue, which latter was strongly tinted with red. On looking through some of these greens, in which both component colours contained red, at the apparently white flame of a paraffin lamp, which is nearer white than a gas-flame, I was greatly suprised to see the flame appear deep orange (this colour many would call deep red) while the rest of the glass appeared green. At first glance this appeared rather extraordinary, and some friends I showed it to were equally struck with the result; but upon thinking the matter over I find it admits of a very simple explanation, In the first place, the flame upon being compared to a white cloud, in daylight, is evidently of a strong orange hue, and the blue and yellow dyes, of which the green was composed, each contained a quantity of red, so that it was quite evident that the colour seen was simply from the red and yellow being strongest under the circumstances, and giving an excess of orange. One very important fact to remember in using aniline dyes is that the red is not only much the most intense, but appears to pervade many of the other colours.

I sent to a wholesale scientific depot for some aniline blue, red, yellow, and green. The red was the only satisfactory colour; the blue when dissolved in a four-ounce bottle showed such a strong tinge of red that I was afraid it would not be of any use, but found the red was not so perceptible when the dye was only in a thin layer. I had three dyes sent me as yellow, which happened to be orange; they contained so much red as to be quite useless for my purpose, and the green dye, as was the case with the stained glass, was nearly all yellow.

I write this to warn "tyros in optics" that when using colours, aniline especially, red may be present even when only its complement—viz., green, is apparent by ordinary light, and I suggest the following as an explanation of "E. H.'s" statement that grass appeared scarlet when looked at through a purple glass.

Grass is a very yellow green, there being a very slight quantity of blue in it. The red in the purple and the yellow in the grass overpower the blue and give a more or less scarlet effect (which many would accept as red, while it is really orange); in fact, it is only a combination of the three primitive colours, red, blue, and yellow, and whichever are in excess will be visible, although the result may appear perplexing at first glance, especially to those whose whole knowledge has been acquired from books.

In aniline colours the red appears to be so much the most intense that it will frequently assert itself where least expected. May not this be owing to its being in a much finer state of division? The blue I used appeared when dissolved to be in comparatively coarse grains, even to the naked eye, and upon superimposing red and blue glasses of the same depth, the latter was almost annihilated.

I think the scientists, in their disregard of artistic reasoning, have sometimes lost themselves in profound sophistry, when a very simple explanation would have kept them right.

I do not altogether agree with "E. H.'s" conclusions in his fifth paragraph, 20339. "E. H." should know that there are many reasons (which are quite beside the subject in question) why different artists do not paint the same object alike. It is impossible, even when desirable, to make an exact copy, and artists have different theories of what to aim at and also of how to get the desired effect; some will be afraid of erring in one direction and some in another. The æsthetic school, for instance, goes in for what they call breadth (but what others call dirt or philosopher's white) at the sacrifice of other qualities. The leaders of this school are, I believe, strongly colour-blind, and only go in for these semi-neutral tones because they cannot trust themselves with purer colours. I do not suppose any artist considers his picture an exact counterpart of nature in colour. When I am painting a landscape I am sometimes painfully aware of this discrepancy, and it would be a great error to take my sketch as an example of how nature appears to me. In fact, this power of copying what we see constitutes the difference between a good artist and a duffer.

If "E. H." will go to any school of art, preferably to one where professional artists study from the figure, and just walk round and note how differently the same figure is rendered by each, one will have drawn the man very tall and slim, with small head, hands, and feet; a second will have depicted him as short and dwarfish, with very large head, &c.; while as to colour, amongst a couple of dozen studies you will find every variety, from a pale pink to a dusky brown figure. But this is not a proof that the various artists saw the man as they painted him; and I do not see that we have any right to assume that these studies give a more correct representation of their views of the figure in colour than form.

I would here point out that I am not claiming infallibility for artists. Perhaps some will say these are not fair samples, while others may smile at these admitted failings in our profession. An artist's work is always on view for criticism, and everyone considers he has a right, if indeed it is not his duty, to criticise a picture, no matter how slight his own knowledge of the subject may be; but it must not be supposed that the members of any other profession are any more immaculate. No other profession offers so great an opportunity for public criticism; but even in this comparatively trifling discussion, I note that some of my critics flatly contradict one another's statements, although they probably imagine they are defending the same view, and think they know all about it. If we could have an *exhibition* of the scientists' views upon colour—not mere quotation, but each man writing a treatise out of his own head, I think we should find the most extraordinary discrepancies amongst people who at present imagine they agree, simply because they have read the same book.

"E. H.'s" proposed test for colour-blindness would, I am afraid, be much too severe a test for most scientific men. The power of mixing pigments to copy any given hue, is not near so simple as might be imagined; and I should consider it quite sufficient if they could match a number of pairs of coloured articles. I agree with "E. H." that the complementary colour of blue is orange, and should like to know why he objects to "any theory of the three primaries." Amongst his other statements with which I agree, I would state that I also have found that a very small quantity of white light on a disc will overpower the colour; and as I have previously stated, any hue, however strong, black included, may be so brilliantly illuminated as to appear white if seen by itself.

Mr. Geo. Smith (20373), in his last paragraph, describes a disc which gives a very simple and true illustration of which are complementary colours. **S. Calton.**

[20433.]—Some of the correspondents who have recently favoured you with remarks upon the subject of colour, appear to be arguing at cross purposes, for pieces of coloured glass, and, above all, pigments, are sure to confuse a student who is examining that branch of light which is denominated Colour. So far as we can tell, there is no such thing as colour in the abstract, but it is certain that the normal human eye is capable of distinguishing very many shades of colour, and of recognising at least seven distinct colours. The modern theory of light holds that these are due to a difference in wave-length combined with a difference in the velocity of undulation which may be roughly represented as 7 to 4 for violet and red respectively. Although the normal human eye sees seven distinct colours in the spectrum, it is obvious that if the undulatory theory is true, the spectrum must be made up of an infinite number of colours, or at least of all wave-lengths between the 434 billion undulations of red to the 758 billion of violet. The exact way in which these waves act upon the eye to produce the sensation of colour is still a matter of pure supposition, and although we know that some animals are capable of appreciating differences in colour, we do not know that they see the same colours as we do. We do know, however, that all human eyes are not alike; that with some, through a disease or defect, the phenomena of what is known as colour-blindness are experienced, and that with certain drugs the action of the optical mechanism can be so disordered that a healthy eye sees objects in their wrong colours.

According to the Young-Helmholtz theory, the retina possesses three distinct kinds of nerve fibrils, each of which is capable of distinguishing one of three colours. Of these sets of fibres one is sensible to red alone, another to green, and the third to violet or perhaps to blue. The entire chromatic scale is made up of combinations of these three so-called primary colours. Every sensation is due to the excitation of the fibres of the retina by these colours, or more properly by the waves of the luminiferous ether, each set of fibres being strongly stimulated by its own special excitant, and feebly stimulated by the others. In the case of red, for example, the terminal apparatus of the fibres adapted for conducting red are powerfully stimulated by the large waves of the less refrangible extremity of the spectrum, whilst the terminal apparatus of the nerves adapted for green and violet are very feebly stimulated, and the sensation of red is the result. In like manner, when the sensation of green is perceived, the terminal apparatus of the nerves adapted for conducting the impression of green are stimulated by the waves of moderate amplitude in the middle of the spectrum, whilst the red and violet fibres respond but slightly to such waves, and the sensation of green results. And so, too, the fibres adapted for conducting violet respond to the short and rapid waves of the more refrangible rays which have only moderate action on the green and still less on the red conducting fibres. The intermediate colours, such as orange, are due to the simultaneous stimulation of the several sets of fibres to a greater or less extent, and when all these sets are equally excited, the impression of white light results.

M. J. Soury, in the *Revue des Cours Scientifiques*, says that lately a new theory—that of Hering—has been advanced. According to this physicist there are six simple sensations of vision, and the various colours seen result from their different association and blending. These elementary sensations are disposed in couples or antagonistic pairs: black and white, green and red, yellow and blue. On this theory violet is a compound colour formed by the blending of blue and red, and in an ordinary perception of colour four primary sensations are excited: black and white and two colours; but the blue and the yellow are never simultaneously excited, nor are the red and the green. Black and white are capable of mingling, and produce all the shades of grey, but red and green or blue and yellow have no disposition to blend, but rather behave like the poles of an electric battery, and in this sense the school of Hering, of which Happe is the chief exponent, speak of the polarity of colours. The organic substratum of colour sensation, according to Hering, is not the terminal apparatus of the nerve fibre itself, but certain hypothetical substances, such as the visual purple, which undergo chemical change. On looking at "white" light, the visual purple, by a photo-chemical process, is constantly undergoing decomposition and destruction, and is as rapidly restored. Red light decomposes the visual purple slowly, violet light decomposes it more rapidly. Further, on Hering's theory, processes both of disassimilation and of assimilation are supposed to take place, so that when exposure to red light has exhausted or partially destroyed the visual purple, or its mother substance, purpurogene, green light aids in the reparation of this material, and fits the eye again for perceiving red light. Black does the same office for a retina exhausted with white light, and blue for yellow. This theory affords a good explanation of the phenomena of contrast, and of complementary colours. A red wafer placed on a sheet of white paper gives the sensation of a vivid red disc. As long as it is looked at it causes disassimilation of the retinal purple, which is as constantly renewed; but if the eyes be closed, the sensation of red vanishes, and is replaced by green, because assimilation is then taking place in excess of disassimilation. When one of these states is equal to the other two, the two antagonistic sensations are reciprocally destructive. Hence red and green do not blend to form white. Another theory, originally suggested by Draper, and more recently developed by Preyer and by Charpentier, refers the colour sensations we perceive to modifications of temperature. Charpentier, who has just completed a series of researches with Landolt, finds that the statements recently made to the effect that certain zones of the retina are specially adapted for the perception of certain colours have been founded on imperfect observations, and that even the most peripheral portions of the retina can differentiate colours providing they are sufficiently intense. Charpentier differentiates in every normal eye a sensibility for light, a sensibility for colour, and a visual sensibility or sensibility for form. In every chromatic impression made on the peripheric regions of the retina he further distinguishes three phases: a simple impression of light, a vague indeterminate impression of colour, and a distinct impression of the true colour. The first phase he thinks clearly proves that the luminous sensation is distinct from that of colour, that it is the result of a simple excitation of the optic nerve; but in the second phase the cerebral centres for colour are excited, and the reason that a quicker and surer recognition of colour is made by the macula and central parts of the retina is only because they are more used. The sense of colour and of light being a general function of the retina, he regards neither the rods nor the cones as the retinal elements which are stimulated by chromatic stimuli. He looks rather to the layer of ganglionic cells which lie on the anterior part of the retina as the functionally active elements.

Although it is abundantly obvious that there is ample room for several investigators in this field of research—the mechanism of the sensation of colour—I imagine there is no room to doubt the facts of Helmholtz, Clerk-Maxwell, Tyndall, and others. I am afraid there is no help for a paradoxer who says "it is really quite time for the old dogma of white being composed of colour to be exchanged for a more rational theory," and who also thinks that "green is composed of blue and yellow, exactly as much as brass is composed of copper and zinc." Some of the experiments of your correspondents—though they have really nothing to do with the subject of light and the sensation of colour—are very interesting, but they would be more valuable if one knew what was meant by the terms red, green, blue, &c. Some people call vermilion, for instance, red, while others class it as orange, and so on. It would be well if the approximate position of the colour in the spectrum could be always indicated.

Calorimeter.

Electricity and Flame.—A contribution to the subject of the electricity of flame has been lately made by Herren Elster and Geitel (*Wied. Ann.*, No. 6). The discrepancies in previous results are attributed largely to the behaviour of the air layer immediately outside of the flame having been left out of account. The authors used a Thomson quadrant electrometer for measurement. They find the supposed longitudinal polarisation of flame merely apparent, and due to unequal insertion of the wires used as electrodes. On the other hand, flame is strongly polarised in cross section; an electrode in the air about the flame is always positive to one in the flame. The theory the authors adopt is this.—By the process of combustion *per se* free electricity is not produced in the flame; but the flame-gases and the air-envelope have the property of exciting, like an electrolyte, metals or liquids in contact with them. To this electrolytic excitation is added a thermo-electric, due to the incandescent state of the electrodes. The amount and nature of the electric excitation is independent of the size of the flame, and dependent on the nature, surface-condition, and glow of the electrodes, and on the nature of the burning gases. *Inter alia*, it is remarked that flames may be combined in series like galvanic elements, and so as to form a "flame-battery." An article giving a full account of the experiments appears in *Nature*, for August 3, over the initials "S. P. T."

REPLIES TO QUERIES.

*** *In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[47144.]—**Bending Wood.**—Will "Collodion" kindly say whether the steam should be under pressure, and, if so, what pressure; and with regard to safety-valve.—No Name.

[47206.]—**Dry Plate Developer.**—I send the following, which I always use now, and which gives me the greatest satisfaction. Weigh out as much pyro. as you want, say 144gr. Then weigh out just 4 times as much soda sulphite (*neutral*), i.e. 576gr., dissolve this in about 4oz. of distilled water, and neutralise with citric acid, as the soda sulphite is sure to be a little alkaline. Then add the pyro., make up the solution to 6oz. with distilled water, filter, and keep for use. These proportions will give 3gr. pyro. per drachm; but it is most convenient to mix it, so that each drachm will contain just the right amount of pyro. for 1oz. of developer, according to the formula sent out with the plates. Pyro. solution made up by this formula will keep almost indefinitely, and, unlike any other pyro. solution, will not turn seriously brown, even if used with twice the usual amount of ammonia and kept on the plate for a lengthened period. With correctly exposed plates, therefore, the same solution can be used for several consecutive plates, and will give negatives with *perfectly clear glass* in the shadows, and *entirely* free from stains, even without using alum and citric acid or any other clearing solution.—Patent Plate.

[47228.]—**Telephone.**—I believe in the present Bell's Telephone the wire is divided into three lengths, and wound on the bobbin together, each set of three ends, being then connected to a binding-screw. It is said to act better.—Amido.

[47261.] — **Arsenic in Wall-Paper.** — The method which I have found easiest and simplest, is to boil the wall-paper with strong pure hydrochloric acid for some time, the neck of the retort passing into a flask, kept cold, and having just enough water in to cover the end of the neck. Chloride of arsenic is formed, which forms a yellow precipitate, by adding sulphuretted hydrogen solution and a few drops of HCl.—Amido.

[47321.] — **Electro - Deposition of Carbon (U.Q.)**—Some experiments which I have been trying under this head have proved very unsatisfactory. I am afraid carbon cannot be satisfactorily deposited, and it is an open question as to whether the particles would adhere.—H. Stooke.

[47346.] — **Boomerang.** — Perhaps "Bushranger" may find what he wants in the following account of this weapon, which I have taken from Beeton's "Encyclopædia." Thinking the description given may be interesting to other readers of the "E. M.," I have copied the whole of the article;—Boomerang, a missile instrument used by the Aborigines of Australia, in war, sport, and the chase. It consists of a piece of hard wood of a bent form, with the curve of a parabola, is about 2ft. long, 2½in. broad, ⅜in. thick, and is rounded at the extremities. One side is flat, the other convex, and it is brought to a bluntish edge. It is discharged by the hand by one end, the convex edge being forward and the flat side upward; and it is thrown as if to hit an object in advance; instead, however, of going forward, it ascends into the air with a rapid rotatory motion, until it reaches a considerable height, when it begins to retrograde, and finally passes over the head of the projector and falls to the ground behind him. This singular motion is produced by the air impinging on the bulged side of the instrument. The boomerang, the invention of which would have done honour to the most celebrated man of science, has long been a common weapon among almost the lowest races of savages upon the earth, and was first made known in this country by Professor M'Cullagh in 1837.—H.

[47396.]—**Simple Rotary Engine.**—You had better make an ordinary reciprocating engine, and not trouble yourself with rotaries, especially as the pressure is only 30lb. If you must have a rotary, I would suggest taking one from Reuleaux's "Kinematics," for he illustrates several; but you will have to make the working drawing yourself.—T. P.

[47402.]—**Summer House.**—You must make sketches and measure off the work; and as to sizes of timber, it depends on how you want the house —strong or light. Posts 1½in. square would be strong enough; but some would prefer 2in. square. You don't say whether you want it close-boarded or trellis; but matched boarding ¾in. thick will do for sides and roof. The latter you can make splendidly waterproof by coating with coal tar applied hot; then lay down flat sheets of good brown paper, and give two more coats of tar, sprinkling sand on the last.—E. G. M.

[47408.]—**Fish Glue.**—I believe this is made in Europe in both Russia and Norway. The process is the same as the other in the main; that is, any parts capable of yielding gelatine are boiled, and, when dissolved, the liquor is drawn off, the first portions forming the best quality of glue.—T. P.

[47411].—**Throwing the Hammer.**—There is no help for it, except to practise the throw in such a manner that the head lands dead, as it were. If it lands so that the shaft is thrown over, and brought on to the ground with the force due to the momentum, the best ash and hickory will break at times.—Blacky.

[47417.]—**Varnishes.**—I do not know of any really good work on the subject. The best "papers" were read before the Society of Arts some years ago, and if you searched the back volumes of this paper you would find much valuable information. The art of varnish-making depends so much upon personal skill, that it is impossible to write very much about it. Copal is valuable for making varnish, because it is difficultly soluble, and is very hard and tough. There are, however, several qualities of the gum. I don't know the "prepared painter's copal."—J. T. M.

[47418.]—**Refrigerator.**—You could make an air-compressing pump, and use the air to do some work, when, escaping, it would absorb heat, and cool the surrounding atmosphere. But you certainly would not do much in the way of refrigeration with a pump worked by hand only; and I fancy you would get more coolness out of one of Pictet's small ice machines.—Essar.

[47426.]—**Regnard Incandescant Light.**—You certainly will not get an incandescent light with the arrangement depicted—not even if you use gasoline. You want something much larger than a bottle with a small tube dipping under the liquid. Try a case in which the air is made to pass amongst cotton wicks kept saturated with benzoline—(you will have a difficulty in getting gasoline; and as to petroleum, I don't think that is sold here, for, of course, it is the crude petroleum that is meant) —like Fletcher's gasoline furnace.—Essar.

[47463.]—**Change-Wheels.**—I see that your printer has made me say that the wheels to cut 31 threads per inch are 20 and 55 driven, and 85 and 100 driven. Of course it is evident that this is a mistake, and it should be 20 and 55 drivers, and 85 and 100 driven. I hope you will correct this in your next impression. When compound wheels are used the drivers should be multiplied together as well as the driven wheels.—T. F. Gell.

[47463.]—**Change-Wheels for Screw Cutting.**—I appear to have a difficulty in making my wants properly understood. Mr. T. F. Gell and "J. K. P." give me combinations, found by trial, for cutting nearly 31 to the inch, Mr. Gell saying his is the nearest to be found. But this is not what I asked for. I can find the combinations by trial; but what I want is, if possible, to calculate directly to the nearest combination, without spending hours seeking for a nearer one. I give below seven combinations, which I have found by a method of trial similar to that recommended by these two gentlemen. They are all nearer than those they gave—one particularly near; but I know that I have not exhausted, by a tenth part, the combinations which might be considered near enough for use, and still I am not sure I have the nearest. Those I have found are—

$$\frac{4 \times 75 \times 125}{22 \times 55} = 30\frac{120}{121} \text{ (very near)}$$

$$\frac{4 \times 95 \times 110}{30 \times 45} = 30\frac{26}{27}$$

$$\frac{4 \times 95 \times 120}{21 \times 70} = 31\frac{1}{49}$$

$$\frac{4 \times 65 \times 125}{30 \times 35} = 30\frac{20}{21}$$

$$\frac{4 \times 85 \times 105}{23 \times 50} = 31\frac{1}{23}$$

$$\frac{4 \times 85 \times 115}{21 \times 60} = 31\frac{2}{63}$$

I hope that my query is now plain enough. To go through, perhaps, a thousand combinations is rather a task, and yet having the change-wheels to use, why not use that particular combination which is nearest truth? It is a method of arriving directly at this one combination for any particular thread that I am asking for. Does such a method exist? —Try Again.

[47473.]—**Gas for Laboratory.** — A few volumes back, a very good illustrated article appeared, entitled, "Gas from Gasoline," by F. H., Godstone, which will give you all the information you want. It tells how to produce a pressure of air direct, by means of a trompe (a kind of simple injector, easily made), which is far simpler than any Root's blower, and less expensive by far. You can use the apparatus there described, or you could use one of Fletcher's gas-generators equally well for saturating the spirit. I followed the latter plan, making the lot myself. I would tell you the date when the article appeared, but am not now in a position to consult back vols.—J. Hezmalhalch, Jun.

[47486.]—**Euclid's Axioms.**—In attempting to show how Euclid's axiom 3 can be deduced from axiom 2, Mr. Romanes says: "A + C = B + D; from this we can deduce A − D = B − C, &c." Surely this is a petitio principii with a vengeance. —A. J. Smith.

[47491.]—**Magic-Lantern Slides.**—I quite agree with "M.I.C.E." that it is possible for a person that is slightly acquainted with painting to colour lantern-slides. I should be obliged to him if he will give full descriptions of his method of transferring prints to glass, as from the reading of the answer I suppose he does, and if specially printed pictures are required.—Grapho.

[47540.] — **Measuring Flow of Water.**— "Ditton," in answering this query, has made a serious omission—viz., the coefficient for contraction; he has omitted the quantity "c," out of the formula, which is, $5{\cdot}35\,c \,.\, b \,.\, h.^{\frac{3}{2}}$; for practical purposes, call $c = \frac{5}{8}$ of the total. The correct quantity is ·22 cubic feet per second, and not ·33 cubic feet. John S. B. Bell, C.E., Newcastle.

[47553.] — **Problem in Dynamics.** — Mr. Romanes says: "Suppose the monkey to ascend to a height v above E, the point at which they are in equilibrium. The action of gravity will cause it to descend." How so, seeing that the monkey and the ball are supposed of equal weight?—A. J. Smith.

[47553.]—**Problem in Dynamics.**—I look upon the problem in this light, which I offer for the consideration of "Tam O'Shanter." It is the ball which descends, and not the monkey, and this I conclude from what follows. Let g = force of gravity, m = the mass of each body, and d = distance from the earth when they are in equilibrium. We know that $g = m / d^2$. When the monkey has climbed through s feet, this becomes $g = m / (d + s)^2$, and since $m / d^2 > m / (d + s)^2$ the ball must acquire a velocity. Now, for every increment in the monkey's ascent, the ball will fall through a corresponding increment; but this will draw the monkey through an additional equal increment, so the monkey, for every s feet in the descent of the ball, will always traverse $2s$ feet. Suppose the monkey to have a velocity v, then it follows the ball will acquire a velocity = $\frac{1}{2}\,v$.— C. H. Romanes.

[47573.]—**Model Locomotive Boiler.**—I should advise "Shakespear," if his boiler is not too far advanced, to adopt a more simple method of construction, unless he is making an exact model of some particular engine; the bend between firebox and boiler and riveting the plates which form the barrel of boiler would not be necessary, and a stronger boiler would be obtained. One way is to cut out a sheet of metal of the shape shown in Fig. 1, which, when bent round, would form the barrel of boiler sides and top of outside firebox in one piece; another method is to obtain a piece of brass tube of the required diameter and thickness—this will form the barrel of boiler; at one end of this, and fitting outside, is riveted the outside firebox shell. However, if I had to make a boiler as shown by sketch (on page 508), I should make the rings in one plate, and the bend at A would be most easily made by cutting out a curved strip of copper long enough to take about ⅔rds of circumference of boiler when bent to shape (see Fig. 2); then each edge must be worked out parallel, the large end to fit inside of outside firebox-top, and the small end to fit outside the two-thirds of diameter of barrel and then riveted (see Fig. 3). This strip will be like a continuation of the front plate of outside firebox, and they must lap each side; the top of this plate must be flanged forward to fit underside of barrel, and the sides flanged back to fit between sides of outside firebox, see Fig. 3. Tubes 5-16in. diameter are much too small—they ought to be at least ⅜in. diameter; about 20 could be put into this boiler. The dome should be screwed to boiler, and the joint

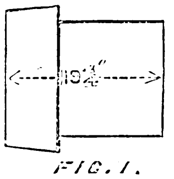


FIG. 1.

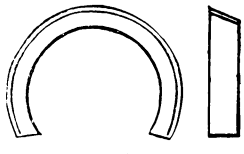


FIG. 2

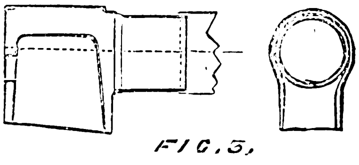


FIG. 3.

made steam-tight with red-lead (see my reply to query 47432, p. 482). In "Shakespear's" sketch the inside firebox is shown too high. There would not be sufficient room for steam and water space; it should not be more than 1in. from centre line of boiler.—E. L. P.

[47578.]—**Egg-end Template.**—I should be glad to give "B. M" the information he requires, but I am afraid it will take up too much space to fully describe and then sketch. I should advise "B. M." to get one of the workshop handbooks on boiler-making, one in particular containing a vast amount of information on templates of all kinds. If he will advertise his address I will give the name and merits of several handbooks and advise which will be the most useful.—Boswell.

[47586.]—**Pure Silver.**—Pure silver may be obtained in the following manner. Dissolve your metal in nitric acid; evaporate to dryness, and fuse the residue as long as red fumes come off. Now dissolve in water and filter, dilute with 30 parts of water and add pure HCl, when you will get a white curdy precipitate of AgCl, which must be well washed, first with dil. HCl, and then with pure water. Dry the precipitate and powder finely in a mortar. Digest several times with aqua-regia, and afterwards wash, until all traces of acid have disappeared. Now reduce the AgCl to the metallic state by boiling with dil. pure KHO solution, to which milk-sugar is added. The reduced silver is washed with dil. H_2SO_4, and then with water, and fused. A solution of the metal thus purified, in HNO_3, should give no blue colour on treatment with NH_3 solution; and if HCl is added to the solution, the precipitate so obtained should be *completely soluble* on adding NH_3.—Caius.

[47590.]—**Honours Chemistry.**—(1) Reduce the volume of air to normal pressure and temperature.

$$\text{Vol. at } 0^\circ \text{ C and 760mm.} = \frac{851{\cdot}4 \times 273 \times 537{\cdot}4}{(273 + 4) \times 760}$$

(2) Find the contraction in the volume after explosion, and this gives the volume of H and O, which have combined to form H_2O; one third of this decrease, therefore, is due to the O.

$$\begin{array}{rl} 657{\cdot}06 & \text{air + hydrogen} \\ 374{\cdot}73 & \text{air + excess of H} \\ \hline 3\,)\,282{\cdot}33 & \text{vol. of H and O which have combined} \\ \hline 94{\cdot}11 & \text{vol. of O.} \end{array}$$

(3) The next thing is to find the percentage of O; and having done that the percentage of N is found by subtracting this from 100.

$$\text{Percentage of O} = \frac{94{\cdot}11 \times 100}{\text{Vol. obtained in (1)}}$$

$$\text{Percentage of N} = 100 - \text{Percentage of O.}$$

—Caius.

[47622.]—**Bisulphide of Carbon Prism.**—You can make one of tin, but composition metal is better. You can get some thin, flatted crown-glass, which answers perfectly. It can be cemented by means of glue. I have not found the bisulphide to act on it. One prism in the form of an equilateral triangle will show double D line, that is with 1in. object-glass telescope.—Amido.

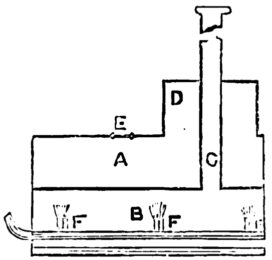
[47623.] —**Electro-Motor.** —Has "Conrad" tried his motor as a dynamo? If not, would it be asking too much to ask him to do so, and give results?—F. W. Ball.

[47636.]—**Gas-Engine.**—"Dun Browne" has not been "done so brown" as some other readers, as he has at least got an engine, and I expect with very little outlay it can be made to work. I expect it is the supply or admission of gas arrangement that is at fault; if so, and he will explain all fully, I shall do my utmost to get it put in order. Has the engine ever run well? As, if so, it should do it again if the obstacle is removed.—Argudante.

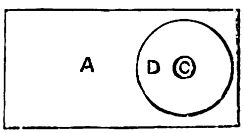
[47639.]—**Legal.**—Mr. Wetherfield, in his reply to this query (letter 20404), appears to base his statement that "a license is not necessary for the purpose of killing birds destroying fruit in a garden," on the fact that the occupier of any land using a gun for the purpose of killing vermin on such land is exempt from duty, rather than on the general ground of use within the curtilage of a dwelling-house. I would warn the querist that the Board of Inland Revenue and Mr. Wetherfield are at variance in this matter, the Board holding that the term "scaring" does not include the killing of any bird whatever, and consequently that the term "vermin" does not include birds of any kind under any circumstances, for if "scaring" excludes, the term "vermin" cannot include the killing of the same object. Further, I know of cases in which convictions have been obtained for killing birds which were engaged in destroying fruit, in one case in an orchard not more than a stone's throw from the dwelling-house of the occupier. Of course, I do not include the fact that a gun license is not required in any case of use within a dwelling-house or its curtilage.—Excisum.

[47642.]—**Silicate of Soda.**—In the "E.M." of June 16, in reply to 46495, you will find the method of applying it. I suppose by outside walls you mean the outside walls of a house? If so, I may say that silicate of soda by itself will prevent rain from beating in, but not dampness arising from the foundation. Silicate of soda has been applied as a preservative to Cleopatra's Needle and the Houses of Parliament. There is one good property about silicate of soda which the silicate paints have not—viz., it does not alter the colour of stone.—W. L.

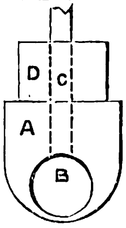
[47647.]—**Boiler.**—The following answer will, I think, meet "J. R. G.'s" requirements. The boiler A is of copper, about 1-16in. thick, brazed or riveted together, brazing being sufficiently strong for a model. The fire-tube B is 2½in. diameter, and is continued the whole length of the boiler. The flue C is carried through the dome D, thus thoroughly drying the steam before use. The water-filter being placed at E, it is impossible to overfill the boiler, for even if the water overflows at E there is ample steam room in the dome. The lamp that should be used is as follows:—A tank for spirit is placed at a certain position in the boat, so as to be above the fire-tube B. A brass tube about ¼in. diameter is carried from the bottom of this tank along inside the fire-tube, as shown. In the holes in the tube, F F F, are inserted bundles of fine brass wire, and the supply of spirit is regulated by a tap in the brass tube just where it leaves the tank. The boiler is 10in. long, 5in. wide, and 5in. deep; the fire-tube 2½in. diameter, dome 2½in. high, 4in. diameter; flue 1in. diameter, and is carried up the height required to make chimney look in proportion to the boiler.—Grapho.



SECTION



PLAN OF TOP



END VIEW

[47648.]—**A Cabbage Broccoli.**—[Mr. R. Gilbert writes that if "W. T. B." will send him his address to Burghley-gardens, Stamford, a circular and full particulars of the cabbage-broccoli, or chou de Burghley, will be forwarded.—Ed.]

[47651.]—**Examination of Malt (Estimation of the Grape Sugar and Dextrine.)**—Preparation of the copper solution:—Dissolve 34·632grm. of pure re-crystallised sulphate of copper in 200cc. of distilled water; dissolve in another vessel 173grm. of perfectly pure tartrate of potassium and sodium (Rochelle salt) in 480cc. of pure solution of soda, specific gravity 1·14. Add the first solution gradually to the second, and dilute the deep-blue fluid exactly to 1 litre; 10cc. of this solution equals ·045grm. of starch or dextrine, or the same amount of the solution equals ·050grm. of grape-sugar. The dextrine will require to be converted into grape-sugar before it can be estimated; this is most conveniently done as follows:—Two or three strong flasks are taken, and into each is placed from ·5 to 1grm. of the substance to be examined, with 50 or 60cc. of decinormal sulphuric acid; the flasks are stoppered with caoutchouc corks, tied down with strong string, and capped with a piece of linen, and the whole suspended in a water-bath, and heated for from 6 to 8 hours. At the end of 4 hours one of the flasks may be taken out, cooled, opened, and titrated, and at the end of 6, the second. If there is no marked increase in the amount of sugar between the first and the second, the operation is finished; but in any other case the third flask should be heated for another 4 hours before being examined. As the dextrine is now converted into grape-sugar the two are estimated in exactly the same manner. Make the solution for examination up to exactly 50cc. Pour 10cc. of the copper solution into a porcelain dish, add 40cc. of water, heat to gentle ebullition and allow the prepared solution containing the grape-sugar to drop slowly into the fluid from an accurately graduated burette. After the addition of the first few drops the fluid shows a greenish-brown tint, owing to the hydrated suboxide of copper suspended in the blue solution; continue the addition of the solution, and when the liquid assumes a deep red colour remove the lamp, allow the precipitate to subside, and give the dish an inclined position, which will enable you to readily detect the least greenish-blue tint—to make quite sure, however, pour a small portion of the clear supernatant fluid into a test-tube, add a drop of the sugar solution, and apply heat. If there remains the least trace of copper salt undecomposed a yellowish red precipitate will form, in which case continue adding the sugar solution till the reaction is complete; read off the amount used—this equals ·050grm. of grape-sugar, or ·045 of starch or dextrine. When the operation has terminated, ascertain whether it has fully succeeded by filtering the solution while still hot, adding to the filtrate (which should be colourless) a drop of the copper solution and heating; this will show if the sugar solution has been added in excess. Acidify two other portions, and test one with potassium ferrocyanide, and the other with H_2S. Neither of these tests should produce the slightest alteration; if, however, a precipitate is produced, the experiment must, accordingly, be repeated. The results are satisfactory and constant. Bear in mind that the copper solution must always remain strongly alkaline. Should the sugar be acid a dilute solution of soda should be added in place of the 40cc. of water. Keep in a cool, dark place when not in use; but it is best prepared for such analysis. Calculation: Before we can find the amount of grape-sugar or dextrine, we must calculate how much malt the quantity of the solution used equals. Supposing we took 1grm., 50cc. would = 1grm. Suppose you used 25·7. If 50cc. equals 1grm. of malt, what does 25·7cc. = ·514. We have now found that the quantity of the solution used equals ·514grm. of malt, and as 10cc. corresponds to ·050 grape-sugar, ·514grm. of malt must, consequently, contain ·050grm. of grape-sugar. We then find the percentage thus: If ·514grm. of malt contains 0·50grm. of grape-sugar, what does 100?—J. C. Belcher.

[47663.] — **Railway Crossing.** — There are many patents in existence relating to "improvements in points and crossings," but the inventions have not come into general use. The best of these systems is considered to be the one designed by Mr. Williams, which is now receiving much attention. The diagram shows the Williams crossing. M represents the main-line rail, B the branch-line rails, and L the moving piece which provides the bearing surface for the wheels of branch trains when crossing the main line. Fig. 1 shows the crossing-piece L placed in position for a branch train, and Fig. 2 shows the piece L withdrawn, leaving a continuous and unbroken main-line rail. It is claimed for the system that it affords a perfect bearing surface throughout the crossing, and that as the piece L is moved over the main-line rail any desired degree of super-elevation can be given to the outer rails on curves. The movable piece L is attached by a rod R and crank to the ordinary point-rod, therefore the points and crossings are worked together. It may be mentioned that this system has been tried in

FIG. 1

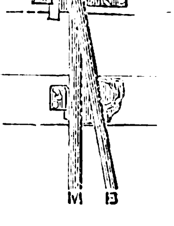
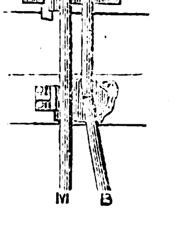


FIG. 2.



Scotland, and after a year's working it is officially stated to have fulfilled all that was promised regarding it, and that its use is attracting much interest in railway circles.—Clement E. Stretton, Saxe Coburg-street, Leicester.

[47673.]—**Electric Lighting.**—It is a pity "Caloric" should have such a warming towards the "Lampe Soleil" in preference to any other form of arc light, and after having carefully examined it be able to testify to "its simplicity, steadiness, whiteness of colour, and general perfection." I might as well inform "Caloric" that I have carefully examined, and had special experience with the Lampe Soleil, and have formed a very different opinion. In the first place, there is the building up of the box with six separate blocks of stone, which have to be filed to fit, and which takes up more time than changing the carbons in any ordinary lamp; also the marble, after the lamp has been lighted, calcines very shortly, absorbs moisture from the atmosphere, and falls to powder (lime). This necessitates building up another box. So much for its simplicity. I must admit its steadiness; but as to its whiteness of colour, I must say that a person who pronounces it a white light must be colour-blind, as it is a reddish, warm-looking light—hence its name. I even made the remark to the patentee himself as to its tinge, and he said, "Ah! you know it is de light of the sun; that (referring to another system) the light of de moon." As to its general perfection, it sometimes leaves an assembly in darkness, and will not relight without switching on another set of lamps (there are two lamps in each globe, in case one should extinguish itself). If the second set of lamps go out, you are altogether done. As to the h.-p. and other details, "John Bull" has explained them very fully and correctly. If "D." wishes the information as to how I have acquired my experience with the Sun lamp, if he will advertise his address in the "E. M." I will be most happy to supply it.—Practicus.

[47694.]—**Taking Top off Violin.**—You really must not do so, and in the case of the Berliner violin it is really not required; but it will not be long before our readers will be able to judge for themselves, and I hope to report progress myself. I forgot all about the soundpost when I recommended a fastening for the resonator through the *f* holes. Of course, it would be too close, and would absorb the return action of the vibrations. I think the adjustment of these patent vibrators will be very simple, as the needful appliances will no doubt be supplied.—Fiddler.

[47705.]—**Incandescent Lamps.**—The Leclanché battery is utterly unsuited for operating incandescent lamps, its work being confined to electric bells, &c., for which it proves eminently satisfactory. The Bunsen battery is certainly the best adapted for this kind of work. In order that you may have some idea of the number of quart Bunsens required, I may say that an incandescent lamp of the "Lane-Fox" type, and of 20-candle power, requires 26 of these—that is to say, 1¼ battery per candle-power. It is rather difficult to say with truth which is the best incandescent lamp extant; but I think it may be safely stated that the "Lane-Fox," if not the best, is, at all events, an excellent lamp.—John Bull.

[47705.]—**Incandescent Lamps.**—You cannot use Leclanché batteries for electric lighting—they fail after a few hours' continuous use, and weaken very much in a few minutes; they are only fit for purposes where the current is not wanted continuously, with long rests in between. Better by half use Bunsens. Swan's incandescent lamps may be had 5, 10, and 20-candle power, 6s. 6d. each. If "Medicus" will advertise his address, I will write him as to price of batteries.—Fred. W. Ball.

[47705.]—**Incandescent Lamps.**—Leclanché batteries are not constant enough. They give good current for short time. If you wish to fail, use them; but if not, try a more constant cell. I was experimenting a few weeks since with about 40 cells, and two carbon points, and after about half an hour power diminished very much, and the spark was not much to speak of at first.—H. Stooke.

[47706.]—**Plumbing.**—Refer to "Practical Notes on Plumbing," Chapter IX., English Mechanic, August, 1881. Nothing can be better for "Anxious" to know.—Plumber.

[47711.]—**Electrical Measurement.**—The formulæ quoted by "Student" are all correct, where C is measured in ampères, E in volts, R in ohms. In speaking of candles per h.-p., it is generally understood per h.-p. expended in the lamp, though some persons refer to the h.-p. expended on the machine. The former is of course correct. Since the ampère is merely another name for the old weber-per-second, a volt-ampère is the same as a volt-weber (per second).—Ll. B. A.

[47712.]—**Largest Dynamo and Coil.**—The largest dynamo ever constructed is Mr. Edison's installed on the Holborn-viaduct; it has four field-magnets placed horizontally. The armature consists of a steel shaft 6in. diameter, on which is mounted a wooden cylinder 12½in. The core of the armature consists of 53 thin iron discs, insulated from each other by tissue-paper; the total diameter of the core is over 45in.; in place of the usual wire 106 copper rods of nearly square section are used, and placed lengthwise; these average 52in. in length, are wrapped by machinery with special insulating paper, and covered by a special insulating material; they are also kept apart by vulcanised rubber encased in mica and placed about every 12in. to admit air. The whole armature is wound with steel wire, with double mica insulation beneath, to counteract centrifugal action. The resistance of this armature is as low as ·0049 ohm. Field magnets are wound with No 10 wire Brown's gauge; resistance, when connected, 6·11 ohms. The pole pieces weigh several tons. The armature is driven by a Porter-Allen engine, fastened on the same base and driving direct by main shaft, making 350 revolutions per minute, and of 125 indicated H.P. The E.M.F. of machines is 125 volts, and current 1,000 ampères, working 1,000 lamps of 16 candle-power. The entire weight of dynamo and engine, installed at 57 Holborn-viaduct, is 22 tons, and for comparison I may state that the 40-light "Brush" machine weighs but two tons. Largest coil was made by Apps, special pattern; length of spark 57in., constructed in 1868 for Royal Polytechnic, and sold this spring for about £16. Dr. Spottiswoode, F.R.S., has coil by Apps, spark 42in. Description in "Engineering," for April 20th, 1877.—Storey, Chemist, Parade, Canterbury.

[47712.]—**Largest Dynamo and Coil.**—I cannot inform "Electrician" who has the largest dynamo. The Brush Company had some fine ones at the Crystal Palace; but, probably, Edison, at Menlo Park, has larger. The largest coil is, I believe, one made by Apps, of the Strand, for Mr. Spottiswoode, of Sevenoaks. Its spark is 42in. long. The Polytechnic coil was the next, I fancy, as it used to give a 29in. spark till it broke down.—B. H.

[47717.]—**Problem.**—By writing $1/y$ for $x + 1$ the equation may be transformed into $5(y^2 - y)^2 + 5(y^2 - y) = a - 1$, when it is easily solved.—C. W. B.

[47720.]—**Oilstone.**—I don't know anything about softening an oilstone, nor do I see why it ought to be softened; but I do know that paraffin oil will quickly remove all clogged matter from its surface, which I conclude is all that is required.—J. J. A., Liverpool.

[47721.]—**Studying for Medical Profession.**—Means a preliminary examination for general education; for this many certificates are accepted in lieu, both English and foreign universities. If "Delta" has not such a certificate, the examination consists of the following: Writing from dictation; English grammar; English composition; arithmetic; geography of Europe, and especially British isles; English history; mathematics, Euclid, books 1 and 2; algebra, to simple equations; translation from "De Bello Gallico," and one of the following optional subjects: Greek, German and French grammar, and translation; mechanics; chemistry; botany and zoology. This enables the person to register as medical student, and it is not until after four years of professional study and registration as student that the "final" can be passed. Compulsory attendance at hospital about two and a half years. Scotch diplomas easiest and cheapest. More privately on addressing—Story, 1, Parade, Canterbury.

[47728.]—**Electrical.**—Could not say how many necessary. That is a matter for experiment. Siemens' alternating current-machine reverses 40 times per second or so.—E.

[47731.]—**Killing-Bottle.**—It is cheaper and better to buy; with care and a good cork always kept tightly in the bottle, it will last a season. They are made by alternate layers of cyanide and blotting paper or gypsum; mine kill in about half a minute. I generally leave the insects in all night, and when about half-dozen are in put a piece of blotting-paper over them to prevent damage.—John Alex. Ollard, F.R.M.S., Enfield.

[47733.]—**Switch for Telephones.**—If "F. C. M." will advertise his private address in next week's number of the "E. M.," I will send him drawings and a full description of a switch I made for myself, which is simple and answers the purpose well.—R. H. R.

[47733.]—**Switch for Telephones.**—There is no switch required. Connect up the set of instruments at Station C as you have done at A and B. Put on earth at the earth terminal of the C set, bring C's line wire into B's office, disconnect B's earth, and place C's line wire on the terminal that you have disconnected from earth. Your "circuit" should now be complete, A to C through B.—Science.

[47734.—**Microscopic.**—(1) Any you may fancy; (2) a binocular is not necessary; (3) one that will move in any direction freely without rack and pinion adjustment; (4) ½in. and ¼in. aperture—I don't know; (5) the eyepiece only enlarges what the objective defines. By using a more powerful eyepiece you get a large image, a less field, and less light. Powell and Lealand, 170, Euston-road, No. 3, £11 11s.; I do not know what accessories it has. Civil Service Stores, from £2 10s.; object-glasses, ½in. 40s., ¼in. 40s., ⅛in. collar adjustment, £6 10s. Shall be pleased to give any further information personally.—John Alex. Ollard, F.R.M.S., Enfield.

[47734.]—**Microscopic.**—To "O. O."—I would recommend a binocular, with removable prism, thus converting it into a "mono." The price named should secure a good instrument, and often a reliable one may be obtained second-hand. A good mechanical stage, with several motions, should be obtained—one which has also concentric rotation. Stand should have quick and slow motions, be free from vibration in all positions, and thoroughly well fitted. Spot lens is very useful in investigation on the animalcule. A 2 – 3 or 1 – 2 is the shortest focus that can be used with "bin"; and to possess a ¼ obj. and deep eyepiece all ordinary investigations may be carried on. If you will write me personally, stating your requirements, I will assist you.—Story, Chemist, Parade, Canterbury.

[47735.]—**Cataract.**—*Don't eat salt.* Notes would be too long for "E.M."—John Alex Ollard, F.R.M.S., Enfield.

[47735.]—**Cataract.**—"Architectus" should not trouble himself about his eyes as long as he can read comfortably in spectacles, and while his distant vision is good. He should be careful to have the right sight in the spectacles.—A. Howes.

[47735.]—**Cataract.**—Cataract is undoubtedly hereditary in some families, but you need not disquiet yourself prematurely. It is highly probable that you may escape altogether. The symptoms you describe are not those of cataract at all. It first interferes with distant vision. You should at your age always wear glasses for reading, especially by artificial light. Proper glasses, such as would enable you to read the small print in the English Mechanic at a distance of 10 or 12in. from the eye will not weaken your sight, but rather tend to preserve it. There is no remedy against the formation of cataract. Keep yourself in good health, mind and body, and you have the best chance of escaping. Laborious occupations, which cause profuse perspiration, undoubtedly tend to produce cataract; hence its greater frequency in the country than in the town.—Charles Ed. Glascott, M.D., Manchester.

[47735.]—**Cataract.**—May I be allowed to call attention to Dr. J. Compton Burnett's "Supersalinity of the Blood; an accelerator of Senility and a cause of Cataract"? I have not seen the work, but only a review in the *Dietetic Reformer* for August, wherein appears the following quotation, amongst others: "If salt can cause cataract in the lower animals, it may be fairly inferred that it possesses a like power over the human body."—Spes.

[47737.]—**Black Shellac Varnish.**—I find the best way to make and use sealing-wax varnish is as follows:—First make a solution of shellac in methylated spirit; also keep separate in a small box some kind of black pigment in fine powder (such as ivory black), dip the brush into the varnish, and then into the powder, and lay it on as thick or as thin as you like. You can use, instead of black, vermilion or ultramarine, if those colours are desired. This is the only method by which I have been able to obtain a perfectly opaque coating.—Os.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

Since our last H. Stooke has replied to 47721.

47137. Wood Splitting Machine, p. 339.
47139. Staircase, 339.
47141. Notes on Dynamo-Machines, 339.
47142. Marquetry, 339.
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47163. Preparation of Bone for Turning, 339.
47172. G.W.R. (B.G.) Engines, 339.
47182. G.W.R. Engines, 340.
47183. Brake Trials in Germany, 340.
47185. Embossing Glass. To A. W. Soward, 340.
47192. Locomotive Engines. 340.
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47379. Model, p. 436.
47381. Wildbad and its Cures, 436.
47389. Engine and Carriage Spring Furnace, 436.
47390. Foundry, 436.
47398. Lewis' Incandescent Gas-Lamp, 436.
47401. Coil. To T. N. Andrews, 436.
47409. Circular Bead-Cutter, 436.

QUERIES.

[47743.]—**Discharge of Egg-shaped Sewers.**—In a translation of "Molesworth," the following formula is given for calculating the discharge in egg-shaped sewers $\frac{2}{3}$ full :—

$$Q = 19{\cdot}320 \sqrt{d^5 \frac{f}{l}}$$

Q being discharge in litres per second.
d = diam. (I presume, diam. of large end ?).
f = fall.
l = distance.

I fail to see any connection between diam. raised to 5th power and the discharge, and should feel obliged to any mathematical reader of the "E. M." who could enlighten me on this formula, or give a more comprehensible one ? In "Abstracts of Papers in Foreign Transactions and Periodicals," Vol. LXVII, p. 25, Session 1881-2, Part II., published by the Institution of Civil Engineers, in a report of various sewage works in Europe, the discharge in egg-shaped sewers in cubic metres per second, is calculated by the following formula :—

$$\text{Log. } D = 2{\cdot}0803 + \frac{5 \log. r + \log. s}{2}$$

D = discharge in cubic metres per second.
r = mean radius (whatever that may mean).
s = sine of slopes, the form being egg-shaped, and width $\frac{2}{3}$ of height, and $\frac{2}{3}$ full.

This formula appears to me to be just as unsatisfactory as the former. By sine of slope, I presume is intended fall per metre. How is the total area of an egg-shaped sewer calculated ? The proper proportions should be, I think, diam. large end = $\frac{2}{3}$ height; diam. small end = $\frac{1}{3}$ height.—Etna.

[47744.]—**Trigonometry.**—I shall be glad if any one will solve the following :—

$$\text{Tan} \frac{a + B}{2} + \tan \frac{a - B}{2} = \frac{2 \sin a}{\cos a + \cos B}$$

—Constant Reader.

[47745.]—**Palpitation of the Heart.**—Will any medical friend tell me of a cure for palpitation of the heart ? Is it heart disease or not ?—A Subscriber.

[47746.]—**Terra-Cotta Paintings.**—Can any reader inform me the cheapest and best preparation for preventing terra-cotta paintings from being spoilt when washed ?—A. C. S.

[47747.]—**Legal.**—I filed my petition in 1877, and the first meeting of creditors broke up without passing any resolution, and no further proceedings of any kind were taken under the petition, nor by any individual creditor. If I am sued for any of the debts contracted prior to the date of the said petition after May 1883, can I successfully plead the Statute of Limitations ?—W. A. B.

[47748.]—**Pickles.**—Some ten or twelve years ago I saw amongst the answers to queries in the Mechanic a recipe for making pickles, signed "Sweedlepipe Cottage." My wife made a large quantity at the time, and they turned out superior to any we had ever met with. Somehow or other, she has lost the recipe. Could any reader furnish me with it ? I have searched through my old Mechanics, but cannot come across it.—Amateur Gardener.

[47749.]—**Polarised Relay.**—Will Mr. Lancaster, or some other able correspondent, kindly explain the make of a polarised relay ? Also, should steel prepared for magnetisation be made dead hard, or have its temper drawn at all ?—G. R. E.

[47750.]—**Polishing Wardrobe.**—I have made a wardrobe of spruce, and not being a practical hand, there are a few places I have had to fill up with putty, and I find that after I come to polish, I can see the marks of the stopping after the polish is applied, but not before. Can anyone tell of a remedy to avoid this ? I don't care if it covers the grain, if it is something I can polish or varnish on ; but I don't want to paint. Any plain instructions would greatly assist.—Amateur.

[47751.]—**Declination Circle.**—My circle has two verniers, and when I am reading the declination of an unknown star, how am I to know whether it is N. or S. ? The two verniers give me the same declination, whichever I read from ; but one will be N. and the other S., and how am I, therefore, to know which I ought to read from ?—Brickwall.

[47752.]—**The Flux of Soap.**—Will Mr. Allen kindly inform me what is meant by the so-called "flux" of soap ? Lately, I have come across the word in the *Chemical News* and other papers, but cannot find out its meaning.—Inquisition.

[47753.]—**Polishing Piano-Keys.** — To Mr. Davies.—I want to scrape and polish my piano-keys. Would it be be best to scrape and polish each key separately, or keep them on the key-frame and do them altogether (of course, removing the black-keys), as you direct for a new set ? Also, should I use putty or pumice powder ?—J. Jones.

[47754.]—**Tin.**—I have about 100 tins that have been imported with castor-oil in them. Is there any means of disposing of them, or have they all to be thrown away ? If some kind reader of ours can suggest a means of making something out of them, he will oblige many, I dare say, besides—Soap-Boiler.

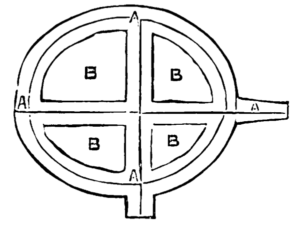
[47755.]—**Heating Henhouse.**—Will somebody kindly tell me the best way to heat a henhouse ? Would a pipe with hot air, heated with a lamp running the whole length of the floor, and back again, be sufficient ?—Jingle.

[47756.]—**Electro-Plating.**—Will Mr. Lancaster, or other kind reader, inform me of the best instrument in use for measuring the intensity of the electric current from the batteries used for electro-plating ? Also, please give instructions how to make, or say if it would be better to purchase the instrument ?—Galvanometer.

[47757.]—**Manganese.**—Will Mr. Allen, or other of our chemical readers, say what the impurities are in commercial manganese ores, and give particulars how to analyse them ?—Chlorine.

[47758.]—**Carbolic Acid.**—Will Mr. Allen, or other of our chemical readers, inform me how to analyse carbolic acid quantitatively, and to estimate the quantities of the impurities usually found in the commercial article ?—Disinfectant.

[47759.] — **Archæological.** — Will some of our antiquarian friends kindly tell me what the inclosed is,



which I came across when walking in the South of Scotland, about three years ago ? I may mention that the neighbourhood abounds in cairns, camps, &c The parts marked A are raised about 18in., and are half-circle in shape, the insides B being the level of the outside ground.—A Would-be Piper.

[47760.]—**Tinning and Galvanising Iron.**—I shall be obliged if any reader can give me information about the tinning and also the galvanising of iron by the electro process ; whether, since the introduction of the dynamo-electric machine, there is a likelihood of the electro process superseding the ordinary dipping process ? Also, which process is the more economical in regard to price, and which produces the best article ? I think I have seen an objection stated somewhere that the coating was more porous—and not so homogeneous—by the electro process than by the ordinary process.—Tin-Plate.

[47761.]—**Steam-launch.**—Will some kind reader help me with the following information ?—I want to build an iron sea-going steam-launch, strong enough to stand *any gale*. What size angle-iron, what thickness sheet-iron—steel or iron, which ? Should the iron be put on in narrow strips or broad pieces ? What power engine to steam 20 miles an hour without strain in smooth water ? Would a boat 45ft. long, 8ft. beam, 7ft. deep l.w.l., and 3ft. freeboard carry enough coal for eight days ? What would be about cost of engine, boiler, propeller, &c., complete ? Living in the jungle, I would like to build above in spare hours. Have built two wooden boats : no experience in working with iron.—Indigo Planter.

[47762.]—**Insects in Fernery.**—Can any of ours tell me of a simple means of destroying insects without injuring the ferns, in a small fernery ? It is about 4ft. by 1ft. 3in. by 3ft. high, fitted in the window outside ? It is nearly airtight, and all appear to thrive fairly well, except Adiantums : these do not get along as I should like. I get very little sun, often none. Is it advisable to water them so long as the soil is moist ? If so how often ?—Boswell.

[47763.]—**Osier-growing and Basket Making.**—Will any reader kindly give information or say if there is a work published on osier-growing and basket-making ?—Dolomite.

[47764.]—**Greenhouse.**—To Mr. Wetherfield.—I have built a greenhouse in garden, the back supported on a 4½in. wall that abuts against the garden wall. I am leaving the house at Christmas, and intend giving notice to my landlord at Michaelmas. I am told that if I take it down before I give notice to quit, I can do so with impunity. Is this legal ?—Douglas.

[47765.]—**Preserving Eggs.**—Can any one tell whether silicate of soda is of much use in preserving eggs ? I have heard that if eggs are coated with a solution of this substance they keep a very long time. If any one can give me their experience in this matter, I shall be much obliged.—A. M. R.

[47766.]—**H.M.S. Ajax.**—Can any reader kindly give me a short description of the engines of this ironclad, which is at present in Chatham dockyard ?—H. W.

[47767.]—**American Loco.**—Can any one tell me what that American loco. that ran from Manchester to Leeds on the 15th, and from Leeds to Doncaster on the 16th of last March, has been doing since those dates ?—H. W.

[47768.]—**G.N.R. Engines.**—I should like to know how many 8ft. single engines there are on the G.N.R., and where they are all stationed ?—H. W.

[47769.]—**Wire for Induction Coils—Incandescent Lamps.**—Would any subscriber kindly tell me whether No. 36 cotton-covered wire will do for induction coils, as I have a quantity, and should like to make use of it in that way ? Also, the filament for incandescent lamps. What is principally used—platinum wire or carbon filaments ?—Amateur Electrician.

[47770.]—**Preventing Rust.**—I have in a glass case a quantity of cutlery and other steel goods which, from exposure, have become covered with rust. I should, therefore, be glad to learn of some method of preventing the rust. The case is against an outside wall, but is well lined with board. I have been told that by keeping a small but constant supply of heat in the case by means of a small lamp or a jet of gas, and making the case as airtight as possible, the corrosion would be prevented. Would this be effectual, or would the gas, as I have heard, increase the evil ?—W. P. M.

[47771.]—**Dead Black for Brass.**—Will some obliging fellow-reader tell me the best method of doing this ? I am told that it is done with nitrate of silver and sulphate of copper, or with dilute acid and heat, or with chloride of platinum. What I want is the "modus operandi." I can get nothing approaching a black with chloride of platinum. What I have seen on instruments is dead black, with no lacquer on it, and evidently produced by chemically acting on the metal.—One in a Fix.

[47772.]—**Henley's Discharge.**—Will any reader give me full directions how to make an "Henley's Discharger" (for a coil) ? About medium size will do.—A. Chapman.

[47773.]—**Voyages in Small Craft.**—Will any of your numerous readers inform me where I can procure books or accounts of voyages in small craft ? I have been much interested in reading the "Log of the Little Western," and should like works of a similar nature. Accounts of cruising round the British coast would also prove interesting. Probably, many of your readers have themselves made similar voyages. Should this be the case, and they would give detailed accounts of the cruise, it would doubtless be interesting to others as well as—Aconite.

[47774.]—**Cutters for Use in Lathe.**—Would any mechanic well up in wood-cutting machinery give design of cutters that would round the ends of brushes to any template, and put the hollow usually seen in the edge of brushes, cutters to run in lathe, and to do the work speedily ? I have cutters on the same principle as circular moulding machine, made to run in common lathe, but find great difficulty in holding the brush to the cutters, as they tug it out of my hand ; but running the cutters horizontal in lathe has the advantage of right and left cutting, and running them vertically you have the advantage of the table to rest and steady the brush, but can only cut one way, and would cause extra expense to have two spindles with cutters. By giving a hint how these brushes are finished by machinery, will greatly oblige.—J. C.

[47775.]—**Staining Sycamore.**—Would any friend give directions how to stain sycamore to resemble American birch ? Water-stains do not suit. Sycamore to be stained are veneers glued on to ground-work.—J. C.

[47776.]—**Reading the Morse Code.**—As this, I believe, consists wholly of dots and dashes, will some one explain how, in reading, the termination of one letter or word is distinguished from the commencement of the next—thus : A being a dot and a dash, and N a dash and a dot, how can AN be distinguished from WE, which would be dot dash dash dot ?—M. E.

[47777.]—**Cloud Negatives.** — Will any reader kindly give instructions for printing clouds into the skies of landscapes so that no join is visible ? Are both the landscape and cloud printed simultaneously ?—Glen.

[47778.]—**Whitewashing.**—Can any of "ours" tell me the cause of ceilings or brickwork drying with yellow stains in it after being carefully washed off and whited (two coats) ? Is it because the work was not dry enough before whiting, or is it due to any chemical present either in plaster or brick, or does the ultramarine blue I put in the whitewash have any effect ? I have done many a ceiling and staircase, but am seldom troubled by these stains. Can any of "ours" tell me the cause and how to remedy it ? I am now doing some brickwork which persistently turns up a brownish yellow half-hour afterwards.—A. Hunt, Lambeth.

[47779.]—**Soda - Water Siphon.**—Can any of "ours" give me the method of filling soda or potash water siphons ? Is the gas forced in by means of a pump or generated in the bottle itself ?—Phenol.

[47780.]—**F.C.S.**—I should be glad if some of "ours" would give me the qualifications required to become a "Fellow of the Chemical Society," and also a "Fellow of the Institute of Chemistry."—Phenol.

[47781.]—**Gold-Dust.**—Is there not some liquid for mixing with gold-dust for painting besides that sold with the gold dust ?—Artist.

[47782.]—**Confectioners' Oven.**—What is the best kind of oven for a confectioner's use (that is an iron oven), not a very large size ?—R. Barraclough.

[47783.]—**Legal.**—To Mr. Wetherfield.—A. (father) transfers certain property in trust of B. and C. (gentleman and unmarried lady) for his daughter, D., about to be married. Marriage takes place ; A. dies ; trustees act jointly in interest of D. Somewhat later B. (the gentleman trustee) also dies, leaving C only (unmarried lady) as acting and sole trustee. Eventually, C purposes marriage.—What becomes of the trusteeship ? Can C., when married, continue legally to act as trustee for D., or does the husband of C. obtain any controlling rights over the trust property, or does the trusteeship altogether cease, and in that case how is the trust property to be dealt with ? Can D. claim its being paid to her ? Kind advice in this difficulty will oblige:—Marienberg.

[47784.]—**Cistern.**—A cistern holding 1,200 gallons is filled by three pipes, A, B, C, together in 24 minutes ; the pipe A requires 30 minutes more than C to fill the cistern, and 10 gallons less run through C per minute than run through A and B together. Find the time in which each pipe alone would fill the cistern.—Sheffield.

[47785.]—**Bisulphite of Lime in Beer.**—Will Mr. Allen give a test for this ?—R. G.

[47786.]—**Bisulphite of Lime in Beer.**—To Dr. Edmunds.—It is no secret that this is used extensively to preserve beers. I am drinking the bottled beer of a leading firm of Burton brewers, and can smell it when I draw a cork. What will be the effect on the system if taken for a long time, say a year ?—R. G.

[47787.]—**Marine Engineering at Woolwich Arsenal.**—Will any reader kindly inform me whether it is likely employment can be obtained as marine engineer at Woolwich Arsenal, and to whom should application be made ?—S. H. F.

[47788.]—**Lending Money on Title Deeds.**—If a person lends money to a building club, and the trustees of the club find and hand over the deeds of property belonging to the members of the said club as security to cover the amount lent, would the lender be fully secured by the above transaction in case of the club coming to grief ?—Thos. Brown.

[47789.]—**Tent.**—I have a canvas tent erected for preaching, and find when it rains the water drops through, to the great inconvenience of the congregation. Can anything be done for it to make it watertight, and still be as pliable as at present, and by no means the light inside to be interfered with? It is often put up and taken down and transferred to another place.—James Wharton.

[47790.]—**Mechanical Lantern-Slides.**—I should be very much obliged if some reader would give a description of some of the various mechanical slides that are sold, some of which are: rippling water, the chameleon, the choreutoscope or lantern actor, the wheel of life, &c.—Grapho.

[47791.]—**Loan.**—Would Mr. F. Wetherfield be good enough to inform me on the following question?—I obtained a loan about a month since for £40, for which I gave a bill of sale on all my goods and furniture. I paid up with the amount all my liabilities but two, one for amount of £2, the other £15. Can either of these individuals sue me through the County Court, and distrain any of my property under the circumstances if I am not in a position to pay, or what course can they take in the matter? I may say the amount for £2 is the balance of an account for which plaintiff obtained judgment in the Court, but I have been unable to keep up instalments. The summons was issued previous to my giving a bill of sale.—Timid One.

[47792.]—**Staining Glass Green.**—What is the best means of staining ordinary window-glass green. Can it be done by a chemical solution? If so, what are the ingredients?—An Old Contributor.

[47793.]—**Electro-Plating.**—Seeing in a work on electro-metallurgy that a silver-plating bath should be made "by dissolving one oz. of nitrate of silver in distilled water, and adding cyanide of potassium in just sufficient quantity to precipitate all the silver as cyanide of silver," I got the cyanide of silver easily by these directions, being a white ppt. when first thrown down, but it soon became brown—by the action of sunlight, I presume. It is the second part of the process that has gone quite contrary to my expectations, as the directions say, "to the cyanide of silver thus produced add 3 oz. of cyanide of potassium, when the cyanide of silver (which has previously been covered with a gal. of water) will be immediately dissolved. Stirring expedites the dissolving." Now I added 6 oz. of cyanide of potassium (commercial) to the cyanide of silver, and only succeeded in 24 hours in dissolving half of the ppt., the other half remaining as a brown mass at the bottom of my electro-plating bath. Will some of ours kindly say where I have gone wrong, and say whether the solution is now useless, or can I repair it in any way?—A Beginner.

[47794.]—**Legal.**—Having been made a bankrupt a year or two ago, and the trustee and committee of inspection had given their unanimous consent to my order of discharge, which, I was given to understand, is to be had for the asking, would Mr. Wetherfield kindly inform me if I can obtain it by myself, and if so, what fee, if any, I should have to pay to the Court official? And if I do not trouble about getting it at all, what effect this would have on any future earnings or property that might come to me?—W. A.

[47795.]—**Riveting China.**—To "Alfojoe."—Kindly say how the brass or copper wire used for rivets is tempered, and, also, how to give the rivets a little spring so as to catch under the holes on the inner side?—A Young Amateur.

[47796.]—**Electrical.**—I have had my field-magnet cast in best iron, also the armature. I have wound the E.M. with 30lb. of No. 10 wire, and properly insulated the whole. I am now waiting to see if I can obtain any guide how to wind the armature for quantity, as I want the machine for electrotyping. Also, the size of the wire? A small sketch of the connections would be of great assistance to me. I have no doubt that many of our readers are stuck fast in the same place as myself. What is required is for some one to give answers to the following questions:—How much wire should there be on E.M., and the size B.W.G.? How much on the armature, and the best form of ditto? How to wind the machine for quantity and intensity? How many revolutions per minute, and a small sketch to show connections?—W. T. W.

[47797.]—**Legal.**—A person who owed me eight guineas has recently (in April last) filed his petition, and a dividend of 2s. 4d. in the £ was declared. As the bankrupt did not schedule my debt, I did not know of the liquidation till a week ago, and am informed there is no dividend reserved for me. The liquidator is now living with and on his mother-in-law. How can I obtain any of my money, and is the bankrupt criminally liable for not scheduling my debt?—Ramchullunder.

[47798.]—**Heating by Steam.**—In manufacture certain articles have to be subjected to a temperature of 212° Fahr., either boiling water or steam, as the case may be; but would the same effect be produced when using that process at an elevation of 4,000ft. above sea-level, at which elevation water boils at a considerably lower temperature—viz., 204°, and where, I presume, the steam would likewise be of the same diminished temperature? In this latter case, would it, or would it not be necessary to subject the articles to steam under pressure, in order to have the temperature of the steam to be used raised to 212° Fahr.?—No Name.

[47799.]—**Small Battery.**—I should be obliged if Mr. Lancaster or some other of your kind correspondents would tell me if it is possible to make a small electric battery to inclose in a small vessel about quarter the size of an ordinary tumbler-glass that would not be in action excepting when the elements were brought in contact by the pressure of a spring or screw, and if such a battery could be constructed, could it be made to produce about 70° Fahr. of heat in another vessel of similar size?—Highfield.

[47800.]—**Deodorising Oil.**—I have bought at a sale a quantity of mineral oil 905 which is strongly impregnated with nitro-benzol. Will Mr. Allen, or other, kindly say how this smell can be taken off?—charcoal, chloride of lime, chloride of zinc do not affect it in the least.—Oleo.

[47801.]—**Re-Olification.**—Can an oil partly saponified by caustic soda or other alkali be retransformed into transparent oil without injuring or darkening the oil? Shall be glad of suggestions or process.—Oleo.

[47802.]—**Legal.**—To Mr. Wetherfield.—A man having married within the table of affinities prohibited by the Church, desires to make his will, leaving all he possesses to his wife for life, with remainder to children of said marriage on her disease. How should he word his will to do this effectually? The said marriage was solemnised in Church of England.—C.

[47803.]—**Third Grade Art.**—I have passed the examinations in the Second Grade, and am desirous of sitting for the higher grade in May next. Circumstances will prevent me attending any classes. I shall be glad of any advice for self-instruction. I shall be able to visit South Kensington Museum occasionally. Would it be possible to do some of the drawing from casts, &c., there?—L.

[47804.]—**Model Engine Cylinders.**—Can anyone kindly tell me the best way to chuck and bore model engine cylinders ½in. and ⅞in. bore? Would a twist drill bore them truly? If not, kindly say the best way to do them.—A. G. W.

[47805.]—**To "Jack of All Trades."**—Will he kindly say what size and pitch of screw-propeller will a compound surface condensing-engine drive cylinders 2in. by 3½in. by 4in. stroke? And, what size of horizontal tubular boiler suitable for the same? and oblige—Coquet.

[47806.]—**Chemical Lung or Sanitary Punka.**—Will someone kindly give a working drawing of a sanitary punka? I think it was noticed some time ago in the *Lancet*, but am not sure. I wish to have one made for a sick friend.—Amateur Printer.

[47807.]—**Gas Water-heaters.**—Will some correspondents, unconnected with the trade, kindly give me their opinion, from practical knowledge, of the advantages and disadvantages of instantaneous (gas) water heaters for baths, especially with reference to the only forms I have heard of?—viz., Maughan's and Braby's.—M. D.

[47808.]—**Telephone.**—To Mr. Lancaster.—Having made two of Bell's telephones, I cannot get them to speak at all. I have made them with a copper reel split, and ½oz. of 36 silk-covered wire on each reel, and all the results I can get when I attached them to a battery is a ticking noise in them, and the same when I put the microphone to them—I can get no better results. Will you please to say if I have enough wire on the reel, and to say what is the best sort of a reel?—W. H., Liverpool.

[47809.]—**Legal.**—To Mr. Wetherfield.—The father A. made his will in favour of his daughter B., who was then married to C. The words of the will are the following:—"I A. give and bequeath the several houses and gardens, situated at ————, unto my daughter B., the wife of C., and her assigns for ever." The daughter B. died some years ago, leaving several children, of which two daughters are still living. The husband C. has married the second time. It is understood that he has lately sold a portion of one of the above gardens to a neighbour living close by. Now, will you kindly answer the following?—1. Is the will valid in favour of the two surviving daughters? 2. Has he a right to sell that portion of the property. 3. If not, what is to be done in order to repossess it?—Petros.

[47810.]—**Heating Soldering Iron.**—Would "Jack of All Trades," or any other brother-reader, be good enough to give me a simple method of heating soldering iron at the bench, where gas or a fireplace would be inconvenient?—T. J. O'C.

[47811.]—**Electric Pendulum.**—Would Mr. Lancaster be so kind as to instruct me how to make an electric pendulum for a clock? Also, the simplest method of transmitting the motion of the pendulum to the works?—T. J. O'C.

[47812.]—**Hydraulic Cylinders.**—There seems considerable difficulty in casting these perfectly tight when kept for 24 hours under pressure. I have a number of small ones to cast for tobacco-pressing, and would be glad to know whether any liquid put inside would close the pores through which a damp sweat exudes? Or, whether any special mixture of iron is required?—Pig-iron.

[47813.]—**Transit of Venus.**—I must tender my hearty thanks to the correspondents of "ours" who have so kindly given me information as to the suitability of Jamaica for observing the approaching transit. The local times and altitudes given by "S. G." are of the greatest value, and he has my sincere thanks for the trouble he has taken. I must also acknowledge my indebtedness to "S. B." for the full and interesting details he sends. Would he kindly give his reasons for selecting Southern Port Royal Mountains? Also, recommend some exact locality, keeping in view ease of access from Kingston, and suitability in other respects? Any information as to local travelling, living, precautions to be taken as to clothing, &c., would be most acceptable. I called at the R.W.I.M. Co.'s offices the other day, and find that in all probability there will be a numerous party of observers, as some passages are already taken by men going out for that purpose.—Jamaica.

[47814.]—**Photographic.**—Could any reader kindly put me right in the following difficulties?—1. My toning bath, after a few days, becomes of a dark indigo colour, and the gold is deposited in a black precipitate in the bottle, although kept in the dark. I wash my prints thoroughly before toning in three changes of water, but then I only float them face downwards. Should they be immersed? My bath is composed as follows:—Acetate of soda, 4½ drachms; chloride of gold, 9 grains; water, 45oz. This formula is the one recommended by Wratten and Wainwright. 2. My negatives have frequently dull-looking spots all over them, which sometimes show faintly in the print, and sometimes not at all. I should be glad to know what causes these, as my chemicals are all pure and clean. Also, my fixing and alum baths. I use dry plates. 3. My negatives have a great many "pin-holes," although I take the precaution of brushing them very gently during development with a very soft badger hair-brush. Any hints will greatly oblige—Negative.

[47815.]—**Thermopile.**—Will Mr. Lancaster, "Sigma," or some other competent authority, kindly answer the following questions?—If a thermopile were made of 100 pairs of copper and iron plates 6in. long, ¼in. wide, and, say, 1/32in. thick, and a difference of temperature of 80° Centigrade were maintained between alternate junctions, would the E.M.F. equal that of a Daniell cell? Would not the resistance of such a pile be lower than that of a Daniell cell? What would be the difference of current from a couple of bismuth and antimony, and from another of iron and copper, the other conditions being equal? Would the former give double the power of the latter?—J. N.

[47816.]—**Silicate of Magnesia.**—Will Mr. Allen or other of our kind readers inform if it is possible to form silicate of magnesia in the cold—e.g., by adding silicate of soda to carbonate of magnesia? I have no furnace, and I want to prepare a small quantity. What method could be recommended?—Magnesite.

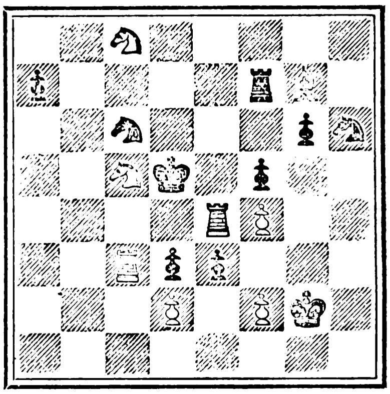
[47817.]—**Rapid Electro-Plating.**—I have seen articles rapidly silvered by first dipping them into a copper bath and then into the silver solution. How are the solutions made up?—A Seven Years' Subscriber.

CHESS.

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden, W.C.

PROBLEM DCCLXXV.—By J. Pierce.

Black.



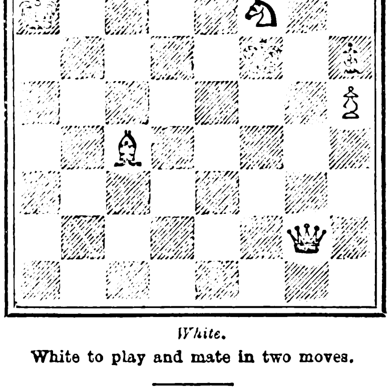
White.

White to play and mate in three moves.

PROBLEM DCCLXXVI.—By "She Soars to Conquer."

From *The Boy's Newspaper.*

Black.



White.

White to play and mate in two moves.

Solution to 771.

White.	*Black.*
1. Q to K R sq.	1. Anything.
2. Mates.	

Solution to 772.

White.	*Black.*
1. B to Q R sq.	1. Anything.
2. Mates.	

PAUL MORPHY.

An Acrostic.

Paled is thy light, so bright
A Pleiad pass'd away:
Unrivall'd star, afar
Lost to our sight, for aye.
Midst wondering gaze, thy blaze
Of glory ceas'd to burn:
Resume thy sway, bright ray,
Proud conqueror, return:
Here do we wait and watch in vain.
Yet time flies on—no hopes remain.

F. F. Beechey

NOTICES TO CORRESPONDENTS.

There is a second solution to 763 beginning 1. Q to K 3.

Correct Solutions to 768 and 769 by W. A. Lee; to 771 and 772 by Schmucke.

W. A. Lee.—770 is, we believe, correct.

W. T. Bayne.—The acknowledgment appeared in last number.

ANSWERS TO CORRESPONDENTS.

*** *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

*** Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Aug. 23, and unacknowledged elsewhere:—

Morris Cohen.—W. A. Thoms.—R. S. Smyth.—Selig, Sonnenthal, and Co.—W. Robertson and Co.—Whitley Partners.—Newton and Co.—Iskender.—L. J.—S. W. Burnham.—W. P. M.—A. Manock.—Vesuvius.—E. A. Brookes.—Anxious.—M. P.—G. W. Tee.—J. F.—Amateur Farmer.—Grapho.—J. H.—P. B.—J. W. Fleming.—Orderic Vital —S. P.

A NEW VOLUME.

The next number is the last of volume XXXV. Readers willing to oblige us by recommending "ours" to new subscribers should do so now, when a new volume is commencing. The index to Vol. XXXV. will be published in the number dated Sept. 22, and cases and bound volumes will be on sale shortly after. Readers desirous of making up their sets for binding the present volume are recommended to do so at once, as the back numbers soon run out of print.

A. Cowlishaw. (Yes, in the majority of cases, and nearly always if ordered through a bookseller.)—Harry Smith. (1. No, if he is in earnest. 2. As an assistant, from £1 upwards, according to ability. 3. Yes. 4. Perseverance and determination, as in most other avocations, are better than mere cleverness. 5. An army corps specially devoted to engineering. You are too old to join, we think.)—Argentum. (Price 6d., published by Cousins and Co., 3, York-street, W.C.)—T. E. D. (You must sue the sisters by their names. County Courts do not recognise "Mrs." or "Miss.")—Y. Z. (We do not understand how the local board can exist without by-laws or regulations. The probability is that the Board is acting within its authority, but if you think you have a good case, you can dispute it, and let the Board summon you before the local magistrates.)—F. Gartside Tipping. (We know nothing of him, and, of course, do not guarantee the honesty of any advertiser. Write to him that you have communicated with us, and if no satisfactory explanation is forthcoming no further advertisement of his shall appear.)—M. C. H. (We can only suggest paste. Such a mucilage as you appear to require would be a valuable commercial article. 2. Black is the correct answer, for without light there can be no colour.)—Parvus Vir. (The heat depends on the kind of plants you wish to keep. Gas, if you can get it, would be the best heating medium, all things considered; but for so small a house one of the paraffin-oil stoves might suffice.)—Barometer. (Yes, the wire "did it." To get the air out, heat the tube and tap gently on end.)—An Amateur. (He has already done so. See pp. 415, 583, Vol. XXXIII.)—Tom B. (Known as Pharaoh's serpents. See p. 485, No. 513.)—Chime. (See the back numbers, or consult an elementary manual on Sound.)—H. Walker. (It is a troublesome job. Try heating and shaking. If that is of no avail you must take it to the optician.)—J. Noon. (It is tolerably well known. You will find something about it on p. 146, this volume. We omit nothing of a practical character.)—Poor Oilman. (You must really refer to the indices, where you will find references to all kinds of telephones, &c.)—W. D. J. (See one of the cheap manuals on pyrotechny, for a full list of the recipes would occupy a column. Blue, metallic antimony 1 part, sulphur 2 parts, nitre 5 parts. Red, sulphur, sulphuret of antimony, and nitre 1 part each, dried nitrate of strontia 5 parts. Green, nitrate of baryta 60, chlorate of potash 18, sulphur 22. The eggs are abominable things. Recipe in No. 513, p. 485.)—E. S. Jones. (There is Reid's "Engineer's Handbook." Get Mr. Calvert's catalogue from Great Jackson-street, Hulme, Manchester. Most books of the kind are entered there.)—Hammer. (We scarcely understand what you mean by "sizes." They are made to numbers, and those can be learned from actual inspection of the machines or from the maker's lists.)—An Afflicted One. (See Dr. Edmunds' reply on p. 430.)—J. C. (You must look in back volumes, or procure some of the illustrated price lists of makers.)—Electric Seeker. (See p. 286, No. 811.)—Co. Limerick. (Lockwood and Co., Stationers' Hall-court, E.C., publish a little book for 6d., entitled, "The Safe Use of Steam," which probably will answer your requirements; but if you want more, the same publishers issue Mr. Reynolds' "Stationary Engine Driving" at 4s. 6d.)—M. E. (You may safely use half a dozen Léclanchés with such a coil. See p. 529. 2. The process has been frequently described. A mould of the type, &c., is taken in plaster or guttapercha, say, and carefully blackleaded. It is then put into the bath, and when the shell of copper is thick enough it is heated, and the back filled up with solder and the usual stereo metal.)—Ignor. (See reply on p. 503.)—G. B. T. (You do not answer the question—how do you get the air out again? You say the "ascending piston would have to rise against the compressure of the inner elastic air, and not against the pressure of the whole atmosphere." The pressure of the elastic air, unless removed by a pump, would therefore be greater than atmospheric pressure, which, with a reduction for friction, is all you have at the other end of the "perpetual motion" machine. If you would make a sketch and calculate the pressures, you would speedily discover the fallacy.)—John P. Davies. (We have failed to find the point of superiority in the brake, which would apparently be very costly. Does it not involve close coupling? If so, that would be an objection.)—Nonplussed. (See Mr Davies's papers on Pianoforte-making in Vol. XXVII., and those on Piano-Soundboards in Vol. XXXII. Your case seems one of those in which personal examination is necessary.)—A. P. (Described on p. 570, No. 778. It is a metallic sulphide mixed with sulphur. It might do for large type, such as is used in posters.)—W. G. (You must consult recent papers on Telescope Construction. 2. You must make a small magneto-electric machine, details of which have been frequently given.)—Electric Mad. (See recent back numbers. You should procure a description of that at the Crystal Palace; but where do you propose to lay it down, or do you want to make a "model"?)—Sufferer. (Recipes of the kind have been given many times.)—One who would Like to Know. (No doubt due to the air; but the correspondent named answered similar query a little time ago.)—A Seven Years' Subscriber. (Query inserted, but if you want a durable coat you must "take a long time.")—An O. B. (Which branch?)—Pecheur. ("The Lathe and its Uses," Trübner, 16s.)—W. J. W. (See p. 284, No. 818. The subject is scarcely suited for a "reply," and if you have no knowledge of such work you ought to get a book on the subject. Donaldson's "Platelayer's Tables," for instance, or one of the books in Calvert's catalogue.)—J. S., 13 Years' Subscriber. (Nos. 529, 696, 734, 847, 856, and 876 can be had, post free, 1s. 3d. The others are out of print.)—Jumbo. (Dr. Edmunds has already intimated that he will be abroad till the middle of September, and therefore unable to reply to queries till then. He has also several times refused to prescribe in such cases as you inquire about, and with good reason.)—T. McE. (If you order Vols XXIX., XXX., XXXI., XXXII., XXXIII., and XXXIV., and all numbers to date of Vol. XXXV., through your bookseller, you will get the series complete. Price £2 6s. 3d.)—Engineer. (You cannot do better than use Leroy's composition, but here is a good recipe when nothing better is to hand for covering steam pipes:—Four parts of coal ashes, sifted through a riddle of four meshes to the inch, one part calcined plaster, one part flour, one part fire-clay. Mix the ashes and fire-clay together to the thickness of thin mortar, in a mortar trough. Mix the calcined plaster and flour together dry, and add to it the ashes and clay as you want to use it. Put it on the pipes in two coats, according to the size of the pipes. For a 6in. pipe, put the first coat about 1¼in. thick, the second coat should be about ½in. thick. Afterwards finish with hard finish, same as applied in plastering a room. It takes the above about two hours and a half to set on a hot pipe.)—Gereb Admi, H. Stocke, P. H., C. H. Romanes, T. J. O'Connor. (In type.)

Every Workman connected with the Building Trades requiring a situation should advertise in "THE BUILDING NEWS," published every FRIDAY, price Fourpence, at 31, Tavistock-street, Covent-garden, London, W.C.

"THE BUILDING NEWS" is the Principal Journal, representing Architects and Builders, and has the largest circulation of any Professional Journal in the kingdom.

Every Workman should insist on seeing "THE BUILDING NEWS" every week at his Club or Coffee House. He will find more "Lists of Tenders" for new work in it every week than in any similar paper, and can thus judge where work is likely to be had. He is also specially invited to make use of "Intercommunication" if he wants to know anything about his trade; to write to the Editor if he has any suggestions to make and to advertise in the paper when he wants work.

The charge for Advertisements for Situations is One Shilling for Twenty Words, and Sixpence for every Eight Words after.

CHARGES FOR ADVERTISING.

	s.	d.
Thirty Words	2	6
Every additional eight words	0	6

Front Page Advertisements Five Shillings for the first 40 words; afterwards 9d. per line. Paragraph Advertisements One Shilling per line. No front page or paragraph advertisement inserted for less than Five Shillings. Reduced terms for series of more than 6 insertions may be ascertained on application to the Publisher.

ADVERTISEMENTS in EXCHANGE COLUMN—for

	s.	d.
Twenty-four words	0	3
For every succeeding Eight words	0	3

ADVERTISEMENTS in the SIXPENNY SALE COLUMN

	s.	d.
Sixteen Words	0	6
For every succeeding Eight Words	0	6

*** It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions; and in cases where the amount sent exceeds One Shilling the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement and charged for.

Advertisements *must* reach the office by 3 p.m. on Wednesday to insure insertion in the following Friday's number.

Holloway's Ointment and Pills.—All ulcerations, sores, abscesses, bad legs, and skin diseases are best treated by these medicaments. The Ointment eradicates all noxious taints, and makes every symptom assume a milder form, and this desirable result is made doubly certain by the purifying, regulating, and alterative powers of the Pills.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

OUR EXCHANGE COLUMN.

The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

Splendid pair of **Horns**, 6ft. from tip to tip, and 11in. at base. Exchange for good 52in. Bicycle; or what offers?—Address, W. T. P., Poundisford, near Taunton, Somerset.

"**English Mechanic**," 114 to 557, in parts and numbers. What exchange?—A. Harris, Wavendon, Woburn, Beds.

Wanted, powerful **Hand Punching Machine** in exchange for one small Horizontal Engine and Boiler, complete, half horse-power.—J. Bilsborough, Alderley Edge, Cheshire.

Picture Frames wanted. Exchange water colour painting or watch, &c.—S. Terril, 409, Monument-road, Birmingham.

Wanted, ¼-plate **Photo. Apparatus**, complete. I will fit up 3½in. lathe-head castings in exchange. Engineer's work warranted, genuine value, quantity, quality.—H. Chambers, 17, Charles-street, Seymour street, N.W.

Wanted, good **Microscope**. Exchange Portable Bellows, value £2, or offers.—Alcock, Sporle, Swaffham, Norfolk.

Handsome Globe-shape street **Gas Lamp**, with bold ornamental swan-neck shape iron bracket to fix to house front, suitable for hotel or business shop, handsomely painted in red and gold. Cost £7, exchange for good bicycle or lathe.—Apply J. Skinner, Sutton Bridge.

"**Cassell's Popular Educator**," complete, in 32 shilling numbers, unbound. Will exchange for a good set of Harmonium reeds.—J. W. Noble, Greetland, near Halifax.

5ft. planed gap **Lathe** bed, leading-screw, full set of change-wheels. Offers—R. D. Smith, Fazakerley-street, Chorley, Lanc.

Amateur wishes to **Exchange** remainder of his stock. 6in. slide rest, turning tools, taps, &c., &c. What offers?—Newman, 27, Raglan road, Plumstead.

Have 34 sixpenny parts of "**Wright's Illustrated** Book of Poultry." Will exchange for "Lathework," by Hasluck, latest edition.—John Holme, 467, Rivington View, Middle Hulton, near Bolton-le-Moors, Lancashire.

Amateur Small Iron **Lathe**, Printing Press, or offers for good electrical goods. List sent. No offers refused. Must be sold.—Walter Wells, Watchmaker, Malvern Link.

Warranted **Joinering Chisels**, assorted sizes, given in exchange for old books, newspapers, or periodicals. Sample chisel and prices, free, 12 stamps.—Mr. Lowe, Ironmonger, Warrington.

52in. **Bicycle**, cone bearings, in perfect condition. Exchange Gold Albert.—F. Ridge, 42 Percival street, Ardwick, Manchester.

Grindstone, about 27in., for Engineer's use. Anvil about 1½ cwt. wanted. Exchange smith's bellows, fan, or cash—Mr. S. Hewett, South Norwood, London.

Slow Combustion **Boiler Pipes** and connections for Greenhouse wanted. Exchange patent gas holders or heating coil—Mr. S. Hewitt, South Norwood, London.

What offers in exchange for Silver Plated **Snuffers** and Tray? Cost 7s.—Miss Lloyd, Leigh, Essex.

"**English Mechanic**," Vols. XXI. to XXXI., with index. Exchange for works by Darwin, Huxley, Emerson, or cash.—R. Dobson, 5, Marine terrace, Whitehaven.

Beautiful silver centre seconds, English **Detached** Lever Watch, manufactured to special order by Wheeler. Extra jewelled and crystal glass, guaranteed for 10 years, just new, worth £12 12s. Will exchange watch and guarantee for good 3½ centre self-acting and screw-cutting lathe complete, 2ft. 6in. beds.—J. Baker, 14, Cannon-terrace, Ashton-road, Preston.

52in. **Bicycle**, first-class condition. Must part. Offers.—Particulars to R. R., 11, Laverton-road, Loftus, Saltburn.

I will give 51in. **Bicycle**, light roadster (Rudge), for an armature lathe with emery wheel, or bicycle fittings.—Address, J. Steward, Conservative Club, Waterfoot, Manchester.

"**Photographic News.**" About 500 numbers of this excellent periodical, many very scarce. Exchange books on anything useful.—Mr Jewell, Westerham, Kent.

"**Old and New London**," 60 shilling parts, special edition, 30s., or exchange to 50s.—T. Gordon Bowman, 31, Compton street, Brunswick square, London, W.C.

Telegraph Instruments.—Mahogany Bodies, with batteries for commercial purposes. Exchange lantern slides, or offers. Approval with pleasure.—Thompson, 82, English-street, Hull.

Wanted, **Induction Coil**. Exchange plated Hub Lamp, cost 16s. 6d. "Keat's Bicycle Bugle," 4 turns, cost 18s. 6d. Sliding seat, 10s. 6d.—G. H. Furmedge, Gillingham, Dorset.

Extraordinary Challenge **Bicycle** 48in., equal to 51in. ordinary, in first class condition. Exchange for tricycle. Good Meteor preferred.—C. Brown, Bookseller, Dudley, Worcester.

THE SIXPENNY SALE COLUMN.

Advertisements are inserted in this column at the rate of 6d. for the first 16 words, and 6d. for every succeeding 8 words.

For Sale.

Electric Machines, Indicators, Bells, Batteries, Wires, Switches, Terminals, Carbons, &c.—King and Co., Electricians, Bristol. (List Twopence.)

Paints.—Armstrong's full instructions for making Paints is now sold by Stevens and Co., 32?, Old-street, London. Price 2s. 6d.

Saxophone's **Musical Supply Scheme**: its origin and object, post free for penny stamp.—Address, H. Wellstead, East Borough, Wimborne, Dorset.

Forty per cent. discount off Standard List of American Twist Drills. Send stamped envelope for sample free of charge. They are made of the very finest steel, by Bentall Brothers, Maldon, Essex.

Cyclists.—Challis's Stop **Bell**, with patent vibrating bracket, is best, 2s. 6d., 3s. 6d.—E. M. Challis Bros., Homerton.

The English Mechanic

AND

WORLD OF SCIENCE AND ART.

FRIDAY, SEPTEMBER 1, 1882.

ON THE PRODUCTION OF LOOPED FIGURES BY GEARING.—II.

AS a help to those to whom the subject may be new, I will now give a sketch or two to elucidate the arrangement suggested in my last article. The ENGLISH MECHANIC has run through a great number of Vols., and gained hundreds of subscribers who have now but little chance of referring to early numbers on lathe matters, so that it must not be taken for granted that all our readers are old stagers, or that what is no novelty to one may not be so to another.

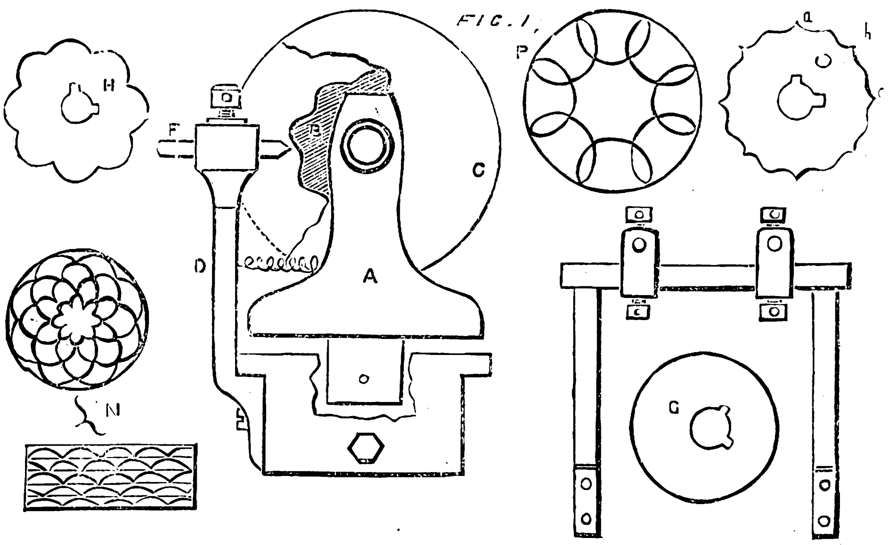


FIG. 1.

Moreover, I propose in this case to sketch out the simplest mode of making a satisfactory geared rose-engine instead of repeating the designs that have hitherto appeared. The first sketch is intended merely to explain to the novice the principle of all those machines in which an oscillating motion is given to the headstock, and consequently to the work also. A is the headstock which is now raised a little above the lathe-bed to give it room to oscillate, and it is suspended on centre-screws, one of which would ordinarily pass through the top of the standard and the other through a web cast in the bed. When not required to oscillate, packing pieces are placed below the base of the headstock, or the centres can be withdrawn and the headstock allowed to rest on the bed as usual. C is the face of the mandrel-pulley cut away to allow the rosette B to appear. This rosette is similar to H, its edge (it is about ¼in. thick) being of waved outline; the exact pattern being of no consequence for the present. It is keyed, or otherwise made fast to the mandrel, so as to revolve with it. G is an eccentric disc, which can be used instead of the rosette. D is a stiff stand, bolted to the bed carrying a rubber, F, of hard steel or other material. This is in practice like K; so that the rubber carriage, L, can be slid horizontally on the top bar, and brought opposite to any one of a row of these rosettes. But for the present, we may consider that there is but one, and that a coiled or other spring keeps the rubber in close contact with the rosette. It is plain that if the mandrel is made to revolve, the headstock will be forced to oscillate in accordance with the undulations upon the edge of the rosette. If, therefore, a disc of wood is mounted on the mandrel and made level, and a pointed tool or pencil held in the slide-rest is set against it, a copy of the rosette will be drawn or engraved upon its surface. Thus far, almost any lathe could be converted into a rose-engine; but to do satisfactory work, it is plain that a very large number of rosettes would be required, as a repetition of the same pattern would not be worth the trouble of tracing it. The next improvement suggests itself—viz., to so mount the rosette on the mandrel as to enable it to be set on either of two positions—a matter easily arranged by making it fit over a key or feather, and cutting two key-ways, as seen in the rosette H. Setting it alternately in one of these positions, we should get a pattern similar to N; but there our power ends, and with this rosette we can effect but little more.

Now, a rosette like the figure is tolerably simple yet not very easy to make, as it must be filed up; and if, instead of so simple a waved outline, the rosette has a more complicated edge, like that of O, the cutting and finishing becomes far more difficult, because each part must be exactly similar to those of the same design—the section *a b*, similar to section *b c*. Hence, the expense of the rosettes, which has hitherto kept the Rose-engine out of the hands of all but a few wealthy amateurs and workmen. In addition to this, there is a certain degree of sameness and monotony in rose-cut work, owing to the fact that there are no looped figures. The eccentric chuck, combined with the rose, will complicate figures; but something is needed of a simpler and more effective character, cheaper to make, and efficient in use. Let us now replace rosette H of eight undulations by G, a simple turned disc with an eccentric hole. We shall get one complete oscillation only of the head stock at each revolution of the mandrel, resulting in a plain, elliptic design.

If, however, we can so arrange matters as to cause the disc to revolve eight times during one revolution of the mandrel, we shall obtain a figure with eight waves, somewhat similar to that produced by the rosette. Thus our simple, cheaply-made disc, which any amateur could make, is made to replace a costly rosette. But we can also now get loops like P, or more complicated ones at pleasure, using no rosette, but the plain disc. How, then, can we manage to multiply the oscillations produced by the plain disc? There is but one way. We must mount it on a separate mandrel, and connect the two mandrels together by intermediate change-wheels. How this can best be done, will, in a great measure, depend upon the means at hand, and upon the lathe itself to which the apparatus is to be applied. Generally speaking, however, a bracket, or rather, a pair of them, would have to be bolted to the existing poppit, as A in Fig. 2. These will carry centres between which to mount the second mandrel. Then inside the poppit must be fixed the quadrant B, shown in place at H, to carry an adjustable stud in the long slot, to take the different change-wheels. If, however, a lathe is fitted with back-gear which can be spared, the back spindle can be removed, and then the arm cast upon the poppit will serve excellently, instead of having to bolt one on—or it may be possible, and probably would often be so, to use the spindle of the back gear as the mandrel, without interfering with its action, and to mount disc and wheels on that side. Of course, in any case, the rubber *must* be fixed to the *bed* outside the second spindle.

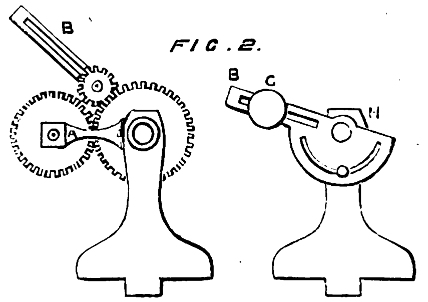


FIG. 2.

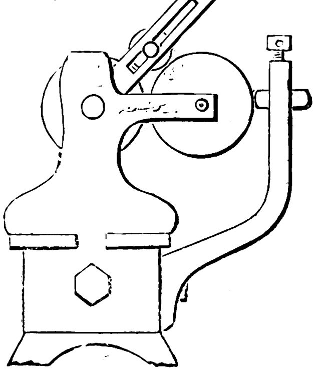


FIG. 3.

In Fig. 3 I have represented the rosette so placed on the back-action spindle.

With this simple equipment you have the means of producing innumerable complicated and beautiful designs, and, I may add, at a minimum of cost. Change-wheels are now to be had, well made, cast from cut patterns, from Lloyd's and elsewhere, and they cost but a few shillings. The radial arm, to carry the stud for these wheels, must be cast in iron or brass; but the pattern is easily made. It usually fits over the nut (circular) of the back or tail-pin, which keeps the mandrel up to its collar, and is retained in position by a short bolt passing through the curved slot into the poppit. It may be fitted, instead, however, upon the front of the poppit, embracing the mandrel, where it may be used in connection with spiral apparatus, or quite at the back, outside the end, instead of inside, where also the spiral apparatus is sometimes placed. There is nothing in all these additions to interfere with the ordinary work of the lathe, and if the rosettes can be applied to the back spindle, the whole apparatus will be quite out of the way. When fastened to the back-action spindle however, the rosettes or discs may probably require to be placed singly, or to be somewhat thinner in substance. All will depend upon the space left outside one or other of the gear-wheels; and if the spindle is made to advance by eccentric collars for the production of slow-motion instead of sliding horizontally, it may be found necessary to substitute an entirely independent spindle to carry rosettes. This is, of course, the better plan in all cases, as admitting of a more perfect and satisfactory way of attaching the rosettes; but the difficulty in most cases will be that the gear-wheels for slow-motion are so keyed that the back spindle cannot be removed from its bearings. The following plan will obviate this and make the back spindle easily available for both purposes: Knock out the keys, remove the gear-wheels, and thus clear the spindle; get a bit of gas-pipe, or stout brass tube that will fit easily, but well over the spindle, so as to form a sleeve to revolve upon it. Cut it off to such a length as just to fit between the arms of the poppit; bore out the pair of gear-wheels and key them upon this sleeve. You can now at pleasure draw off this sleeve with its wheels, and use the spindle—another almost similar one with the discs and rosettes. If you cannot get a nice bit of tube, to fit exactly, get a bit still larger, and insert a washer at each end, bored to fit the spindle. The back gear will work quite as well thus fitted, to revolve *on* the spindle, as if it revolved with it. J. L.

(*To be continued.*)

A STEERING SCREW-PROPELLER.

THE idea of placing the screw-propeller in such a position with regard to the rudder that it would aid in steering the vessel is not new, nor is the modification which places a smaller supplementary propeller on the rudder in such a manner that it swings with it; but whether or not any of the various devices have been actually tried on the scale of twelve inches to the foot, it is doubtful if they gave better results than those recently obtained with Kunstädter's screw-steering apparatus, which was illustrated and described in No. 744, p. 393. The patent was taken out in 1878, and was for an improvement on a similar invention by the same inventor, who, a native of Buda-Pesth, has now been residing in England for some years. That we should only now be in a position to give an account of a fair test experiment in actual work shows with what reluctance owners of vessels take up any new thing in screw propulsion. Kunstädter's steering screw had, we believe, been fitted to sundry small craft (see p. 8, Vol. XXIX.), and to one large vessel owned abroad, before it attracted the attention of shipbuilders on the Clyde; but a satisfactory trial has been recently made with it as fitted to the *Stratheden*, a vessel of 1,500 tons measurement, having engines of about 1,200 horse-power. The vessel is employed in the coal and iron, wine, and grain trades, between the Clyde and Bordeaux, Bilbao, &c., and is, we believe, the largest steamer engaged in the trade, which demands considerable handiness in so large a vessel in order to manœuvre readily in narrow harbours and rivers. A reference to the place cited will give a fairly accurate idea of the arrangement as actually fitted to the *Stratheden*, the principal detail being the universal joint connecting the main shaft with the shorter one running through the rudder. The propeller proper is much of the same pattern as commonly found, and is fitted in the usual way, save that the shaft carrying it passes through a boss in, or a bracket let into, the stern-post, outside which it terminates in a fork, which is connected to another fork at the inner end of the shaft passing through the rudder. A block of steel, or other suitable metal, is placed between the prongs of the forks which are held to it by means of four screw-pins. Nice and accurate work is required in connection with this joint, which is one of the special features of Kunstädter's invention, and allows of the rudder being placed at any desired angle without putting any undue strain on the joint. In Kunstädter's specification the rudder-screw is represented with two blades and about half the diameter of the propeller proper; but it is expressly stated that the rudder-screw may have two or more blades. In the *Stratheden*, the propeller proper is an ordinary cast iron one, having a diameter of 14ft. 6in., while the rudder or steering-screw is 10ft. in diameter, and is fitted with four steel blades, having a variable pitch. A number of speed trials made with the vessel light, half-loaded, and fully loaded, gave a mean speed on the measured mile of about 11$\frac{1}{2}$ knots, with the blades of the rudder-screw in position; while a mean of several runs without them showed a speed of 9·8 knots. The speed of the vessel, however, is not the point to which we wish to draw attention, for the real merit of the invention lies in the fact that it unquestionably exerts considerable power over the movements of the *Stratheden*, which is reported to answer her helm very rapidly, and to be always perfectly under control. In order to test the effect of the steering-screw, two sets of trials were made, and compared with a set made with the blades of the screw-rudder removed, the mean of two full circles to starboard shows a time of 8min. 22sec., but one trial made to port occupied 7min. 20sec. for the full circle; but in this case the engines were going a trifle faster. In the trials with Kunstädter's screw, the vessel going full speed ahead, full circles were made in 4min. 55sec.; 5min. 3sec. and 6min. 7sec. with helm to starboard; with helm to port, the full circles were made in 5min. 58sec., 6min. 2sec., and 6min. 21sec. Going astern, half-circles were made in 4min. 2sec., and 4min. 16sec. respectively to starboard and port. The average time for the half-circle going ahead was under 3min.; but the most remarkable feature in the trials was the complete circle in about two lengths and a half, the engines being started full speed astern while the vessel was without any way on her. That was accomplished in about the same time as a full speed ahead circle to port without the rudder-screw—viz., 7min. 27sec. The importance of that fact will be readily appreciated by mariners in days when collisions between steamers are so frequent, for it gives the master the power of almost immediately altering his course, with engines reversed and going astern. A jointed screw-propeller formed the subject of a patent obtained by Shorter in 1800, and it is stated that it was applied to some Government ships; but if so, it could scarcely have resembled Kunstädter's invention. Fowler's steering propeller is a submerged wheel worked by a vertical shaft, the steering being effected by "feathering" the paddles at different parts. That is accomplished by means of an eccentric cam which can be so actuated that the paddles can be made to present at one part of their revolution a pushing and drawing action on the water, while, at another, they present only their edges to the water. The steersman controls the action of the cam, and the vessel can be turned almost on her centre or backed in a straight line. This propeller, like Hunter's, patented in 1874, is useful only on small craft. The last-named consists of two wheels, one each side of the stern-post, which revolve in opposite directions, the blades being so feathered as to have only one dead point. It will be readily seen by mechanics that just as the universal joint is the chief feature of Kunstädter's arrangement, so also it is the weak point mechanically; but the inventor not only describes the joint he prefers, but gives reasons why other forms are objectionable. Link-joints, ball-and-socket joints, are rejected as being subject to great friction, and consequently to rapid wear. In the universal joint adopted by Kunstädter, there is a common centre, or intersecting lines of centre of action, so that the strain is equally divided between, and is simultaneously borne by the four screw pins; and, besides, there is an ingenious adaptation of the back part of the fork on the main shaft as a thrust collar, to take up the thrust from the steering screw when going astern. That the parts are well-proportioned and properly made, so far at least as the *Stratheden* is concerned, may be gathered from the fact that although she has made two voyages, and experienced some fairly severe weather, no signs of wear or strain can be detected in connection with the steering screw. In the experiments which he made on the Clyde some years ago, Prof. Osborne Reynolds showed that by reversing the engines of screw-steamers all command over the vessel was lost. The facts learned by the experiments were embodied in the report of a committee to the British Association, in which it was laid down that a screw-steamer at full speed could not be stopped in less than five lengths, whereas by using the rudder, without reversing, the vessel would be able to turn through a quadrant without having advanced five lengths in the original direction. From the facts above noticed, it would appear that Kunstädter's steering-screw gives complete command of the vessel, even when the engines are reversed and going astern, and, besides the advantages it confers in navigating narrow waters and sinuous harbours, it is also a useful and, perhaps, invaluable appliance in cases of threatened collision.

CHRONOLOGY OF TELEPHONIC DISCOVERIES.

IN view of the partiality with which the history of telephony is presented in different countries, the editor of *La Lumière Electrique* (M. Du Moncel) offers his readers a brief chronological *résumé*, which is as follows:—

1854.—First idea of electric transmission of speech with complete description of means to be used by M. Bourseul.

1856.—Discovery by M. Th. Du Moncel of the variation of intensity of currents over interrupters with metallic contacts *light and well cleaned*, with the pressure exerted on them. Experiments proving the truth of this principle with substances of mediocre conductivity, 1864, 1872, 1874, 1875, &c.

1857.—Representation of vibrations produced by the voice by means of a stretched membrane before which one speaks, by M. Leon Scott.

1860.—Application of M. Scott's system to the electric transmission of sounds, by M. Reiss.

1865.—Application of the principle of variations of intensity of currents with pressure to making tubes with variable resistance, by MM. Clerac and Elsasser.

1865.—Discovery by Mr. Wright of the reproduction of sounds by a condenser.

1875.—Application to the electric transmission of sound of undulatory currents, by Mr. Bell.

1876 (14th Feb.).—Discovery by Mr. Bell of the magneto-electric telephone.

1876 (10th April).—Application to the Reiss transmitter, or to Bell's liquid transmitter, of a contact with permanent action for electric transmission of sounds, by Mr. Donough.

1877 (30th July).—Application of soft carbon contacts to the Reiss transmitter, to furnish more developed undulatory currents in telephonic transmission, by Mr. Edison.

1877 (16th Oct.).—Application of hard carbons with one or two contacts to the same transmitter, for the same purpose, and at the same time to form a receiver capable of repeating speech, by M. Berliner.

1878 (Jan.)—Discovery by Mr. Hughes of a telephonic carbon transmitter, whose arrangement is such as to magnify sound; an apparatus to which was given, for this reason, the name of *microphone*.

1878.—Discovery by the same savant of the transmission of sounds by the action exerted by the voice on crushed fragments of carbon, or conductive powders applied to two metallic electrodes connected with a battery and a telephonic circuit.

1878.—First application of the microphone to the hearing at a distance, of sermons and divine service, by Mr. Crossley.

1878.—First application of the same instrument to hearing an opera, by M. Patochi.

1879.—Reproduction of speech by an iron wire used as receiver, by M. Ader.

1879.—Construction of the *motophone* of Mr. Edison.

1880.—Reproduction of speech by means of the condenser with sheets of paper, by M. Herz.

1880.—Development of this mode of reproduction of speech, by M. Dunand.

1880.—Discovery by Messrs. Bell and Sumner-Painter, of the *radiophone*.

1880.—Transmission of speech without a battery by the effect of percussions between fragments of iron wires, by M. Ader.

1881.—Speaking condenser with air-layer, of Mr. Dolbear.

1882.—Simultaneous transmission a long distance, of speech and a telegraphic message, by M. Van Rysselberghe. Same problem solved in another way, and in laboratory experiments by M. Maiche, in 1880.

[It may be remarked as strange that no mention is made in this statement of the harmonic telegraphs of Mr. Varley (1870), and of Mr. Elisha Gray (1874).]

ASTRONOMICAL NOTES FOR SEPTEMBER, 1882.

The Sun.

Day of Month.	Souths.	At Greenwich Mean Noon.		
		Right Ascension.	Declination.	Sidereal Time.
	h. m. s. a.m	h. m. s.	° ′ ″	h. m. s.
1	11 59 51·99 ,,	10 42 3	8 14 5N	10 42 11·37
6	11 58 14·50 ,,	11 0 9	6 23 30 ,,	11 1 54·13
11	11 56 32·26 ,,	11 18 9	4 30 15 ,,	11 21 36·89
16	11 54 47·30 ,,	11 36 7	2 35 3 ,,	11 41 19·65
21	11 53 1·77 ,,	11 54 4	0 38 36 ,,	12 1 2·41
26	11 51 17·99 ,,	12 12 3	1 18 22S.	12 20 45·18

The Method of finding the Sidereal Time at Mean Noon for any other Station will be found on p. 390 of Vol. XXXIV.

At 4 a.m. on September 23rd, the Sun is said technically to enter Libra, and Autumn is supposed to commence. He will really be at this instant to the west of η Virginis.

The Zodiacal Light may now be looked for before sunrise in the East.

Spots, faculæ, and prominences continue to manifest themselves.

The Moon.

Enters her Last Quarter at 1h. 26·2m. p.m. on the 4th, and is New at 58·6 minutes after Noon on the 12th. She will enter her First Quarter at 1·27·9 p.m. on the 20th, and be full at 5h. 9·9m. in the early morning of the 27th. Pretty high tides may be looked for about the 28th.

Day of Month.	Moon's Age at Noon.	Souths.
	Days.	h. m.
1	18·6	2 44·9 a.m.
6	23·6	7 17·0 ,,
11	28·6	11 5·6 ,,
16	4·0	2 39·3 p.m.
21	9·0	6 56·6 ,,
26	14·0	11 32·5 ,,

Occultations of (and a near approach to) Fixed Stars by the Moon.

Day of Month.	Name of Star.	Mag.	Disappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.	Reappearance.	Moon's Limb.	Angle from N. Point.	Angle from Vertex.
			h. m.				h. m.			
1	51 Piscium	6	1 56 a.m.	Bright	193°	194°	2 13 a.m.	Dark	220°	225°
5	68 Orionis	6	12 0 p.m.	Bright	124	87	12 46 p.m.	Dark	238	198
20	μ Sagittarii	4	9 19 ,,	Dark	71	99	‡10 17 ,,	Bright	312	345
20	15 Sagittarii	5	10 10 ,,	Dark	129	162	‡11 6 ,,	Bright	254	291
21	B.A.C. 6536	6½	7 50 ,,	Dark	106	114	9 5 ,,	Bright	285	304
23	8 Aquarii	6	6 6 ,,	Dark	42	18	6 33 ,,	Bright	356	335
26	22 Piscium	6	†6 56 ,,	N.N.W.	203	166				
27	δ Piscium	4½	5 47 ,,	Bright	90	52	6 35 ,,	Dark	312	273

† Near approach. ‡ Stars below the horizon.

The attention of the Student is directed to the occultation of μ Sagittarii on the night of the 20th, as, being a triple star, it will present an interesting spectacle.

The Moon will be in conjunction with Saturn at 10 a.m. on the 3rd; with Jupiter at 8 p.m. on the 5th; with Mercury at 4 p.m. on the 14th; with Mars at 1 a.m. on the 15th; with Venus at 5 p.m. on the 16th; and once again this month with Saturn at 6 p.m. on the 30th.

Mercury

Is an Evening Star during the whole of September, attaining his greatest elongation East (25° 45′) at 5 p.m. on the 28th; his rapidly increasing South Declination however places him in a very unfavourable position for the observer at this epoch. His angular diameter varies from 5·2″ to 7″ during the month.

Day of Month.	Right Ascension.	Declination	Souths.
	h. m.	° ′	h. m.
1	11 39·8	2 50·5 N.	0 57·5 p.m.
6	12 8·2	0 53·9 S.	1 6·2 ,,
11	12 34·8	4 28·4 ,,	1 13·0 ,,
16	12 59·8	7 49·0 ,,	1 18·2 ,,
21	13 23·0	10 51·6 ,,	1 21·7 ,,
26	13 44·0	13 31·2 ,,	1 23·1 ,,

Commencing at a point to the West of β Virginis, the path of Mercury this month will traverse nearly the whole constellation of Virgo. At 4 p.m. on the 20th, Mercury will be in conjunction with Spica Virginis and only 12′ North of that Star. He will also be in conjunction with Mars at 7 a.m. on the 21st.

Venus

Is also an Evening Star during the entire month, and attains her greatest eastern elongation (46° 31′) at 1 p.m. on the 26th. She is even worse placed than Mercury, though, for observation. Her angular diameter, which is 19·2″ on the 1st, increases to 25·8″ by the 30th.

Venus.

Day of Month.	Right Ascension.	Declination South.	Souths.
	h. m.	° ′	h. m.
1	13 26·4	10 24·3	2 43·7 p.m.
6	13 46·3	12 45·5	2 44·0 ,,
11	14 6·3	15 0·5	2 44·3 ,,
16	14 26·3	17 8·0	2 44·5 ,,
21	14 46·2	19 6·8	2 44·7 ,,
26	15 6·0	20 55·9	2 44·8 ,,

The path indicated by the above Ephemeris begins a little to the east of Spica Virginis, and extends through Virgo into Libra. Its neighbourhood is singularly free from conspicuous stars.

Jupiter

Is a Morning Star, in the sense of southing in daylight, but he rises a little before 11 o'clock at night at the beginning of September, and not long after 9 p.m. at the end of it. He is in quadrature with the Sun at 11 a.m. on the 23rd. His angular diameter, which is 34·6″ on the 1st of September, becomes 37·8″ by the 30th.

Day of Month.	Right Ascension.	Declination North.	Souths.
	h. m.	° ′	h. m.
1	5 50·5	22 57·7	7 9·2 a.m.
6	5 53·4	22 58·3	6 52·3 ,,
11	5 56·1	22 58·8	6 35·3 ,,
16	5 58·4	22 59·1	6 18·0 ,,
21	6 0·5	22 59·2	6 0·4 ,,
26	6 2·3	22 59·3	5 42·6 ,,

Hence Jupiter travels from the eastern limit of Taurus into the western boundary of Gemini.

Jupiter's Satellites.

Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.	Day of Month.	Satellite.	Phenomenon.	H.	M.	S.
1	*I*	Ec D	4	31	48 A.M.	11	*II*	*Sh I*	10	22	P.M.	21	II	Oc R	1	19	A.M.
2	I	Sh I	1	46	,,	11	*I*	*Oc R*	10	54	,,	22	III	Sh I	11	27	P.M.
2	I	Tr I	3	2	,,	12	II	Sh E	1	4	A.M.	23	III	Sh E	1	52	A.M.
2	I	Sh E	4	0	,,	12	II	Tr I	1	5	,,	23	III	Tr I	4	49	,,
2	*I*	*Ec D*	11	0	10 P.M.	12	II	Tr E	3	47	,,	24	I	Ec D	4	40	17,,
3	II	Ec D	1	22	27 A.M.	12	*III*	*Ec D*	5	25	33,,	25	I	Sh I	1	56	,,
3	I	Oc R	2	30	,,	13	*II*	*Oc R*	10	41	P.M.	25	I	Tr I	3	16	,,
3	*I*	*Tr E*	11	47	P.M	15	III	Tr I	12	48	,,	25	I	Sh E	4	11	,,
5	II	Tr E	1	10	A.M	16	III	Tr E	3	20	A.M.	25	*I*	*Tr E*	5	31	,,
5	III	Ec D	1	26	24,,	16	*I*	*Sh I*	5	34	,,	25	I	Ec D	11	8	36 P.M.
5	III	Ec R	3	37	38,,	17	I	Ec D	2	46	55,,	26	I	Oc R	2	41	A.M.
8	*III*	*Tr E*	11	15	P.M.	17	I	Sh I	12	2	P.M.	26	II	Sh I	3	30	,,
9	I	Sh I	3	40	A.M.	18	I	Tr I	1	22	A.M.	26	*I*	*Tr I*	9	45	P.M.
9	*I*	*Tr I*	4	58	,,	18	I	Sh E	2	17	,,	26	I	Sh E	10	39	,,
9	I	Ec D	12	53	33 P.M.	18	I	Tr E	3	37	,,	26	I	Tr E	12	0	,,
10	II	Ec D	3	59	11 A.M.	18	I	Oc R	12	48	P.M	27	II	Ec D	10	30	3,,
10	I	Oc R	4	25	,,	18	II	Sh I	12	56	,,	28	II	Oc R	3	54	A.M.
10	*I*	*Tr I*	11	27	P.M.	19	II	Sh E	3	39	A.M.	29	*II*	*Tr E*	10	13	P.M.
10	I	Sh E	12	23	,,	19	II	Tr I	3	40	,,	30	III	Sh I	3	26	A.M.
11	I	Tr E	1	42	A.M.	19	*I*	*Tr E*	10	6	P.M.	30	*III*	*Sh E*	5	52	,,

Ec Eclipse; Oc Occultation; Tr Transit of Satellite; Sh Transit of Shadow; D Disappearance; R Reappearance; I Ingress; E Egress. The printing of a phenomenon in *italics* indicates that its visibility is rendered doubtful, either by the brightness of the twilight or by Jupiter's proximity to the horizon.

Mars

Is practically invisible.

Saturn

Is a Morning Star in the same sense that Jupiter is, but he rises soon after 9 p.m. at the beginning of the month, and between 7 and 8 o'clock in the evening towards the end of it. His angular diameter slowly increases from 16·8″ to 17·6″ during September, and his ring continues to open almost imperceptibly, but quite steadily.

Day of Month.	Right Ascension.		Declination. North.		Souths.		
	h.	m.	°	′	h.	m.	
1	3	37·5	17	4·9	4	56·5	a.m.
6	3	37·7	17	4·4	4	37·0	,,
11	3	37·7	17	3·4	4	17·3	,,
16	3	37·5	17	1·7	3	57·5	,,
21	3	37·1	16	59·5	3	37·4	,,
26	3	36·6	16	56·7	3	17·2	,,

From which it will be seen that Saturn will remain sensibly stationary to the naked eye in an entirely blank region in Taurus.

Uranus,

Coming as he does into conjunction with the Sun at 8 p.m. on the 11th, has left us until next year.

Neptune

Will scarcely come into view for the observer's purpose until the early mornings of next month.

Shooting Stars

Are rare in September. They may be looked for, though, about the 10th, and again between the 18th and 25th.

Greenwich Mean Time of Southing of Ten of the Principal Fixed Stars on the Night of September 1st, 1882.

Star	Souths. h.	m.	s.	
Vega	7	49	30·90	p.m.
ε Aquilæ	8	10	47·35	,,
Altair	9	1	25·03	,,
α² Capricorni	9	27	49·92	,,
α Cygni	9	53	39·37	,,
α Cephei	10	31	54·96	,,
α Aquarii	11	15	45·11	,,
Fomalhaut	12	7	1·27	,,
Markab	12	14	45·16	,,
δ Sculptoris	12	58	31·61	,,

The Method of ascertaining the Greenwich Mean Time of Transit of either of the Stars in the above List for any other night in September, as also that of ascertaining the Local Instant of its Southing at any other station, will be found on p. 392 of our XXXIVth. Volume.

PRACTICAL NOTES ON PLUMBING.—XLI.*

By P. J. DAVIES, H.M.A.S.P., &c.

(*Continued from page* 563.)

THE machine siphon, Fig. 229, is nothing more than a common gas siphon made for the purpose of catching the water partially given off by the steam from the acid, water, &c., within the machine. The inlet pipe A is best taken down into the bottle part B; the gas exit pipe is marked D. For my part I prefer to make C with a piece of $\frac{3}{4}$in. pipe about 5in. long. A and D are both $\frac{1}{4}$in. gaspipe soldered on to B, the rubber pipes are slipped over the ends, and of course securely fixed. F is a strap of 6lb. sheet lead bent to form a hook to hang over the rim L of the machine, Fig. 228, and as shown at Q, &c., Fig. 231.

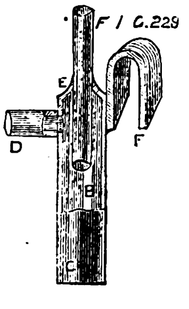
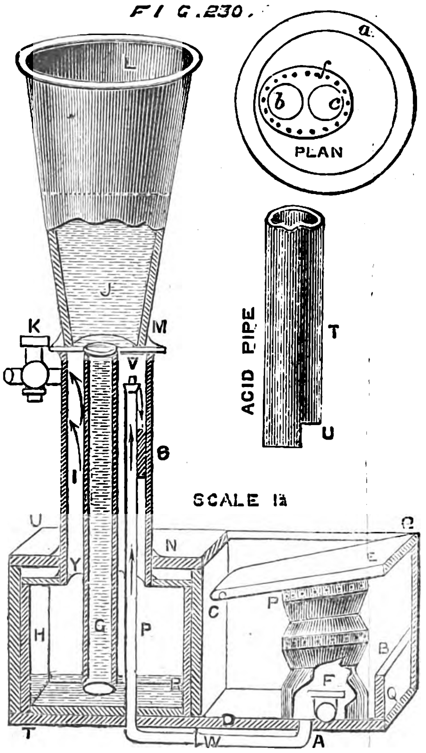


FIG. 229

The Davies Bellows.

The bellows illustrated at Fig. 230 is of an improved form, and is made as follows, the scale being $1\frac{1}{4}$in. The frame A T U V is an oblong wooden box about 1ft. 9in. or 2 feet long, height about 9in. and width about 9in. or 10in. The half end B is fixed to answer as a stop for the treadle, which prevents the bellows spring being injured by excessive pressure from the foot, the box has also the partition C for the support of the side lead of the cistern. UN is the top board, having a 4in. hole for the wind-chamber S. The top and bottom parts, or boards, of the bellows B are made with $1\frac{1}{4}$in. mahogany; the diameter should be about 1in. less than the width of the box, that is, if the box is 9in., the top should be 8in. Round the inside of these boards should be turned the groove A, to receive the ends of a spiral spring, such as is used for sofas or easy-chairs; this spring must in size equal nearly that of the boards, and stand, when not compressed, about 15in. high. In the bottom board the aperture C is made for the inlet valve and pipe, and the aperture 6 for the outlet pipe. We now come to the inlet valve. this is simply a $\frac{3}{4}$in ground-in *short* spindle valve soldered on to a piece of $\frac{3}{4}$in. pipe properly flanged for bedding with white-lead to the board; the flange should be cut large enough to admit of both the inlet valve pipe and the outlet valve pipe being soldered to it. Then the whole can be bedded, and nailed down on the board together. Having got so far, next fix with wire or otherwise the sofa spring to the bottom board, and over the valve and outlet pipe, also fix the spring to the top board; this will have the appearance of a concertina frame without the leather. Now provide the leather casing—the best material for this purpose is sheepskin of a medium thickness: this must be properly sewn together, and perfectly windtight; the length required is about $7\frac{1}{2}$in. or 8in. Next insert a cane hoop in the middle, to keep the sides distended while drawing in the wind—then with $\frac{1}{2}$in. tin-tacks and an extra band of leather about $\frac{3}{4}$in. wide nail the leather to the bellows-boards. Now with two screws of suitable length fasten the bottom of the board to the bottom board of the box, seeing that the screws do not pass through the bottom board of the bellows; fix the outlet pipe as shown at W, ready for connecting by a blown or copper-bit joint, and bend the inlet pipe up the side of the frame as shown at F, Fig. 231. Next line the close cistern HR, Fig. 230, having a piece of $\frac{3}{4}$in. lead pipe P soldered in the bottom, and long enough to reach to the top of wind-chamber as at V, and to bend round the bottom, so as to meet the outlet pipe A from bellows as shown at W. Having the cistern made, and top and bottom soldered on, fix the $\frac{3}{4}$in. spindle valve V on the pipe P, and to a suitable height, say 10in. above box; next fix the 1in. water column or dip pipe G to the top of the box, steady it with a flange joint at Y, let the pipe go to the bottom of the box but with the end cut to the shape as shown at VU at the bottom of the ACID PIPE: this will allow a free passage for the water when the bellows is at work. Next bore two 1in. holes in the top of the cistern near the soldered pipes, to allow the free passage of the wind from the bellows to press upon the top of the water in the cistern (to be explained further on). The wind-chamber S—this is made with a piece of 5in. soilpipe of suitable length, say about 12in., by first soldering a piece 2in. long to the top of the lead cistern, then fix the top board N and taft down the end of the short piece of 4in. lead pipe over the top board, and solder the 4in. wind-chamber to this; this flange will keep up the top of the lead box. Next turn, or flange over the top of the wind-chamber as shown at M to receive the middle partition, and take the pipe VP, to the inside as shown at S; then cut a piece of sheet-lead V for the partition, and to this solder the top end of the water column pipe G, as shown in diagram. Prepare the funnel LJ, and solder it together, with the middle partition to the wind-chamber as shown; fix a $\frac{3}{8}$in. gas-cock as at K, to the top of the wind-chamber; after this fix the treadle E by putting a 10in. $\frac{3}{8}$in. or other bolt of a suitable length through the end, and through the two sides of the frame, as shown at C, then with two stout screws fasten the top of the bellows to the treadle, and in such a manner that the bellows will work nearly upright; make the joint at W and the bellows will be completed. *Turn off the wind-cock* K and fill the bellows with water to about half-way up the funnel J, then open the wind-cock and let the water run down, and the bellows is ready for use. Notice that if you get too much water it will rise above the valve V, and most likely will by degrees work its way into the bellows, thereby softening the leather, and causing it to work very flabby, and badly. For the same reason the bellows must not be left exposed to the rain, &c.

FIG. 230.



In theory the construction of the bellows is as follows:—Suppose the wind-cock K to be open, then by the water being put into the funnel L, Fig, 230, it must run down the water column pipe G and into the box R, so that by closing the wind-cock would prevent the escape for the wind or air; now suppose the box to be full of water, and an additional quantity of wind pumped in through the valve V: as the bellows is worked, so will the wind become compressed, and will press upon the surface of the water at R with sufficient force to cause it to flow back up the water column pipe G until all is forced out, when, if the bellows be kept at work the air will bubble up through the water, (exactly as the machine would when throwing up); now open the cock K, and there is the exit, and the water will flow back in proportion to the amount of wind allowed to pass through the wind-cock. The theory of the machine.—Refer to fig. 228, shut the gas-cock 2, and close up the cap and screw G, also the pipe XX; the zinc is to be placed on the strainer at ZZ (bar zinc is the kind to be used); this must be broken up to size suitable for putting through the cap CC; next pour into the machine about 5 parts of water, and 1 part of the strongest sulphuric acid (not such as is generally to be had at oil-shops, but from the makers), then open the gas-cock 2, the acid water will then run down into the bottom of the machine, and attack the zinc. The zinc takes the oxygen from the water and releases the hydrogen, which rises in small bubbles through the water; now close the cock 2, and with this action going on, the bubbles soon fill the space M with hydrogen gas. Pressure is generated, and, as in the bellows as before explained, forces the water back up the pipe RP, and into the top compartment, until the acid water is all removed from the surface of the zinc, when the action is discontinued; open the cock 2, the pressure is at once relieved, and the acid runs down again, attacks the zinc, and

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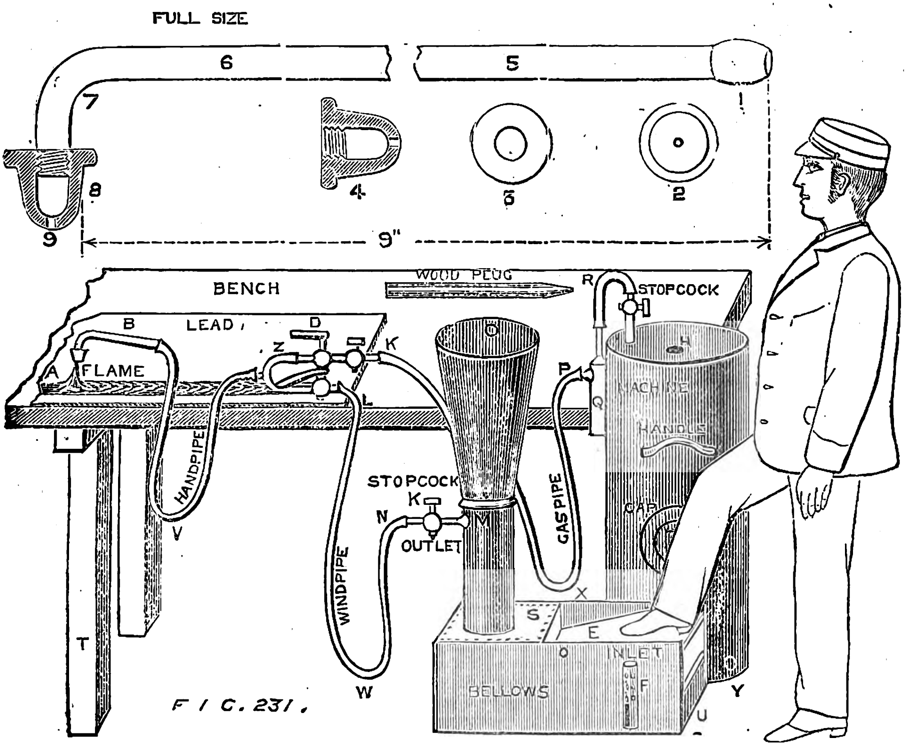


FIG. 231.

generates more gas. If the machine is a small one, it has now become heated, and should be kept at work, for if it be left to cool down, the chances are that you will require a fresh quantity of acid. The machine while working should be kept warm, and never allowed to get below 70 degrees Fahr.; otherwise, if it has been worked hard, and the exhausted liquor allowed to stand, it will soon become crystallised, when it would require a pail or two of boiling water to dissolve the crystals, and clear them away. Sometimes the machine is cased with felt &c. to keep it warm. If the machine does not make gas fast enough, it must have the acid stronger; if no gas can be obtained then look to your zinc. Probably you will not find any left; of course then you must put in more. Should you require to do this without emptying the acid from the machine, take the rubber off the gas-tap, and with your mouth, blow up all the acid water into the top chamber, but be careful not to blow too strong, for this would cause the acid to bubble up, the splashes of which would in all probability, come in contact with your face. N.B.—To prevent this it will be quite as well to place a small piece of lead over thehole H, which will also keep foreign matters from getting into the top chamber. Of course you would only apply your mouth under extreme circumstances, and when the gas cannot be got up otherwise; with a little judgment it can be blown up with the bellows. When the acid is all up, take the plug 4, 6 Fig. 228, and plug the end of acid pipe, this will prevent the return of the acid; you may then take off the large cap, throw in a pail of fresh water, next examine for zinc. Important caution: do not take fire near enough to explode the machine. The machine and bellows fitted up.—Having explained the construction of my lead-burning machine and bellows, I will now proceed to explain and illustrate the whole, exactly as I exhibited it at South Kensington before the competitors for the prizes offered for plumbing by the National Health Society, March 1882, and as used by myself and men in different parts of England, Wales, and Scotland. Fig. 231 illustrates the whole arrangement, the gas is generated in the machine, and conveyed through a *stout*, pure, rubber tube W to the regulating cock D; from there through the breeching piece Z, and through the hand-pipe V to the nipple A, at the same time wind is pumped from the bellows through the rubber tubes W, and through the breeching, where it is regulated by the spanner cock I to meet and to mix in a certain quantity or proportion (to be explained hereafter), with the gas at the meeting point of the breeching Z, and through the hand-pipe to the nipple near A.

This flame illustrates the burning of two pieces of lead together at A, known as flat-butted work. The blow-pipe, 5, 6, 7, is made of stout brass tube, ⅛in. bore, the nipples 8, 9, 4, are drawn full size; 3 is a plan looking from the back, and 2 is a plan looking from the front; these nipples are made to screw off or on to the pipe, the sized hole for the jet must vary according to the class of work done, and also the workman. The ordinary size is from 1-32 to 3 32 of an inch, or larger, if required for very heavy work, such as from 12 to 28lb lead.

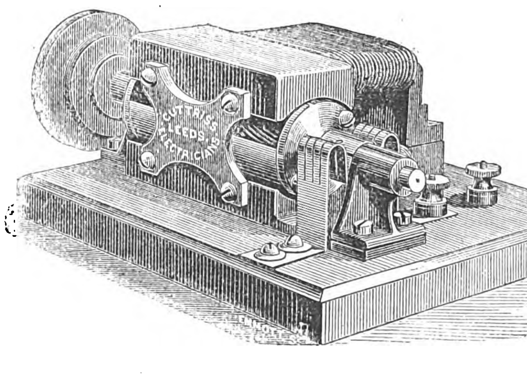
(*To be continued.*)

THE CUTTRISS ELECTRO-MOTOR.

ONE of the objects of interest to be seen at the exhibition now being held at Bradford is a small electro-motor driving a "Singer" sewing-machine, a description of which will doubtless interest many of our readers.

The accompanying engraving will almost explain itself. The total weight of motor, with base-board, is 2½lb.; the armature, "a Siemens," is 1in. diam. by 2¼in. long, which, with a current from six cells, attains a speed of about 8,000 revs. per min., when running light. The motor can be applied to any sewing-machine, the power being transmitted to the periphery of the hand-wheel by means of a rubber friction-ring on the motor-shaft, which makes a very simple and effective means of driving.

When not required, the motor may be disconnected, leaving the sewing-machine capable of being driven in the usual way. The average speed obtained by the one under notice is 450 stitches per minute, which may be varied as required by the simple pressure of the foot upon a treadle connected with a battery of six bichromate cells, each zinc being 2¼in. by 3in. It need scarcely be added that the motor is capable of being applied to various uses, such as the driving of fans, light lathes, &c.



The motors, which are of various sizes, are manufactured by Messrs. Cuttriss, electricians, Leeds.

NEW CLOCK AND CARILLONS FOR BOMBAY UNIVERSITY.

A NATIVE of Bombay having munificently provided the necessary funds for a large clock and carillons for Bombay University, the Indian Government intrusted the work to the following firms:

The bells to Messrs. John Taylor and Co., of Loughborough, Leicestershire, founders of the new ring of 12 bells for St. Paul's Cathedral, and of Great Paul; the iron bell-frame, designed by General Hyde, of the State Railway Department, to Messrs. Westwood, Bailey, and Co.; and the clock and carillon machinery to Messrs Lund and Blockley, of 42, Pall-mall, by whom the whole of the work has been erected in London, preparatory to its shipment to Bombay. The bells are 16 in number, in the key of C (12 consecutive and four half-notes.) The largest weighs about 3 tons, and the whole peal about 10 tons; they are contained in a wrought-iron bell-frame, weighing about 7 tons more.

The clock will show time on four dials, each 13ft. diameter, glazed with opal glass for illumination, either with gas or electricity; has a two-seconds pendulum about 14ft. long, iron and zinc compensation, and a bob, 600lb. weight. Inside minute and seconds dials are provided for setting the exterior hands, and the necessary apparatus is applied, by which it can telegraph its time daily to the observatory, and synchronise to correct time all the other clocks in the building, Bombay city, and on any of the railways, and in towns having wire communication with it. The escapement is that known as Denison's double three-leg gravity, and trials made here of the going qualities of the clock show that it does not vary half a second from its daily rate. The quarters (known as the Westminster) are chimed on the 2nd, 3rd, 4th, and 7th bells of the largest consecutive 8, and the hours are struck on the 8th of the same number.

The carillon machinery plays 16 tunes (two barrels of eight tunes each) one, changed automatically.

On Week Days.	On Sundays.
At 6 0 a.m.	At 6. 0 a.m.
„ 12.0 noon.	„ 1.30 p.m.
„ 5.0 p.m.	„ 5.30 p.m.
„ 9.0 p m.	„ 9. 0 p.m.

The tunes are:—

Sinfonia (Handel).
Those Evening Bells.
When the Rosy Dawn.
Luther's Hymn.
Hanover.
God Save the Queen.
The Harp that Once.
St. Bride's.
Blue Bells of Scotland.
My Lodging is on the Cold Ground.
March of the Men of Harlech.
Last Rose of Summer.
Rule, Britannia.
Home, Sweet Home.
Harmonious Blacksmith.
Auld Lang Syne.

Any number of tunes can be added hereafter.

For the Queen's birthday, and other joyous occasions, a barrel is provided by which 150 changes on twelve bells, rounds and changes on eight bells, and firing will be chimed at full proper speed, as done by ringers in this country. There are two hammers to each bell, each held by wire connections by a separate catch in the carillon machinery, ready to drop and strike its blow;

the pin in the music or change-barrel having only to withdraw the catch, like pulling the trigger of a gun, to discharge the hammer on the bell, the heavy action of relifting being done by a rapidly-revolving independent cam. The diameter of the pin-barrel is only 12in. instead of nearly 6ft., as it must have been if constructed on the old chimes plan, and the pin of brass 1-16in. diameter, instead of steel ½in. square, and being made of wood instead of iron one barrel is easily substituted for another, when it is desired to play eight other tunes, or to chime the changes.

The whole is so constructed that any one part can be removed for repair without disturbing the rest.

ASBESTOS FIREPROOF PAINT.

AN improved fireproof paint, prepared from asbestos and silicate of soda, has been recently patented by Mr. C. J. Mountford, of Birmingham. It is said not only to resist the action of fire, but also to have good covering capacity and body. In preparing the paint the patentee first reduces the asbestos to a fine state of division (usually with water to a stiff paste by means of a pug-mill or suitable grinding apparatus) and then mixes the reduced asbestos with a strong solution of silicate of soda in water: five parts by weight of the former to three parts of the latter. During mixing the mass of the material being treated is maintained at a temperature which may vary from 150° Fahr. to 240° Fahr.—a temperature of about 160° Fahr. being, however, found most suitable. The heating is advantageously effected by causing a jet of steam to rise through the mass, or the mixture may be conveniently heated in a closed vessel, say of cast iron provided with stirrers, motion being given to the vessel, the stirrers, or both. After the incorporation, the paste so formed is thinned down to the required consistency for use with a weaker solution of silicate of soda in water. Colouring matter of any desired kind may be added to the reduced asbestos and silicate solution whilst they are being incorporated together. The proportions of the materials used may be varied to suit different requirements, but the proportions and method of treatment above described are those which the patentee prefers for the standard. Silicate of potash may be used instead of silicate of soda.

UNWRITTEN HISTORY, AND HOW TO READ IT.

THE lecture to the "operative classes" during the meeting of the British Association was delivered on Saturday evening by Mr. John Evans, D.C.L., F.R.S., on "Unwritten History, and how to Read it." Commencing with a few remarks on the origin of the practice of delivering the lecture, he went on to say that it was not easy to find a suitable subject, which should, he considered, be possessed of some local interest. He thought if he spoke of those who in remote times had lived and laboured in this part of the globe, he should have a theme of general human interest. If, in addition to giving particulars of their mode of life, he pointed out the methods by which our knowledge of the manners and customs of remote antiquity was obtained, he should assist his hearers to appreciate the value or the application of scientific methods to the study of the past, and to feel that our knowledge of antiquity rested upon something more secure than vague conjecture. The neighbourhood was the home of some of the witnesses he would call. Our best evidence of what must have been the condition of occupants of the earth without the most simple appliances of modern civilisation was to be found in the relics of the past found buried in the earth. The town was formerly known as Hamtune, and Northampton had the same name; and North and South were prefixed for distinction. Ham was home, and Tune was probably derived from the name of the river in each case. Going back beyond the Roman occupation of the island, we entered the border of the domain of unwritten history. The ancient Britons had coins; particular forms had been found in particular districts: the inscriptions on some determined the names of British princes and the districts in which they reigned. In Hants and Sussex were found coins struck by two princes as to whom written history was silent. In the southern counties, and especially in Kent, coins had been found which were, no doubt, imitations of those made by Philip, the father of Alexander the Great. There was evidence of an uninterrupted succession of coins copied the one from the other. The coins justified us in saying that the Southern Britons were sufficiently civilised to make use of a coinage 150 B.C., or 100 years before Cæsar came. Besides coins of gold, silver, and brass or copper, with devices derived from Gaulish copies of a Macedonian original, there were others cast in tin with devices in imitation of some coins of Marseilles. Many of these had in relief the grain of wood in which they were cast. They had been found with iron tools and weapons near Lewes. In graves which must have belonged to the first few centuries before Christ there had been found swords of iron, with ornamental bronze sheaths. It was the custom to bury with the dead a number of ornamental or useful objects, and in graves in the Austrian Tyrol had been found swords with hilts of ivory inlaid with amber, daggers with golden sheaths, helmets, girdles, bracelets, brooches, and vessels of bronze. In other graves had been found swords, spearheads, and hatchets of bronze, of which the iron weapons appear to be imitations. It was inferred that the bronze weapons must have been in use when iron was introduced as a substitute. The terms "iron age," "bronze age," "stone age" meant certain stages of civilisation, the chronological periods of which would vary in different parts of the world. It was not known when it was discovered that an admixture of tin made copper harder and more fusible, but the discovery was made independently in the New World, for some of the weapons and tools of Peru, made before there was any contact with Europeans, were of bronze of the ordinary composition. The bronze period of Britain was well illustrated by relics (representations of which were shown on the wall). There were swords, spear-heads, daggers, shields, chisels, gouges, and hatchets or axes. In the last-named weapons the gradual development of the socket from the flat blade was traced in curious detail, and the conclusion was drawn that the art of casting hatchets with a socket was introduced into this country from abroad. The bronze-using people were skilful both in founding and in the manufacture of ornaments, and a dagger had been found in Wiltshire as delicately inlaid with gold as any ornament of our own time. But man's history in this stage might be better read on the Continent than at home. In Switzerland, Italy, and the South of France the foundations had survived of the artificial islands carried on piles above the water which the men of those days built to protect themselves against their enemies or wild animals. Those men were hunters and fishermen; to some extent too they were husbandmen, and reaped their corn with sickles of bronze. They made vessels of clay, they could spin and weave both linen and woollen cloth, they possessed domesticated animals—the dog, ox, sheep, goat, and even the horse. Besides bronze, they used flint for their weapons and other appliances, and made utensils of jet and amber. The number and varieties of instruments of that metal found in Britain seemed to carry us back to 1200 or 1400 B.C. as the beginning of the bronze period. But the flint arrow heads and scrapers and the use of stone for battleaxes carried us back to a still earlier chapter of unwritten history. It was astonishing that men in so low a stage of civilisation should have been able to furnish themselves with so many and such perfect appliances made of stone—hatchets and adzes of flint, with carefully ground edges, hollowed chisels, drills, hammers, knives, and saws. The presence of spindle-whorls—the small fly-wheels by which hand-spinning is carried on—proved that the art of spinning was known, and charred fragments of woven garments had been found in the lake dwellings of that primitive time. Wheat, barley, and millet, too, were cultivated, and the apple and pear were not only eaten, but stored up for winter consumption. It was impossible to trace the beginnings of that Neolithic period, as it had been called, although we might fix within some centuries the time at which bronze began to supersede stone as material for the most necessary utensils of life. But the circumstances under which the implements of those days were found proved that the general physical features of the country, the alternation of hill and dale, and the beds of streams, were much the same as they are in the present. In the facts which he had mentioned there was little to prove the inaccuracy of the popular chronology which fixed the creation of the world about 6,000 years ago. But within the last 20 years a marvellous vista of antiquity had been opened out to us by the researches of geologists. The drifted deposits of the Test and the Itchen, and more strikingly those of the Avon, which joined the sea at Christchurch, proved that the earth was many times older than she had formerly been supposed to be. Some of those drift-beds were as much as 90 or 100ft. above the existing river, and it must have required an enormous amount of time to scoop out channels of such a depth. The discovery also of the bones of the elephant, rhinoceros, hyæna, lion, and reindeer, of the pouched marmot, and the Greenland lemming pointed to climatic conditions as diverse as could well be imagined from those under which we now lived. At Southampton itself there were beds of old gravel capping the hill at the common 150ft. above the sea level, and yet the top of that hill must at one time have been a valley surrounded with hills. Thus the aptness of the comparison "as old as the hills" was lost, for

> "The hills are shadows, and they flow
> From form to form, and nothing stands.
> They melt like mists, the solid lands,
> Like clouds they shape themselves and go."

The Stone Age was divided into two periods. That which he had been describing was called the Surface Stone or Neolithic Period, while the earlier times had been designated the Palæolithic or Ancient Stone Period. The implements of the earlier era were of ruder construction, and never had their edges ground. Those implements had been generally found in the river drift, whence arose the term, the "River-drift Period." Yet a great gulf of time was fixed between these two periods. There was little doubt that the gravels which now capped Hengistbury Head, Barton, and Hordle, 100ft. above the sea, were originally deposited in the bed of a river which flowed in an easterly direction, and that the Needles at Alum Bay were the shattered and seaworn remains of an extension of the great chalk ridge of High Down, westward from Freshwater. There must have been a time when the chalk downs of Dorset and the Isle of Wight formed one continuous ridge, and the island was not separated from England by any arm of the sea. In those days, the rivers at Poole, Christchurch, Lymington, and Exbury, must have contributed to form one river flowing from east to west, which in the course of time had widened out until it became the Solent Sea and Spithead. Thus he had shown, though necessarily in an imperfect manner, that the history of man might be carried so far back into a dim past; and even Egyptian chronology, extending as it did over thousands of years, appeared but to cover a small link in the chain of human existence.

SIR W. THOMSON ON THE TIDES.

THE Friday evening discourse during the meeting of the British Association was delivered by Sir W. Thomson, who, after exhibiting and explaining his tide-gauge, tidal harmonic analyser, and tide-predicter, announced that the Committee of Recommendation had determined to recommend the continuance of the tidal harmonic analysis with a view to a more accurate valuation of the long period tides than has been hitherto obtained. From calculations which Mr. G. H. Darwin has already made, it seems that the earth's rigidity may be about the same as that of an ideal globe of homogeneous steel of the same dimensions. A much more accurate valuation is expected from the labours of the committee. The solar, semi-annual and annual tides, which are of high importance, will also be investigated. The learned professor described the difficulty he felt in answering the question, "What is meant by the tides? They were motions of water on the earth due to the attraction of sun and moon. There were places where lunar tides vanished altogether, and where there was only a rise and a fall once in the solar day, or twice in the solar day. There are places where the water rises and falls according to the sun, and not according to the moon; but such rises and falls may depend on other causes than those which we now know to be essential to the lunar tide. We have winds depending on the sun, and changes of temperature depending on the sun. The barometer has regular diurnal periods of change. It is a little higher in the forenoon somewhere about 10 o'clock, a little higher again about 10 o'clock at night, a little lower about 4 in the afternoon and about 4 in the morning. We must be ready, then, to expect rises and falls in the water depending on the heating power of the sun, either directly, or indirectly. It is necessary to separate these motions of the waters from others. We had to explain, and in doing this to consider variations of sea level at different times of the year, and to remember the existence of monsoons and trade winds. We have certain regular annual rises and falls of water depending on the winds, which change with the seasons of the year. These he excluded, but one very interesting point in the theory of tides proper is a solar annual tide, and again, a solar semi-annual tide. The earth being nearer to the sun in January than in July, the action of the sun will operate more powerfully on the waters of the earth in our winter than in our summer. We wish to find by observation how much this effect of the sun's attraction is. The results of observation are utterly inexplicable on the theory of gravitation. We are forced then to look to the meteorological influence—the great discrepancies between the result of observation upon the average sea-level from day to day throughout the year, and what we should expect from a purely gravitation theory of the rise and fall of the sea. But meteorological rises and falls he excluded from the denomination of tides; they were disturbing influences baffling inquiry. They did not affect the lunar influence. But did not the weather change with the moon? Careful observations with the barometer, thermometer, and anemometer at the times of new moon, full moon, and half-moon have failed to establish any relation whatever, and have proved, on the contrary, that if there is any dependence of the weather on the phases of the moon it is only to a degree quite imperceptible to ordinary observation. The discoverer of gravitation failed to reap the fruit of his discovery in explaining rises and falls of the waters of the sea; it was reserved to Newton to explain them on dynamical principles, and he left his successors to work out his theory of tide-generating force. The first rough view of the case was that the moon attracted the waters of the earth towards herself, and heaped them up on this side of the earth. That was not so; it would be so if the earth and the moon were stuck on the two ends of a strong bar and put at rest in space, but there was no such rigid bar. Why did not the moon fall towards the earth? According to Newton's theory, the moon is always doing so. Newton compared the fall of the moon with the fall of a stone at the earth's surface. Why did it not come down? Could it be always falling and never come down? That seemed impossible. It was always falling, but it had a motion perpendicular to the direction in which it was falling, and the result of the continual falling was simply a change of direction of its motion. That was simply the dynamical theory of centrifugal force. If a stone were thrown horizontally it descended in a parabola, the stone falling away from the line in which it was thrown; so it was with the moon. It was seen always to be falling from the present direction and from the further altered line, and so it might be always falling and never coming down. The parts of the moon nearest to the earth were falling most rapidly, the parts further from the earth least rapidly. Each preserved a constant distance, or very nearly a constant distance, from the common centre of gravity of the two. The earth experienced according to its mass a force depending on the average distance. The result clearly was, then, a tendency towards the moon and from the moon, and thus, in a necessarily imperfect manner, he had explained to them how it was that the waters were not heaped up on the side next the moon, but were drawn up towards the moon, and fell away from the moon, so as to tend to form an oval figure. The result of calculations founded upon those principles might be illustrated by an exceedingly delicate spring-balance, having a piece of lead, iron, or brass upon it. It would be found that when the moon was overhead the weight would be diminished by a six-millionth part. Again, when the moon was under foot at lunar midnight, there would be an apparently increased heaviness. Thus the moon's attraction made a variation in the apparent heaviness of bodies amounting to one six-millionth part above and below the mean value. The same result might be attained by a plummet, which would be found to be drawn aside by one 12-millionth part of its length, when the moon was off the vertical. Such observations gave the answer to very important questions regarding the condition of the earth. When the moon was in quarters, as it was called, its influence was greater than that of the sun. Why? Because it was 400 times as near, though enormously less massive. Calculating the moon's mass and the sun's mass, the lunar influence was 2 1-10th times that of the sun in respect of solar tides. The lunar tide-generating force was thus more than double the solar. The sun and moon acted conjointly, and when they produced opposite effects the tide-generating force was their difference. Another question arose: Would not the whole earth yield under the influence of these forces? Would not the six-millionth part of the whole force of gravity operating in different directions squeeze the earth out of shape? It would be so were it not for the enormous rigidity of the earth. That consideration sufficiently disposed of the theory that the earth was a mere crust 40 or 50 miles thick and filled with molten lava. The inference was that the earth had, on the whole, a rigidity greater than that of a globe of steel of the same dimensions. Recurring to the tides, Sir W. Thomson observed that the results of the theory which he had been setting forth, coincided with the actual observation of the tides. Tides were considerably greater when the moon was nearest the earth, and less when she was furthest from the earth. The variations in the tides due to the difference of distance of the moon from the earth were called lunar ecliptic tides, the expression "tide" being used for any of the constituents of the mean action. There was the mean solar tide in the first place, and the mean lunar tide in the second. The sum of the effects of the sun and the moon was a compound luni-solar tide. To take an illustration from the wind, there was what he might call spring and neap sounds, alternately loud and soft. When the two produced their effect together there was a spring tide, as it were, of sound; when the two were going in opposite directions there was a neap or scanty effect of sound. If the two influences—that of the sun and that of the moon—were equally loud, the alternation would be from loud sound to silence; but if one was twice the amplitude of the other we should have a phenomenon comparable with the spring and neap tides. The alternation would not be from loudest to least loud, but from loudest to silence. He might then mention the important experiments carried on by Mr. George and Mr. Horace Darwin in a pendulum so delicately hung as to be sensible of the very smallest effect. They found incessant variations, which went to prove that the palpitation of the earth was traceable to local disturbances, such as the traffic of a town. These palpitations were in effect minute and unceasing errthquake tremors, which completely masked the delicate regular periodical variation which their pendulum would have shown had the earth been worthy of its name *terra firma*.

RECENT ADVANCES IN PHOTOGRAPHY.—VI.*

By Capt. Abney, R.E., F.R.S.

I WISH to commence this evening by showing you the production of a positive picture from a positive picture; not that there is anything essentially novel in it, but it points to a moral to which I shall presently have to draw your attention. What I propose to do, is to take some sensitive iodide paper, expose it to light, and then soak it in a weak solution of potassium bromide, and next expose it behind a positive on glass. On developing, I think the probabilities are that we shall get a positive picture. It is perfectly immaterial, as I am going to expose it to light, whether the paper sees the light now or not, and the small modicum of light we have here will make very little difference to this comparatively insensitive paper. I now burn a small quantity of magnesium wire, in order to fully expose the sensitive surface. If I were to put a developer on that paper as it is now, it would at once blacken. Instead of applying the developer, I will place it in the solution of potassium bromide, then expose it under a transparency, and subsequently develop it. I will give it rather a prolonged exposure, for this paper is not very sensitive, and of course, the time in which this positive is produced depends on the sensitiveness. [A lantern image was thrown on the paper.] Half a minute with this light would be sufficient, but for safety's sake I will give 20 seconds longer. I will now develop the picture with ferrous oxalate, and a positive instead of a negative appears, as it would do in the ordinary way. In other words, the lights are reversed.

Before I draw any conclusion as to this, I will show what part of the spectrum produced this positive picture, because this is an important item in the deduction I shall have to draw. I will take another similar piece of paper, and throw the spectrum upon it. You will recollect that we applied a solution of bromide of potassium to an exposed piece of paper, and that it was then exposed to the image. I will, therefore, expose this second piece of paper to the light from the magnesium wire, as before, and immerse it in a dish in which there is a solution of potassium bromide, and place it in the spectrum. I leave it to be acted upon for about half-a-minute. This I propose to develop on the screen, so that you may see absolutely the part of the spectrum which affects the paper. If everything goes right, there ought to be a bleaching action in the blue rays, and the red rays also will exert a bleaching action if the exposure is continued for some time.

Now, if you will allow me, I will point the moral. These may seem paltry experiments to bring before an audience, but those of the audience who are interested in gelatine plates, and I believe there are a great many here who are, will now, perhaps, be able to draw an inference equally well with myself. All gelatine plates, without exception, I believe, are prepard with an excess of soluble bromide, and I will now ask you to consider what happens, supposing any bromide is left in the film. While the light is acting on the film, the bromide of silver is decomposed, and at the same time the bromide of potassium (or ammonium), is also being decomposed, and undoing the work that the light has done upon the bromide of silver; so that you see that the sensitiveness really got by gelatine plates with an excess of soluble bromide is only the difference between the effect of the light on the silver bromide, and on the bromide of potassium (or ammonium). I think those two experiments ought definitely to settle that gelatine plate-makers have not, as yet, obtained the highest sensitiveness possible, simply because they prepare their emulsions with an excess of soluble bromide. I may say with reference to this, that Dr. Eder has recently shown that on immersing gelatine plates in a weak solution of silver nitrate (in which is a little citfic acid), though strong enough to neutralise any soluble bromide which may be left behind, an increase of sensitiveness, two or three-fold, is produced. The problem to be solved by gelatine plate-makers is this—How to get rid of any possible excess of soluble bromide in their gelatine films? When they do that, no doubt they will get more more rapid plates even than they have done at present. I will now show on the screen those interested in the chemistry of the subject the formula which represents the action which takes place—

$$\text{(I.)}\ 2Ag_2I + 2KI + H_2O + O = 4AgI + 2KHO$$

$$\text{(II.)}\ 2Ag_2Br + 2KBr + H_2O + O = AgBr + 2KHO$$

In the first equation (I.) we have silver iodide, but a similar formula (II.) applies to bromide of potassium, and bromide of silver. In (I.) there is sub-iodide of silver, iodide of potassium, water and oxygen, and that forms iodide of silver, potash, and iodate of potassium. When you have more iodine or bromine liberated, we get—

$$\text{(III.)}\ 6I + 6RHO = 5KI + KIO_3 + 3H_2O$$

or the iodine and potash combine, and form fresh potassium iodide, water, and iodate of potash. When this reaction is finished, we have to go back to the equation (I.), and the same decomposition is repeated.—The oxygen of course is a crux; where does it come from? It comes from the air. It will find its way through the gelatine. Gelatine is not impervious to the air. Dr. Eder has very recently found that this reaction does not take place when there is no oxygen present. So that you see, in order for this reaction to take place, there must be oxygen obtainable from some external source. If you prepare your emulsion with hydrochloric acid, as some do, you have nitric acid left in the film, and that will supply the necessary oxygen for this formula to take effect. I need not enter into details of what takes place with the nitric acid, it is sufficient to say that the nitric acid will supply the oxygen.

This leads me next to consider what causes the destruction of the photographic image. You may destroy the image on a photographic plate, or photographic paper, by any substance which will readily part with oxygen. You can destroy it, for instance, by bichromate of potash; you can destroy it by any of the ferric salts; or you can destroy it by oxygen-yielding substances, like permanganate of potash; ozone, peroxide of hydrogen, or hydroxyl; in fact, there is hardly any substance which will part with oxygen which will not destroy the developable image; the photographic image remains behind as a rule, though not always, but these reagents prevent it becoming developable. Here is a paper prepared with bromide of silver, which has been already exposed behind a negative. After immersion in water, I propose to apply to it some of these destructive agents which I have already mentioned. First I will give it a streak of bichromate, next ferric oxalate, and next permanganate of potash. If everything goes right, on those parts to which these solutions have been applied, the image will be destroyed, or almost destroyed, and a little longer application of the solution would entirely destroy it. This demonstrates then that oxidising agents will destroy the devolopable image.

Now, I do not wish to detract from any developer, but this shows you the care you should take in seeing that your ferrous oxalate developer is tolerably fresh, for you have a large proportion of *ferric* oxalate present with it, it will be very liable to "slow" your plates, and those who are photographers will know what that means. If you take your pyrogallic acid which has been fully oxidised, you will find that it will play you the same trick as this ferric oxalate does, so that neither the ordinary alkaline developer nor the ferrous oxalate developer is certain to give you the best results unless it is fresh. Photographers take warning, and when using a ferrous oxalate developer, use it fresh! If you use the ferrous-citro-oxalate which I have introduced so often to your notice, you get the same result; it has the same bad qualities that the ferrous oxalate has.

(*To be concluded.*)

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[*] Condensed from a series of Cantor Lectures delivered before the Society of Arts.

Ebonising.—How to make woods, such as cherry, mahogany, &c., look like ebony is often desirable, and a correspondent of the *Hub* gives the following directions:—To imitate black ebony, first wet the wood with a solution of logwood and copperas, boiled together, and laid on hot. For this purpose 2oz. of logwood chips, with 1½oz. of copperas, to a quart of water, will be required. When the work has become dry, wet the surface again with a mixture of vinegar and steel filings. This mixture may be made by dissolving 2oz. of steel filings in one-half pint of vinegar. When the work has become dry again, sandpaper down until quite smooth. Then oil and fill in with powdered drop-black mixed in the filler. Work to be ebonised should be smooth and free from holes, &c. The work may receive a light coat of quick-drying varnish, and then be rubbed with finely pulverised pumice-stone and linseed oil until very smooth.

BRITISH ASSOCIATION.

THE ADDRESS IN MATHEMATICS AND PHYSICS.

THE address in Section A was delivered by the president, the Right Hon. Lord Rayleigh, F.R.S., and was mainly occupied with a discourse upon the value and importance of measurements. Even, said the president, where we may fairly suppose that the fundamental principles are well established, careful and often troublesome work is necessary to determine with accuracy the constants which enter into the expression of natural laws. In many cases the accuracy desirable, even from a practical point of view, is hard to attain. In many others, where the interest is mainly theoretical, we cannot afford to neglect the confirmations which our views may derive from the comparison of measurements made in different fields and in face of different experimental difficulties. Examples of the interdependence of measurements apparently distinct will occur to every physicist. I may mention the absolute determinations of electrical resistance, and of the amounts of heat developed from electrical and mechanical work, any two of which involve also the third, and the relation of the velocity of sound to the mechanical and thermal properties of air. Where a measurement is isolated, and not likely to lead to the solution of any open question, it is doubtless possible to spend upon it time and attention that might with advantage be otherwise bestowed. In such a case we may be properly satisfied for a time with work of a less severe and accurate character, knowing that with the progress of knowledge the way is sure to be smoothed both by a better appreciation of the difficulties involved, and by the invention of improved experimental appliances. I hope I shall not be misunderstood as underrating the importance of great accuracy in its proper place if I express the opinion that the desire for it has sometimes had a prejudicial effect. In cases where a rough result would have sufficed for all immediate purposes, no measurement at all has been attempted, because the circumstances rendered it unlikely that a high standard of precision could be attained. Whether our aim be more or less ambitious, it is important to recognise the limitations to which our methods are necessarily subject, and as far as possible to estimate the extent to which our results are uncertain. The comparison of estimates of uncertainty made before and after the execution of a set of measurements may sometimes be humiliating, but it is always instructive. Even when our results show no greater discrepancies than we were originally prepared for, it is well to err on the side of modesty in estimating their trustworthiness. Perhaps I may be allowed to illustrate my meaning by reference to a subject which has engaged a good deal of my attention for the last two years—the absolute measurement of electrical resistance. The unit commonly employed in this country is founded upon experiments made about twenty years ago by a distinguished committee of this Association, and was intended to represent an absolute resistance of 10^9 C.G.S., *i.e.* one ohm. The method employed by the committee at the recommendation of Sir W. Thomson (it had been originally proposed by Weber) consisted in observing the deflection from the magnetic meridian of a needle suspended at the centre of a coil of insulated wire, which formed a close circuit, and was made to revolve with uniform and known speed about a vertical axis. From the speed and deflection in combination with the mean radius of the coil and the number of its turns, the absolute resistance of the coil, and thence of any other standard can be determined. About ten years later Kohlrausch attacked the problem by another method, which it would take too long to explain, and arrived at the result that the B.A. unit was equal to 1·02 ohm—about two per cent. too large. Rowland, in America, by a comparison between the steady battery current flowing in a primary coil with the transient current developed in a secondary coil when the primary current is reversed, found that the B.A. unit was ·991 ohm. Lorentz, using a different method again, found ·980, while H. Weber, from distinct experiments, arrived at the conclusion that the B.A. unit was correct. It will be seen that the results obtained by these highly competent observers range over about four per cent. Two new determinations have lately been made in the Cavendish laboratory at Cambridge, one by myself with the method of the revolving coil, and another by Mr. Glazebrook, who used a modification of the method followed by Rowland, with the result that the B.A. unit is ·986 ohm. I am now engaged upon a third determination, using a method which is a modification of that of Lorentz. Bulky records of crude and uninterrupted observations are not science, nor even in many cases the raw material out of which science will be constructed. The door of experiment stands always open; and when the question is ripe, and the man is found, he will nine times out of ten find it necessary to go through the work again. When an unexpected effect is observed, the question will arise whether or not an explanation can be found upon admitted principles. In repeating, at the beginning of the century, the well-known experiment of the inaudibility of a bell rung *in vacuo*, Leslie made the interesting observation that the presence of hydrogen was inimical to the production of sound, so that not merely was the sound less in hydrogen than in air of equal pressure, but that the actual addition of hydrogen to rarefied air caused a diminution in the intensity of sound. How is this remarkable fact to be explained? Does it prove that, as Herschel was inclined to think, a mixture of gases of widely different densities differs in its acoustical properties from a single gas? These questions could scarcely be answered satisfactorily but by a mathematical investigation of the process by which vibrations are communicated from a vibrating solid body to the surrounding gas. Such an investigation founded exclusively upon principles well established before the date of Leslie's observation was undertaken years afterwards by Stokes, who proved that what Leslie observed was exactly what ought to have been expected. The addition of hydrogen to attenuated air increases the wave-length of vibrations of given pitch, and consequently the facility with which the gas can pass round the edge of the bell from the advancing to the retreating face, and thus escape those rarefactions and condensations which are essential to the formation of a complete sound wave. Examples such as this, which might be multiplied *ad libitum*, show how difficult it often is for an experimenter rightly to interpret his results without the aid of mathematics. By direct observation one of the most experienced and successful experimenters of the last generation convinced himself that light of definite refrangibility was capable of further analysis by absorption. It has happened to myself, in the course of measurements of the absorbing power of various media for the different rays of the spectrum, to come across appearances at first sight strongly confirmatory of Brewster's views, and I can therefore understand the persistency with which he retained his opinion. But the possibility of further analysis of light of definite refrangibility (except by polarisation) is almost irreconcilable with the wave theory, which on the strongest grounds had been already accepted by most of Brewster's contemporaries; and in consequence his results, though urgently pressed, failed to convince the scientific world. Further experiment has fully justified this scepticism, and in the hands of Airy, Helmholtz, and others has shown that the phenomena by which Brewster was misled can be explained by the unrecognised intrusion of diffused light. The anomalies disappear when sufficient precaution is taken that the refrangibility of the light observed shall really be definite.

THE ADDRESS IN CHEMISTRY.

The address in Section B was delivered by the president, Prof. G. D. Liveing, F.R.S., who said that if he were asked in what direction chemical science had of late been making the most important advances, he should reply that it was in the attempt to place the dynamics of chemistry on a satisfactory basis, to render an account of the various phenomena of chemical action on the same mechanical principles as are acknowledged to be true in other branches of physics. He could not say that chemistry could yet be reckoned among what are called the exact sciences, that the result of bringing together given matters under given circumstances could yet be deduced in more than a few special cases by mere mathematical processes from mechanical principles, but that some noteworthy advances have in recent years been made, which seem to bring such a solution of chemical problems more nearly within our reach. In the first place, notwithstanding the slowness with which new ideas replace old familiar images, the molecular theories developed by Clausius, Clerk-Maxwell, and Boltzmann, and by Sir W. Thompson, have been long enough before the world to have greatly loosened the hold upon our minds of many old notions. The vortex theory, whether we think it probable or not, at least gives us a standing ground for the assertion that the supposed impenetrability of matter, and the curious compound of nucleus and atmosphere which had been invented to account for elasticity, are not necessary assumptions. The kinetic theory of gases has analysed for us the different motions of the molecules in a mass of matter, and has facilitated the conception of the part which heat plays in chemical action.

Proceeding with his remarks, Prof. Liveing referred to two hypotheses which have created a little interest lately. The notion that there is but one elementary kind of matter is at least as old as Thales, and underlies Prout's hypothesis that the atomic weights of our elements are all multiples of that of hydrogen. This famous hypothesis has gone up and down in the scale of credibility many times during the present century. Quite recently, said the speaker, a fresh revision of the combining weights has been made on the other side of the Atlantic by Professor F. W. Clarke, who, on the whole, concluded that Prout's hypothesis, as modified by Dumas, is still an open question—that is to say, his final numbers differ from whole multiples of a common unit by quantities which lie within the limits of errors of observation and experiment. Let us turn again to the evidence afforded by our most powerful instrument for inspecting the inner constitution of matter, the spectroscope. A few years ago Mr. Lockyer supposed that the coincidence of rays emitted by different chemical elements, particularly when those rays were developed in the spark of a powerful induction coil and in the high temperatures of the sun and stars, gave evidence of a common element in the composition of the metals which produced the coincident rays. Later results cannot fail to shake our belief in the existence of any common constituent of the chemical elements; but it does not touch the evidence which the spectroscope affords us that many of our elements, in the state in which we know them, must have a very complex molecular structure. Professor Liveing said he could not dismiss the subject of chemical dynamics without alluding to the ingenious theory by which the President of the Association has proposed to account for the conservation of solar energy. Commenting on this, he remarked that if it be true that the compounds are decomposed by absorbing the sun's rays, we ought to find in our atmosphere the products of decomposition; we ought to find it in free hydrogen, carbonic oxide, and acetylene or some other hydrocarbons. The hydrogen, from its small specific gravity, would not be concentrated in the lower regions of our atmosphere in the same proportions as the denser gases, but carbonic oxide and hydrocarbons could not fail to be detected in the air if they formed any sensible proportion of the gases in the planetary space. Dewar and he had recently shown that if nitrogen already in combination, as, for instance, ammonia, be brought into a hydrocarbon flame, cyanogen is produced in sufficient amount to give in a photograph (though not so as to be directly visible) the characteristic spectrum of cyanogen as it appears in the comet. It is therefore, he said, no longer necessary to make any other supposition to account for the cyanogen bands in the spectra of comets, than that ammonia, or some such compound of nitrogen, is present as well as hydrocarbons in a state of ignition.

THE ADDRESS IN GEOLOGY.

The address in Section C was delivered by the president Mr. R. Etheridge, F.R S., who referred to the geological features of the district, and gave an epitomised history of the work that had been done in the Hampshire basin, the channel, and the opposite coast. In Selsea, said the President, I draw attention to a locality of extreme interest both to the geologist and archæologist, where cause and effect are manifested in both investigations, the historical portion being based upon physical causes and changes that have long been and still are going on, to modify the form, extent, and structure of the Sussex coast, from the mouth of Chichester Harbour to Littlehampton and Bognor. The peninsula of Selsea is celebrated in English history as one of the places where Christianity was first taught in this country. It was one of the most ancient Saxon establishments. This peninsula was granted by Edilwalch, King of the South Saxons, to Wilfred, the exiled Bishop of York, about the year 680 At that time it is stated to have contained 5,220 acres of land, with 85 families and 250 slaves. The parish now contains only 2,880 acres, 2,340 having been slowly denuded away by the action and encroachment of the sea. This encroachment and destruction during the past 800 years has been very extensive. The creek called Pagham Harbour, on the south-east side of the Bill or peninsula, was due to an irruption before the year 1315, when 2,700 acres of land were destroyed. The site of the ancient cathedral and episcopal palace of Selsea, believed to have been situated to the south-east of the present church of Pagham, is no longer to be determined, but there is no reason to doubt but that it stood nearly a mile out in what is now sea. We are led to believe that when Selsea became known to the English nation is was an island, and that in Bede's time the process of silting up the estuary must have commenced, and the completion of this process would seem to have been before the Conquest. The action of the tides on this coast carries the sand and shingle from west to east, therefore the gradual wasting which has taken place on the shore of Bracklesham Bay has served to supply a large portion of the material of which these marshes are formed. The ground on which Selsea, Bognor, Littlehampton, Worthing, and other places on the Sussex coast westward of Brighton are built, is of very recent formation, being composed of gravels, sands, and loam belonging to the post-pleiocene or pleistocene series.

THE ADDRESS IN MECHANICAL SCIENCE.

The address in Section G was delivered by Mr. John Fowler, C.E., who said that in the future the present age will be remembered chiefly for the vast strides which have been made in the advancement of mechanical science. The civil engineer is essentially a product and a type of the latest development of the present century. The work which above all others would have astonished and perplexed our ancestors is the little one known to all the civilised world as "Bradshaw." The President then made some remarks on the speed and regularity of the train service, and contrasted it with the achievements at the opening of the Liverpool and Manchester Railway half a century ago. An essential condition of the attainment of high speed on the railway is that the stopping places be few and far between. On the Metropolitan Railway no sooner has a train acquired a reasonable speed than the brakes have to be sharply applied to pull it up again. Sixty per cent. of the whole power exerted by the engine is absorbed by the brakes. In other words, with a consumption of 30lb. of coal per train mile, no less than 18lb. are expended in grinding away the brake blocks, and only the remaining 12lb. in doing the useful work of overcoming frictional and atmospheric resistances. Comparatively high speed and economy of working might be attained on a railway with stations at half-mile intervals if it were possible to arrange the gradients so that each station should be on the summit of a hill. An ideal railway would have gradients of about one in 20 falling each way from the stations, with a piece of horizontal connecting them. With such gradients gravity alone would give an accelerating velocity to the departing train at the rate of one mile per hour for every second; that is to say, in half a minute the train would have acquired a velocity of 30 miles an hour, while the speed of the approaching train would be correspondingly retarded, without the grinding away of brake blocks. Could such an undulating railway be carried out, the consumption of fuel would probably not exceed one-half of that on a dead level railway, while the mean speed would be one-half greater. Although the required conditions are seldom attainable in practice, the broad principles should be kept in view by every engineer when laying out a railway with numerous stopping-places. The construction of tunnels was not one of the novelties presenting itself to railway engineers, for many miles of tunnel had been driven by canal engineers before a single mile of passenger railway had been built in this or any other country. To foreign engineers belongs the honour of having boldly conceived and ably accomplished tunnel works of a magnitude which would have appalled a canal engineer. Tunnels under broad navigable rivers and estuaries have been a subject of discussion by engineers for at least a century, but the only one at present completed is the unfortunate and costly Thames tunnel. Two important works of the class are, however, now well in hand—namely, the Severn tunnel at Portskewet, and the Mersey tunnel at Liverpool. One lesson enforced by the Thames Tunnel was the necessity of leaving a reasonable thickness of ground between the water and the tunnel. In the Severn tunnel the *minimum* thickness is 40ft., and in the Mersey tunnel 22ft. The width of the river at the point of crossing of the former tunnel is 2¼ miles, and the *maximum* depth of the rails below high water 163ft. In the case of the Mersey tunnel the width is nearly three-quarters of a mile, and the depth 144ft. The Thames tunnel, as almost every one knows, was carried on by means of a special contrivance termed by Brunel a "shield." No special appliances have been adopted in the case either of the Severn or the Mersey tunnel. Both are driven in the ordinary way, but of course enormous pumping-power is required and has been provided. Where no special appliances are used in the construction of a subaqueous tunnel, it will be clear that an unknown risk is encountered. All may go well, and the engineer will then justly receive congratulations from every one for his boldness and success But, on the other hand, something may go wrong, even at the last moment, and the engineer then would be abused by the unthinking public for his temerity and consequent failure. In many cases of tunnels under estuaries, special appliances could be used which would obviate all risk and make the successful completion of the work a mathematical certainty. A tunnel over a mile in length now in progress under the Hudson river at New York is being driven through a silty stratum by the aid of compressed air, and with a certain amount of success, as only some twenty men have been drowned up to the present time. The principle upon which the compressed air is used, however, a false one, since it is merely forced into the tunnel with a view to uphold the ground by its pressure, like so much timbering, and not to keep out the water on the principle of a diving-bell. It is clear, therefore, that the completion of the Hudson river tunnel, if the present system be persevered in, is purely a matter of conjecture, and all we can do is to hope for the best. The same remark applies, of course, to the Severn tunnel and the Mersey tunnel, although in those cases the character of the ground is such that the contingencies are small in comparison with those encountered in the construction of the Thames tunnel and the Hudson river tunnel. Nevertheless, unless special appliances of the nature of the pneumatic process be used, a subaqueous tunnel, whether it be the Channel tunnel itself or one but a few yards in length, must necessarily present an unknown risk. The prototype of all these tunnels is the one commenced at Rotherhithe in 1809, which was successfully driven a distance of 900ft. under the Thames, and failed when within little more than 100ft. of the opposite shore. A tunnel about 1½ miles in length was commenced about ten years ago under the Detroit river in America, but was abandoned in a similar manner. So far good fortune has attended both the Severn and the Mersey tunnels, and there is, I am glad to say, every chance of its continuing. Only a few months ago I became aware of the fact that a scheme, identical in all its main features with my Humber tunnel project, had been suggested for adoption in the case of the Thames tunnel, in lieu of the plan proposed by Brunel. Fifty-nine years ago a working smith named Johnson proposed to construct the Thames tunnel without coffer-dams by making it in parts, 28ft. in length, each part having the ends temporarily stopped up and being constructed on the same principle as the diving-bell. If another tunnel be constructed under the Thames, which is far from improbable, as the requirements of below-bridge traffic necessitates some such means of communication, it will be built in accordance with the plan suggested fifty-nine years ago by the working smith, and not on that of Brunel's Thames tunnel, or of any other tunnel yet carried out. A ferry still is the only means of communication across the Forth at Queensferry. Parliament by the passing of the Forth Bridge Act during the present session, has given a practical recognition of the truth that the improvement of the Forth passage is a "national object." After a careful consideration of the difficult problem, in concert with my able colleagues, Mr. T. E. Harrison, the chief engineer of the North Eastern Railway, and Mr. W. H. Barlow, chief engineer of the Midland Railway, we unanimously advised the directors of the Forth Bridge Company to abandon the project of a suspension bridge, and to construct a steel girder bridge of the uprecedented span of 1,700ft. The total length of the structure is 1½ miles, and it includes two spans, as aforesaid, of 1,700ft., and two of 675ft., over the navigable channels on each side of Inchgarvie. The execution of the work has been intrusted to me, and my intention is that the Forth Bridge shall be not only the biggest, but the strongest and stiffest bridge yet constructed. Although great navigable rivers offer the most serious impediments to lines of communication lying at right angles to the direction of the stream, and necessitate such formidable undertakings as the Forth Bridge, with a clear headway of 150ft. above high water, and the Severn tunnel, at a depth of 163ft. below the same datum, still it must be remembered that such rivers were the earliest, and are yet the cheapest highways for inland communication.

ABSTRACTS OF REPORTS, PAPERS, &c.

Report on the Ultra-Violet Spark Spectra.

The report of the committee on the photographing of the ultra-violet spark spectra emitted by metallic elements and their combinations was presented by Professor Huntington. It stated that the chief objects to be gained from a knowledge of the character of the spark spectra of metallic elements were the means of readily identifying the metals by photographs of their line spectra; a knowledge of the alterations producible in the spectra of metallic salts by the presence of various non-metallic elements; a knowledge of the alterations in spectra caused by the dilution of metallic solutions; the possible means of performing rapid quantitative determinations of metallic substances by the aid of photography and obtaining permanent records of the results. In a paper on the reversal of metallic lines as seen in over-exposed photographs of spectra presented to the Royal Society, Professor Stokes said an under-exposed plate was likewise difficult to develop, and was liable to cause the strong lines to appear reversed. Any strong lines might be reversed by over-exposure without materially altering the appearance of the rest of the spectrum. The reversal took place in the centre of the line, and was where the radiation was most active and subject to reversal by over-exposure. Professor Hartley had stated that some 14 years' practice in photography had convinced him that when a plate was properly exposed the development of the image was the simplest of all operations. In order to simplify spectroscopic work he had carefully ascertained the time of exposure required to produce the spectra under various conditions, such as intensity of spark and conductivity of the electrodes. He preferred a general period of half a minute. It was a remarkable fact that at the present time they knew little or nothing of the sensitiveness of the spectrum under certain various conditions, notwithstanding that such knowledge was absolutely necessary for the purpose of giving stability to numerous theories and arguments which were based on spectrum observations. The President said he thought the committee had a little exaggerated the difficulties regarding over-exposure.

A Small Dynamo.

Mr. W. H. Preece brought under the notice of Section A a new form of hand dynamo machine worked by two men. Mr. Preece showed a small arc light and produced a good light with three Edison lamps. The E M.F. of the machine at full speed was 70 volts. The resistance of the field magnet was 4 ohms, and the resistance of the armature was 4 ohms. One capital Swan light would be produced if only one man worked the machine. The price of the dynamo itself without the mechanical construction was only £15. He strongly recommended the machine for its usefulness in homework or in the demonstrations of the lecture-hall. Mr. Ladd explained that a hand machine of his own would produce two Swan lights with the labour of one man. Mr. Swan feared that the imposition of a heavy royalty had restricted the use of Mr. Ladd's machine, and as he understood Mr. Preece, the machine now described would be useful and cheap. Mr. Ladd having pointed out that the price quoted by Mr. Preece did not include the mechanical gearing, Mr. Preece said the cost of this new dynamo was 350 francs, and an additional £5 would complete the fitting up of the instrument. It is designed by M. De Meritens.

Secondary Batteries.

Dr. Gladstone made a communication to the same section on the secondary batteries known as the Plante or Faure accumulators, which have been proposed and used as a valuable adjunct to the means of electric lighting. The amount of force that can be obtained from one of these cells depends upon the quantity of peroxide of lead which can be reduced, and it was shown by a consideration of the chemical reaction which takes place that this peroxide is somewhat rapidly destroyed by local action, both during rest and discharge. The great object to be overcome is to minimise this destructive action. Everyone, he said, wished these secondary batteries to be successful. When they were perfected they would be extremely valuable. One important way of getting at the best secondary battery was to continue the examination of chemical reaction, with a view to getting a secondary battery which should not be subject to loss, but should be free from local action and capable of retaining the electricity put into it for any length of time that might be convenient.—An animated conversation arose, in which the main point discussed was whether the sulphate of lead formed in these batteries is reduced or not by subsequent charging. —The President (Lord Rayleigh) agreed that a minute and thorough investigation of the chemical reaction should be the key to the difficulties that remain to be overcome in the secondary battery.—Sir W. Thomson also said that a great deal of investigation into chemical theory, as compared with practical results, was urgently wanted.—Prof. S. P. Thompson pointed out that Faure, in his earlier experiments, met some of the difficulties by a process of alternately charging in different directions, and also by giving his battery periods of rest during the time of charging. When he charged his batteries in this way he obtained from them a greater electromotive force. During the period of rest local action had been going on, but the sulphate of lead deposited was by the subsequent charging itself peroxidised, and thus a stronger peroxidation was obtained. He believed the best form of secondary battery was the old Planté accumulator of 1860, pure and simple.

Report on Underground Waters.

Mr. C. E. de Rance read the report of a committee appointed to investigate the circulation of underground waters in the permeable formations of England, and the quality and quantity of the water supplied to various towns and districts from those formations, to which was added an appendix, written by Mr. Edward Wethered, on the density and porosity of rocks in relation to the water-supply, in which the author set out by averring that a knowledge of the porosity of rocks was important as regarded the water-supply, the suitability of stone for building purposes, and in accounting for some of the lithological changes often observed in the earth's strata. Though the matter had not escaped investigation, the vast volume of water stored in the rocks had not been fully realised. The density of the old red sandstone was 2·61, the volume of water absorbed by a cubic foot being 0·707 gallon, and by a square mile, 3ft. thick, 59,000,000 gallons. The conglomerate beds of the same formation were still more absorbent, being capable of taking in 0·805 per cubic foot, or 67,000,000 gallons to the square ile 3ft. thick. The millstone grit which lay at he base of the coal measures varied much in different localities, that found in the Forest of Dean being the most porous, absorbing 66,000,000 gallons to the square mile 3ft. thick. Some of the coal-measure grits also stored large volumes of water. The Pennant rock, about 900ft. thick in the Bristol coalfield, and extensively developed in Somersetshire, as also around Swansea, was capable of absorbing 12,000,000 gallons in a square mile 3ft. thick, and specimens of magnesian limestone taken from the neighbourhood of Bristol showed a porosity of 86,000,000 gallons, but the carboniferous limestone was quite the reverse, and only absorbed three and a half millions. Oolites held vast stores of water, and the rock was much used for building.

SCIENTIFIC NEWS.

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AFTER an animated discussion, the general committee of the British Association decided to hold the next meeting at Southport, by 64 votes to 57 given for Canada. For 1884, Montreal, Birmingham, Aberdeen, and Nottingham were proposed, and the first place was chosen by a considerable majority.

Prof. Cayley was elected president for next year, and for vice-presidents the Earls of Derby, Crawford, and Lathom, and Profs. Greenwood, Roscoe, and H. J. S. Smith. Prof. T. G. Bonney was re-elected secretary.

There has been the usual number of amusing papers read at the recent meeting—one which brought out from Sir W. Thomson a reiteration of his belief in the possibility of germs reaching the earth in meteors. The paper was by Prof. Schwedoff, on a theory of hailstones. The writer gave an account of some remarkable hailstones, one 26in. in diameter being completely eclipsed by another "as large as an elephant," which was three days melting. Prof. Schwedoff holds that hailstones come from ultra-terrestrial regions—are in short a species of meteor of cosmic origin. Prof. S. P. Thompson read a paper in support of Prof. Schwedoff's theory, which he thinks is the only one sufficiently accounting for the phenomena and variety of form of hailstones; but Sir W. Thomson thought the paper might have been put forward as a joke. A particle of Schwedoff's hail falling through the atmosphere with meteoric velocity would perform 13,000 times as much work as would raise water one degree Centigrade, and if that would not melt hailstones he did not know what would.

In a paper on electric railways, Dr. Fleeming said that Edison's electric locomotive saved about one pound of coal per horse-power per hour over the ordinary locomotive—a statement which was promptly corrected by pointing out that he had assumed the consumption of the steam locomotive to be 6lb. per horse-power per hour—about double the quantity actually consumed.

In the course of the discussion on a paper by Mr. W. S. Duncan, Professor Ball mentioned that he had seen monkeys, on an island where trees and fruit were scarce, go down to the shore and eat oysters. Mr. Duncan's paper was an endeavour to show that the scene of man's evolution might be discovered by palæontological researches. He adduced reasons for believing that the South of Europe and Asia was the probable scene, and consequently a likely field for successful explorations.

The deaths are announced of Sir Woodbine Parish, F.R.S., and of Count Lutke, the Russian Arctic explorer. The former was in his 86th year. He was made a Fellow of the Royal Society in 1824, for his contributions to science, and in consideration of his having brought to this country the fossil remains of the Megatherium, Glyptodon, and other monsters of the ancient Pampas.

Captain R. G. Morris, R.E., and Lieutenant Darwin, R.E., sailed on Saturday in the *Liguria* for Australia, to take up their stations for the transit of Venus.

Two Belgian expeditions have also left, one under M. Houzeau for Texas, and the other under M. Niesten for Chili.

Prof. H. A. Newton has been appointed director of the new Observatory at Yale College, Connecticut. The observatory possesses an 8in. refractor by Grubb, and a heliometer by Repsold.

Vice-Admiral Stephen C. Rowan has been appointed superintendent of the Naval Observatory at Washington.

The Italian Minister of Public Instruction has agreed to the proposed international expedition to the Marquesas Islands in 1883, to observe the solar eclipse in May. Prof. Tacchini has been directed to make all necessary preparations.

Mr. W. H. Neale, M.B., the medical officer of the *Eira*, expresses the opinion that if they live on the meat of the country—that is, walrus and bear—Arctic voyagers will run little risk of scurvy, even without vegetables. Preserved mutton and beef are to be preferred, but the doctor means that walrus and bear flesh will serve to keep away scurvy. At first the whole crew were attacked by diarrhœa, but recovered after about two or three weeks of the diet. He has brought some to England in sealed tins.

The courses of Gilchrist Lectures to be delivered in the autumn and winter will be by Mr. Lant Carpenter, Dr. W. B. Carpenter, Rev. W. H. Dallinger, Dr. Martin Duncan, Mr. R. A. Proctor, Prof. Balfour Stewart, Prof. W. C. Williamson, and Dr. Andrew Wilson. The English courses will be delivered in Leicester, Lincoln, Chesterfield, York, Doncaster, Reading, and Banbury; the Lancashire courses in Burnley, Bolton, Bacup, Bury, and Stockport; the Scotch courses at Forfar, Brechin, Arbroath, Dunfermline, and Kirkcaldy.

A practical trial of one of Berthon's collapsible lifeboats has been recently made. The boat in question is 28ft. long, 8ft. 6in. wide, and 3ft. 6in. deep, spreading about 460ft. of canvas in four sails. It can accommodate between 60 and 70 persons, and stores of all necessary kinds for several weeks, including 250 gallons of water. The boat, under the command of Capt. Harvey, R.A., with Capt. W. Nicholson and four seamen, was dropped from the R.M. Co.'s ss. *Essequibo*, about 400 miles W. of Land's End, and reached Scilly on the sixth day. The boat left Scilly the next day in a violent gale, and arrived off the Needles early in the morning two days afterwards. The weather throughout the voyage was very stormy, and the sun was seen once only. At times the speed of the boat is said to have exceeded 10 knots an hour.

Two series of experiments of an imitative character were described at the French Academy meeting on the 14th inst. Mr. Bergeron gets an imitation of craters in the moon by sending a current of hot air through a brass tube inserted obliquely in an alloy (Wood's *e.g.*), that has been melted and is gradually cooling. The bubbling clears away in a circular space the pellicle that is beginning to form, and the heaped-up matter forms a sort of crater. With further cooling the mass becomes pasty, and the current ceases to clear the surface, merely forming a prominence or cone in the middle, while the crater becomes hollower. The appearance is like that of a lunar crater, for which the author suggests a like action. Some modifications are described. Thus, temporary interruption of the current produced two concentric circular *enceintes*, recalling those of Copernicus and other lunar craters. The other series of experiments are by M. Decharme, in imitation of the magnetic figures obtained with electric currents or magnets. In one case, he forces a current of water through a tapered glass tube perpendicularly against a plate covered with minium in water. This gives concentric circles, like those of iron filings acted on by an electric current. Blowing air through a similar tube moved parallel to the plate gives another variety of lines of force. In another case, water is forced through one tube against the plate and drawn off by another, and so on.

We learn from *L'Ingenieur*, that M. Saur has devised a new photo-electric battery—(*i.e.*, giving a current when exposed to light.) It consists of a square glass vessel, with a solution of 15 parts of marine salt and 7 of sulphate of copper in 100 of water. This has an electrode of sulphide of silver. An inner porous vessel with mercury has an electrode of platinum. The electrodes are connected with a galvanometer, and the battery is placed in a box with light excluded. Closure of the circuit displaces the needle, the sulphide of silver being the negative. When the needle is at rest, exposure of the battery to solar light causes further deflection. The passage of a cloud causes a variation. The effect of the battery is due to attack of the mercury by the bichloride of copper formed by the mixture of marine salt and sulphate of copper. The protochloride of copper formed reduces the silver sulphide, but this reduction requires the intervention of solar light, which produces the photoelectric current.

It has been lately announced, by authority of a U.S. Government Bureau, that the white pine forests of the United States would, at the present rate of consumption, furnish less than twelve years' supply of that indispensable timber. The advance in cost of pine-timber has already begun, and the question of employing some other material for the coarser uses of building is being earnestly discussed among architects and contractors. But a decided progress will have to be made, it is thought, in the art of seasoning and working the timber of deciduous trees, before it can be used satisfactorily in place of pine.

At the Dresden Polytechnikum, Herr Ernst Müller has been making experiments as to the relation between moisture in the air and moisture in fibrous materials. The weight of such a material was determined from a series of different degrees of air moisture, and then the weight of the absolutely dry substance; hence the amount of moisture in the fibre could be inferred. The limits of temperature were 9° and 26° with a mean of of 19·67° C. In general, it was found that the fibrous substances do not take or give up water so quickly as the air, so that with increasing air moisture the values for water-content of the substances are under the mean values, while with decreasing air-moisture they are over them. The amount of these divergencies gives a measure of the velocity with which the different materials follow; expressed in percentage of the absolute dry material this is 0·12 for silk, 0·20 for flax, 0·26 for cotton, 0·21 for silver, 0·50 for washed wool, and 0·54 for unwashed. The general course of the change of water-content with increasing air-moisture from zero occurs at first very quickly with that, then proportionally to it, then, again, much more quickly. The absolute moisture-content of the air at high temperature increases very quickly, while the hygroscopic power of the fibres diminishes. (Further details will be found in Dingler's *Journal*).

Diabetes is known to be a very stubborn disease. M. Claude Bernard produced the saccharine form of it in animals by irritation of a part of the *medulla oblongata*—*i.e.*, the link between the brain and the spinal cord; and M. Félizet believes such irritation to be the cause in normal cases; therefore, instead of treating the disease by severity in diet (exclusion of bread, starchy matters, sugar, &c.), he aims at suppressing the irritation by the sedative action of bromide of potassium on the organ named. The sugar rapidly decreases. M. Félizet has cured 15 cases thus.

La Lumière Electrique has a fine illustration of the Partz system of electric lighting by reflection, for streets, squares, &c. The light produced underground is thrown up through a cylinder enamelled interiorly, and about 10ft. high, to a reflector on four slender supports, at a height of, say, 160ft., whence the rays are thrown around. The advantages claimed are the possible use of large lights (avoiding loss from division), less loss by reflection than through globes, equal diffusion, accessibility of apparatus, superiority in fogs, &c.

Among the various arrangements in connection with the American Association meeting at Montreal on the 23rd ult., the telegraph companies agreed to transmit, free of charge to all parts of the United States and Canada, members' telegrams relating to family, social or scientific, matters. Three express companies undertook to forward and deliver, free of charge, all parcels of books, drawings, instruments, or specimens of natural history for use of members at the meeting, and return them at the lowest rates. The railway companies seem also to have acted with praiseworthy liberality. The excursions during the meeting were to be to Ottawa and Quebec, to Lake Memphremagog, and to Lachine.

Operations are in progress for providing hydraulic force on a large scale from the Rhone at

Bellegarde. The property will belong to the Banque des Travaux. Permission was granted several years ago to furnish a motor force of 10,000 horse-power. A canal has been formed, capable of giving 60 cubic metres of water at low water; it is fed by about a third of the water of the Rhone, which it brings to a rock pierced with a tunnel 550 metres long, with slope corresponding to a velocity of 2 metres per second. The enormous volume of water comes into a basin, where are to be placed 6 turbines of 600 horse-power each. A second tunnel will bring the Rhone water by another basin, where, with a fall of 18 metres, five or six other turbines will be placed. The total force at once indicated will then be practicable. It is on the territory of Gex, separated from Bellegarde by the river of Valserine and according to a treaty with Switzerland, beyond the French customs line, that the various industries to utilise the force are expected to locate themselves.

LETTERS TO THE EDITOR.

[We do not hold ourselves responsible for the opinions of our correspondents. The Editor respectfully requests that all communications should be drawn up as briefly as possible.]

All communications should be addressed to the Editor *of the* English Mechanic, 31, *Tavistock-street, Covent-garden, W.C.*

All Cheques and Post-office Orders to be made Payable to J. Passmore Edwards.

⁂ *In order to facilitate reference, Correspondents, when speaking of any Letter previously inserted, will oblige by mentioning the number of the Letter, as well as the page on which it appears.*

> "I would have everyone write what he knows, and as much as he knows, but no more; and that not in this only, but in all other subjects: For such a person may have some particular knowledge and experience of the nature of such a person or such a fountain, that as to other things, knows no more than what everybody does, and yet, to keep a clutter with this little pittance of his, will undertake to write the whole body of physicks: a vice from whence great inconveniences derive their original."
> —*Montaigne's Essays.*

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DOUBLE STARS.

[20434.]—I have read with much interest Mr. Perry's valuable letters relating to double stars. Whatever may be the performance of reflecting telescopes generally, there can be no doubt that he has a most excellent instrument, and one capable of doing, in his hands, the very best work in this field. The class of stars observed, and the excellence of the measures furnish satisfactory evidence on this point. Mr. Perry, however, will agree it has rarely happened that a large reflector has been so severely tested in any tangible way. We have had plenty of descriptions of how planets, nebulæ, &c., have looked, which, however satisfactory to the observer, could be no evidence to any one else. Fortunately, with the micrometer no description is needed, and the correctness of the observation can be verified at any time. In the discovery of new pairs, the imagination of the observer is entirely eliminated, provided always he does not belong to the now rather limited class of astronomers who see companion-stars where none exist. I trust Mr. Perry will continue to employ his telescope in the measurement of neglected and difficult pairs. The necessity for such work is likely to continue for a long time.

I have measured some of the pairs mentioned by Mr. Perry and others, and in that connection the following unpublished measures may be of some interest:—

η Coronæ	124·3°	0·51″	1881·32	5 nights.
μ Boötis	125·3	0·63	81·38	4 ,,
OΣ298	350·3	0·36	81·42	3 ,,
λ Ophiuchi	37·7	1·45	80·46	4 ,,
ζ Herculis	110·6	1·53	81·45	5 ,,
42 Comæ	193 0	0 64	81·37	4 ,,
,, ,,	193·1	0·68	79·37	2 ,,
25 Can. Ven.	155·9	0·41	81·43	3 ,,
ξ Ursae	269·7	1·66	81·35	4 ,,
Σ 2062	114·5	2·23	81·49	2 ,,
Σ 1555 AB	346·5	0·68	82·24	3 ,,
AC	145·1	21·17	82·24	2 ,,

Ordinarily I have not spent any time in measuring the old binaries of this class, believing a large reflector could be more profitably employed, but most of the bright pairs mentioned above were measured by daylight, and therefore did not interfere with the observation of more difficult and interesting objects. In this connection I may mention that the last of the new pairs given on page 260 is identical with β 112, for which Dembowski found, P = 292 4° : D = 1·75″ (1875·07) 3n. This is a distant companion to p. XII. 243, the distance by the same observer being 153·39″ in the direction of 347·4°.

August 8th. **S. W. Burnham.**

A BEGINNER'S METHOD OF OBSERVING.

[24035.]—In the introduction to the Rev. T. W. Webb's "Celestial Objects"—an invaluable book for the student of astronomy—the author says, "How is he to use his telescope in a really improving way? What is he to look for? For want of an answer many a good instrument is employed in a desultory and uninstructive manner, or consigned to dust and inactivity."

I feel I am attempting a very bold thing, but may I beg a little space to say how I have lately gone to work, so that, possibly, it may be helpful to others. I premise by saying that my instrument is a Wray 3in. ach. with powers of 60, 130, and 240, and my experience has taught me that a telescope by one of the best makers is by far the cheapest in the end.

Now for the method. I assume the beginner knows the constellations fairly well. This is indispensable. I would then recommend him to procure "Celestial Objects," published at 9s., and a large "Star Atlas," by Proctor, published at 15s.

Next, let him get a book, for MS. entries, of some 200 pages, size, say, 10in. by 8in., page it properly, and cutting up a Gall's shilling atlas into constellations, paste these separately, or at most by twos or threes, into the book, some pages apart. Let an alphabetical index be also made, and much trouble in reference will oftentimes be spared.

Then I would suggest to the beginner a careful study of "Celestial Objects," such doubles, &c., being selected for observation as his telescope might be expected to show well.

Let these selections be entered on the pages next the pasted constellations, taking care to leave plenty of room between the entries for remarks and memoranda—e.g.:—

Objects.	Mag.	Dist.	Pos. Ang.	Memoranda.	Remarks.
61 Androm.	7, 11	50″	355″	11 mag.: test 3in.	Obs. 240: 19/8/82.
2 Camel..	5½, 7½	1·7″	299°	Near limit of 3in.	A failure: 240: but def. bad. 15/8/82.

I may say that caustic soda liquefied, and used as ordinary ink, is the only thing that I have found to show well on the deep blue background of Gall's Atlas. The α, β, γ, &c., of the constellations can thus be inserted, and smaller stars than Gall gives put into their positions.

With a working list such as this, the beginner has in a small compass a fund of useful material, and a glance at his list shows him at once what he can hope to see, and where in the constellation it may be seen.

But perhaps the objection may arise, What cost of time and labour?

Not overmuch, I think; and when the beginner has his MS. book nicely in order, he has a compendium of useful information which will amply repay a little trouble.

I may add that such leisure as a busy life affords me for astronomical study is not unprofitably spent, I think, in following the method here given.

Discipulus.

TELESCOPIC.

[20436.]—In a letter from Mr. Purkess, published in the "E. M.," Feb. 11, 1870, reference is made to flats for reflecting telescopes. Mr. Purkess stated that "as to polishing an ordinary flat, I should, for my own part, scarcely consider it worth the trouble when excellent ones may be cut out of good selected plate-glass." I have also read somewhere that all the flats are selected in this manner, but I cannot remember where I know that a general opinion prevails that plate-glass is perfectly flat, but is a very great mistake. I have made a number of experiments on pieces of plate, and I am fast becoming convinced that an optically perfect piece of plate-glass 2in. by 1in. does not exist. The importance of perfection is obvious, since the most perfect speculum will fail in performance with an imperfect flat. I have tested some dozens of pieces by the colour-test, placing them upon one another, well cleaned, and observing the colour of the thin film of air betwixt. Some few are so far from flat that no colour appears, but the majority are channelled or fluted, and a considerable portion irregular, while in a few cases Newton's rings are tolerably circular. In one instance, however, where the rings are almost perfectly round on rotating the pieces, so as to cross the former contact, the rings become ellipses, and then vanish, showing that the pieces each have a cylindrical curve nearly approaching each other, but of which one is flatter than the other. Of course, when crossed the pieces are separated enough to destroy the colour test. By continually turning these on each other, the circles and ellipses and disappearances follow with great regularity. So far, I have only found two pieces in which rotating produces but a small alteration in the rings. In these the rings are nearly round in all positions; therefore, I suppose the pieces to be slightly convex, and tolerably regular in curve. I have, therefore, come to the conclusion that "excellent arcs" cannot be cut out of selected plate-glass, and that even decent ones would require so much selecting as to cost as much as would buy a perfect plane. I am satisfied there is nothing for it but to work the flat with as much care as the large speculum, and that any makeshifts of selected plate will always prove disappointing, and not improbably cause the condemnation of otherwise good instruments.

But supposing a flat, so-called, to be very slightly convex, and a true curve, would any perceptible evil follow, or would the result be confined practically to a small lengthening of the focus? I am aware that, theoretically, distortion would arise; but considering how very little a flat would deviate from perfection when Newton's rings were produced by contact betwixt two, I am inclined to think the result would practically be an almost imperceptible lengthening of the focus. I would test this myself, but the air with me is never steady enough to allow any comparison worth anything. In addition, I do not know that I have a perfect flat, to compare imperfect ones with. I commend this question to some abler correspondent. I have become convinced that almost everything that is said to the disadvantage of the silver on glass reflector is without foundation. They are so much more convenient for observation than refractors, as almost to settle the question; but the great drawback alleged is the rapid deterioration of the silver film. I have taken no particular care, and find very little alteration in a year in the film, and have never seen a trace of dew. But I have found that the ordinary commercial process by which looking-glasses are silvered, gives a film which is harder, much more firmly adherent, and far denser than any of the processes recommended to amateurs appear to do. I do not know what this process is; but it certainly can be done at a price which would not buy the chemicals to do it one's self. I think those who condemn reflectors cannot have tried them.

Edwin Holmes.

CASSEGRAIN MIRRORS.

[20437.]—In reference to this I omitted to consider that it is necessary (to avoid aberration) that one of the conjugate foci of the small (hyperbolic) mirror should coincide with focus of large (parabolic) mirror, and that as this requires a displacement of x, the point X will also be displaced. How far this would occur in practice I cannot tell, as in reality the mirrors are not true to the curves assumed to be employed.

Lens.

CROWN-GLASS ACHROMATISM.

[20438.]—On reading the last letter of your esteemed contributor, "W. G. P." I was tempted to exclaim, "Sorry I spoke"! But the writer puts forward the claims of his instrument in a manner so temperate and courteous, that I venture to reply again, even though my criticism is, I regret to say, not more favourable than before. For some reasons it might be better to let the matter rest, until an instrument is made on this principle; but, knowing that the mathematical treatment of chromatics in the text-books is not in a very satisfactory state, and being convinced that "W. G. P." is one to whom we may look for improvements on existing methods, I think this discussion may lead to some profitable result.

I am sorry I cannot see through the proposed instrument in the same manner that "W. G. P." does; I may be, and I hope I am, mistaken, but at present I ask for more light. Your correspondent quotes four lines from my letter, which he says has caused him the "greatest astonishment." I should have been better satisfied if he had shown how it is that I am wrong in my assumption; but after reading his letter several times, I cannot find any proof involving the values of extreme indices, that f_2 need *not* be less than f_1. I am not going to deny the correctness of equation (A) *mathematically* but unfortunately, it is one thing to be mathematically correct, and another to be practically so. All I say is that it seems to me inapplicable to the case in hand, and even in the form given it contains something which I do not thoroughly comprehend. If f_2 be negative, and the root of each member be taken, it states that

$$(f_1 - d) = \pm \sqrt{f_1 f_2} \text{ or } d = f_1 + \sqrt{f_1 f_2}.$$

Now, if the upper sign be taken, which is the only one admissible, the value of d is negative, for the root of the focal product is greater than f_1. What does this signify? How can $(f_1 - d)$ the reduced focus of the first lens be *greater* than the whole focus. Yet the equation says that $(f_1 - d)$ is equal to the root of the focal product, and this is necessarily greater than f_1.

Let us take two values for the foci, the first a convex lens 10in. focus, the second a concave lens 16·9 focus. Then evidently $(f_1 - d) = \pm 13$ or $d = -3$. Does this mean that the flint lens when place 3in. behind the convex will achromatise it? I should have thought that d would be a positive number, since f_1 and d are measured in the same direction. As to whether the shallow concave will correct the dispersion at 3in. behind the convex, we will examine by comparison with the position which a flint lens of equal focus would have to occupy.

Your able contributor says I give no proof that f_2 must be less than f_1. I did not think it necessary, as it seemed self-evident; but this is how I arrived at my conclusion. He proposes to use as the object-glass a convex lens, producing a certain amount of *refraction*, and, therefore, accompanied by a certain amount of *dispersion*. To correct this a *shallower* concave is to be employed causing *less refraction* and therefore necessarily *less dispersion* also. Hence, I say the concave is *too weak* to correct the convex when they are in contact, and if they are separated its effect will be still weaker. How does "W. G. P." purpose to get as much dispersive action out of a small-angled prism as out of a large one? Brewster succeeded in achromatising a pair of lenses of the same material when they were in contact, but I should judge this was effected by the form or relation of curves rather than by a definite proportion of foci.

I treat the general problem of achromatising two separated lenses in this way. Keeping the same notation as "W. G. P." we have for the compound focus (f_2 being negative)

$$\frac{1}{v} = \frac{1}{(f_1 - d)} - \frac{1}{f_2}$$

First, let us assume that the second is a different kind of glass from the first. Then for the chromatic variations we have—

$$d\left(\frac{1}{v}\right) = \frac{f_1}{(f_1 - d)^2}\,\frac{d\mu}{(\mu - 1)} - \frac{1}{f_2}\,\frac{d\mu_1}{(\mu_1 - 1)}$$

Now, if the extreme rays have a common focus, the variation of v will be o; also suppose the second, a flint lens, and δ the quotient of $d\mu\,/\,(\mu - 1)$ divided by $d\mu_1\,/\,(\mu_1 - 1)$: then—

$$\frac{f_1}{(f_1 - d)^2}\,\delta = \frac{1}{f_2} \text{ or } f_1 f_2 \delta = (f_1 - d)^2$$

And by taking the root of both sides we find the value of d to be thus indicated—

$$d = f_1 \mp \sqrt{f_1 f_2 \delta}.$$

Now, if δ be unity or the lenses of the same material this agrees with "W. G. P.'s" result. But is this condition allowable? I believe it is not. The entire utility of the combination depends upon the root quantity being less than f_1, or the focal product being multiplied by a factor less than unity. Suppose we had two of Chance's glasses—say f, a convex of hard crown 10in. focus and f_2 a dense flint, what must be its negative focus to achromatise f_1, when placed 3in. behind it? In this pair I believe the value of δ is 0·59 or very near it, but its exact value is not material for our present purpose. With this we find f_2 to be 8·3. If the 10in. crown requires a *flint* of this short focus for a corrector, how can we expect to achieve a like result with a much weaker *crown* concave lens. Even if our 16·9in. were of dense flint it would only be sufficiently powerful to achromatise the 10in. crown when they were in contact; the two would not bear separation.

Let us further examine the equation for d. If f_1 is the greater of the two quantities composing it, its sign is positive. Secondly, if $d = o$, we have, $f_1{}^2 = f_1 f_2 \delta$ or $f_1 = f_2\,\delta$, which, of course, is the focal condition for an ordinary double objective. Thirdly, if the root quantity is the greater, d is negative. Is this negative quantity applicable to the arrangement we have under consideration? The sign of d changes; its positive value requires the concave behind the convex; what then does the negative one signify?

Thus have I endeavoured to express my views upon the theoretical combination of your very able correspondent. I have done so in no contentious spirit, being, like "W. G. P.," wishful to arrive at a definite and useful result. The accuracy of the mathematical treatment is all that can be desired, and all I would ask "W. G. P." to throw a little more light upon is: Do the lenses—a deep convex and a shallow concave—possess the equal counteractive chromatic aberrations when the second is placed at a defined distance behind the first?

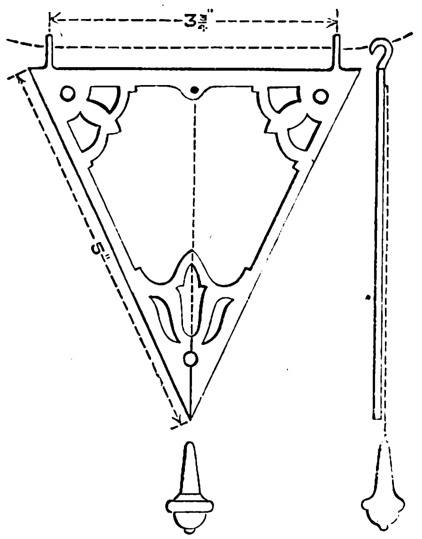
It ought not to be a very difficult matter to obtain two lenses both of the same sort of glass—convex and concave to certain foci. These would, I should think, irrespective of any particular ratio of radii, show whether chromatic error was likely to be eliminated by the method in question. But to get two ground to certain curves would most likely be an expensive job; for unless the work was executed by a firm having a very large number of tools, there would probably be four pairs of new ones to make, which is no slight consideration.

In conclusion, may I ask "Prismatique," when he has a little leisure, to favour us with his opinion on this matter, and whether he considers it possible to secure achromatism by means of a longer focus concave situated behind a short focus convex, both lenses being of the same kind of glass.

Orderic Vital.

TURKISH CARPENTERS' AND MASONS' LEVEL.

[20439.]—As I have not seen anything similar in this country, I send you a sketch of a levelling instrument commonly used by masons and house carpenters to Constantinople. It is very portable, and will be found serviceable in situations where a straight-edge cannot be applied. The principle of its arrangement is so apparent that explanation is unnecessary. It is obvious that the line on which it is suspended does not need to be quite "taut" as the sailors say, but it is indispensable that the little plummet should hang at the centre. The readiest way to find the centre, after finding the extreme distance, is to bring the two ends together—make a simple mark, with a thread or so, and then open out again and apply, when the fine line of the plummet will show the deviation from the scratch line on the face of the plate.



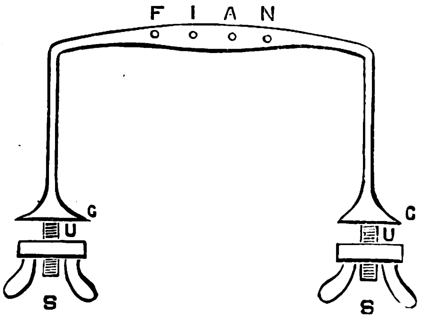
The above is a very common size, and I have never seen any double this size. It is made of brass, about 1-10th of an inch thick. Some of them are very lightly made and tastefully designed, but all embody the same principle.

Iskender.

BERLINER VIOLIN IMPROVEMENT.

[20440.]—Our good friend Mr. Berliner very justly remarks (p. 549)—"The fact is, with this new mode of stringing an endless change of experiments is before an observant experimenter," and in this observation I agree with him; but at least. until the "resonator" is in the market, it will be interesting to try this simple method of dispensing with the tailboard and relieving the pressure of the breast.

A strong brass wire is bent so as to pass through the end of the F holes behind the bridge; on either end is a flange and thumb-screw. These are represented at G V S. Those screws pass through holes in the back, and firmly clamp the wire; but so as not to allow it to press or lean against the F holes through which it passes. Then at F I A N, just behind the bridge, are holes to attach the strings to the wire. Being flattened out here, I am sure any of my readers will at once understand this application. The great trouble will be to make it stiff enough to resist the strain of the strings when the whole four are screwed up to concert-pitch.



Even if we help the string-holder by placing a stay from it back to the tail-pin, and thus taking off some of the pressure, very marked improvement is manifest, or at least, was manifest, on the one cheap violin on which I experimented.

Mr. Berliner deserves the best thanks of the readers of the "E. M." for his invention, and the kind courtesy with which he has freely placed it before the public, and yet I think the greatest modern improvement has come from the ingenious and no less generous gentleman who writes in our paper under the cognomen of "Fiddler." Drawings and descriptions of his new violin will be found in previous pages.

E. B. Fennessy.

STRING VIBRATIONS.

[20441.]—Kindly allow me space for another letter on the above subject, as I should like to ask "Fiddler" if he considers the best quality of a violin to be loudness. Most musicians prefer quality of tone. "Fid.," however, does not seem to appreciate the distinction between loudness, which depends on the amplitude of vibrations, and timbre, which depends on the sum of the fundamental and related harmonics. This last is a matter which has been proved, even to "Fid.'s" satisfaction (if he should read up the subject which he discusses), by the experiments of Helmholtz and others with Koenig's resonators, &c. I do not think even "Fid." can dispute the fact that two notes of the same pitch and timbre have the same fundamental, and, in most cases (excepting pure tones, as in the flute), the same harmonics added, resulting from secondary vibration. "Fiddler" says the s.p. diminishes the loudness of the tone. I say, no; unless it be so placed that it diminishes the amplitude of vibration of the string and soundboard. If "Fiddler" diminishes the tension of his string, and increases its diameter in corresponding ratio, he will get the same number of vibrations from it with greater amplitude, and consequent loudness, irrespective of the presence or absence of the s.p.

Just a few words more. "Fiddler's" demolition of the "old formula" is, to my mind, far more incomplete than the proof which he finds insufficient. The same incompleteness must strike everyone who has the least knowledge of acoustics. "Fiddler's" ideas about nodes are, to say the least of them, decidedly rudimentary. I do not demand the existence of a node between s.p. and bridge; if it be present, it is the result of the conjoined pressure of the s.p. on one side, the bridge on the other side, of the soundboard. I must try to explain again to "Fiddler" that a node does not represent a tone, but is the result of a certain determinate mode of vibration of a sounding body, which gives ascendency to some particular set of harmonics.

"Fiddler's" knowledge again fails him. The "intelligent schoolboy" of the educational department could tell him that a free reed does produce harmonics (½), which can be heard easily in the same reed stops of the organ, the clarionet, &c.

"Fiddler's" illustration and jargon about primary circles, the production and analysis of sound from a centre. as light, I cannot pretend to understand. "Voilà mes amis," a magnificent example of the statement that language was made for the purpose of concealing thought, for I defy any one to extract any defensible idea from "Fiddler's" sentence on the direction and formation of vibration.

The much-despised "back" of the violin is to form with the soundboard a resonance chamber which contains air vibrating in unison with the string and soundboard. I am afraid "Fiddler" doesn't understand what a resonance chamber is. His favourite instrument, the banjo, hasn't got one, which accounts for the noted feebleness and insipidity of the tone. Let me tell "Fiddler" that my argument with him is not professional blaming. I am neither a maker of violins nor a professional violinist, but a tinker of bodies, and a musical amateur who takes some degree of interest in the scientific construction of musical instruments.

Let me give "Fiddler" two pieces of advice:—Learn something about the purpose of the various parts of the violin, and with your well-known perseverance you will no doubt produce something musically of value, instead of destroying an already fairly perfect instrument. 2. Don't expose your hand by bragging of the "loveliness" of your violin.

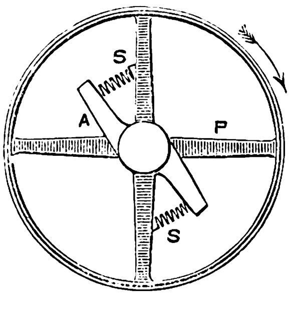
Aug. 27. **Nur ein Geiger.**

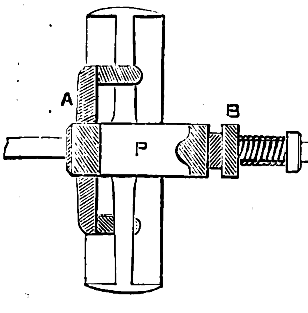
A STEAM GOVERNOR.

[20442.]—The readers of the "E.M." who use steam will readily agree with me when I say that the governors as used at present are very unsatisfactory, and also that they are likely to continue so, so long as centrifugal force is employed in working them. True, they will, if properly set, keep the speed of an engine within certain limits; but these limits are at the best far from being what a governor ought to do.

My idea of a governor is that the power being transmitted ought to be the agent employed in working the valves; the more power transmitted the more steam on, &c., and I have ventured to send a sketch, hoping that fellow-readers will give their opinion of the principle. I have supposed the power to be given off by a pulley, which is represented at P P, whose boss is live upon the crankshaft, and which is driven by the spiral springs S S, impinging upon the steadfast arms A A. The slipbox B, works upon a read, and is kept up to the boss of the pulley by spiral spring. The boss of pulley and slip-box are cam faced, so that upon the pulley being caused to transmit power, the springs S S are compressed, and the slipbox B is forced away from the pulley, and can be made to work either slide or throttle-valve, by any of the usual arrangements. Thus it becomes merely a matter of adjustment of springs and valves. Of course this cannot be employed when an engine drives off the flywheel, as it is necessary for that to be steadfast; but when pulleys or gears are employed I fancy it might be. An index hand might also be fitted so as to show the amount of power given off.

George Button.





LEGAL REPLIES.

[20443.]—Bankruptcy: Statute of Limitations (47747). The six years allowed upon ordinary contract debts begin to run from the time when the right of action first accrued. The fact that the debtor filed a petition which was abortive, and the proceedings under which were in no way continued, would have nothing to do with the Statute of Limitations. The plain result, therefore, is that six years after this petition was filed the debtor could plead the statute in answer to an action; and if the six years expired before that time, then he could do it sooner; his legal position in this respect being the same as if no petition had ever been filed.

Trustee: Married Woman (47783).—There need be no fear that a trust, once created, will ever cease; for, if necessary, the Court of Chancery would prevent this from happening. C., the lady, the acting and surviving trustee, should be asked to appoint another trustee before her marriage, to save any confusion. Formerly, if a married woman were a trustee, she could only act conjointly with her husband, being unable without him to deal with the legal estate; but, by recent legislation, a married woman who is a bare trustee can act alone. There need, thus, be no difficulty, and D. can still claim the payment of the income to her; but, should any trouble arise, any solicitor will advise how to set about appointing a new trustee.

Lending Money on Title-Deeds (47788).—Presuming the building society to have borrowing powers, the deposit of its title-deeds to secure advances would be legal and binding upon the trustees and the members. Such a deposit of deeds is really an equitable mortgage of the property they represent; and this will be so even though there be nothing in writing, so long as the deeds were delivered by way of securing the money lent upon them.

Loan (47791).—Of course, the creditor who has obtained a judgment in the County Court can proceed with it, and upon proof of means to pay can obtain an order for his debtor's committal to prison. So also the other creditor can sue for his money when he likes. But if the bill of sale be valid and registered, it would protect all such goods of the debtor as it comprises against execution by either creditor.

Bankrupt's Discharge (47794).—A bankrupt can only obtain his order of discharge upon proof to the court that he has paid 10s. in the pound, or that a special resolution has been passed by his creditors assenting to his discharge, for which purpose a meeting must be called by the trustee. The querist does not seem to have obtained such a resolution, though that he must do, presuming his bankruptcy to be closed. I really cannot tell him how to set about the requisite legal formalities. It would be quite impossible to do so with success, and he had better consult his solicitor. But as long as he remains an undischarged bankrupt, all his future earnings, and after-acquired property, remain liable to the payment of his old debts, after his new creditors are satisfied. For this reason every bankrupt or liquidating debtor should get his discharge as soon as he can, for he will be saved all risk and trouble, as the discharge becomes a conclusive plea to every action for debts barred by the bankruptcy or liquidation.

Liquidation—Dividend (47797).—It is the duty of a trustee to advertise his intention to declare a dividend at least seven days before so doing, and call upon creditors to come in and prove their claims. If this advertisement were not inserted the trustee might be liable to a creditor omitted from the debtor's statement; but it is more probable that the querist did not happen to see the advertisement. If the estate has all been paid away, the only thing the omitted creditor can do is to sue the debtor, who would be liable unless he had obtained his discharge. But if he has his order of discharge this has been held to be a good defence even to the claim of a creditor not inserted in the schedule, unless fraud be shown; and even then the discharge must first be set aside. I do not see how the bankrupt could be criminally responsible.

Will. — Illegitimate Children (47802).—I understand the marriage in this case to be illegal and void, and it would therefore be necessary that the testator should not leave his property to his "wife" and "children" without further description, as both bequests might, and the latter certainly would, fail altogether. For "wife," in law, means lawful wife; and "children" would only include legitimate children, which these are not. The will, therefore, requires to be very carefully drawn, and the so-called wife and children should be specifically mentioned by name; but I really cannot draw the will for the querist, and should advise him to consult a solicitor upon the whole matter if he wishes to leave his affairs in good order after death.

Will.—Married Woman (47809).—It is not stated in this question. 1. Whether the houses were freehold or leasehold? 2. When the wife was married, and when she died? 3. Whether she made any will?—although these points are most material to the legal aspect of the case. If the houses were leasehold and the wife died intestate they passed to her husband, and he could do as he liked with them. If freehold they would descend to her heirs, but her husband would be tenant for life by courtesy. But unless I know more of the facts above mentioned, and also how many and what children were left by the wife, &c., I cannot possibly advise further upon the many points that may be raised in this case.

Fred. Wetherfield, Solicitor.
2, Gresham-buildings, Guildhall.

RAILWAY SIGNALS.

[20444.]—Compensating levers will, of course, overcome the difficulty of expansion; but if you ask why they are not introduced, you will probably be told that "our board of directors won't pass the amount."

The set-screws might obviate the error caused by the axle wearing, as suggested by Mr. J. G. Moon; but unless they were of considerable size, with coarse thread, I am afraid the continual falling of the weight on them (or rather the weight-rod) would soon put them out of order, and restore the original error. I should insert a sliding wedge for this purpose, and secure it by means of a nut under the iron bracket which carries the weight. Of course, new signals would have to be specially made like this; it would be a big matter to alter all existing ones, and they must remain as they are. In this case there would be no screw thread subjected to strain, the rod coming down dead on the wedge, and transmitting strain to bracket. The screw for the tightening nut would have to come through a slit made for the purpose. Pivoting the arms in the centre is a capital idea, and should be adopted in the case of new signals. We should then have a good alteration of one bad point. The spars at back of arm practically carry out the suggestion of another correspondent to put a weight in that position, but in a more sightly manner.

H. Stooke.

[20445.]—I have already stated that I do not consider that the engine-driver is able to discern to a *nicety* the angle at which the arm is standing; and perhaps he would not, from a practical point of view, be able to distinguish to within 5° the true position; but in one of my letters I endeavoured to explain that my rule was to apply to "the fixing," so as to get the arms to work uniformly. And I am not aware that it was at any place stated by myself that a driver was expected to tell at what angle the signal exactly stood—which is, by the way, a moral impossibility. It must be remembered that the signal I called "doubtful" is only a provisionary one, and the engine-driver would not act on it as danger, unless he had really a doubt as to what the signal was intended to be. The rule which I laid down has, I believe, now been introduced on some lines, although to what extent I am not quite aware. I do not propose that a driver shall be able to distinguish 44° from 46°, when running in a train at any speed. I hope "F.R.A.S." now understands me, and will overlook the indefiniteness of which I must have been guilty to call forth his conciliatory and at the same time explanatory remark (20405).

Will Mr. A. Manock, before we go any further, tell me whether we are not to have a limit theoretically or otherwise, established between the two signals? He states that, "According to Mr. Stooke's arrangement, 20267, the angles from 45° to 85° are allowed as clear, but immediately the arm falls to 86° it must be treated as danger. I am inclined to think that there are very few drivers who are capable of distinguishing in this case between the clear signal and the one for danger." So far so good; but let us apply this very remark to Mr. Manock's own system (or any other) theoretically—practically we know that discernment to a degree or two cannot be clear. The gentleman in question states, "Divide the quadrant into three distinct divisions of 30° each, say, from zero to 30° danger, from 30° to 60° clear." This is quite sufficient. Now, how much difference can there be from discerning between an angle 30° danger and 31°, which is fairly within the province of clear than between an angle of 85° and 86°? "Of course, if the suggestion is barren, let it pass as such." Mr. Manock's suggestion has never been treated as barren by me. I could not agree to it, as the fall for clear did not seem to me to be sufficient; but at the same time I did not doubt the good meaning of the proposal, neither do I doubt the whole of the correspondents engaged in this discussion have been, and are still desirous of assisting me. We often condemn an opinion because it does not seem what we approve of; at the same time we do not doubt the integrity of the originator, and mean no harm to his person. If Mr. Gladstone asked Bradlaugh and Sir Stafford Northcote round to dinner during the recess, does anybody believe that they would not both be present, *despite* their diversity of political opinion?

What I intended to convey by "we do give a positive signal to come on," was when the arm shows clear. I was, however, I admit, very indefinite here, having apparently, though not actually, overlooked the running of trains past the distant signals; but as the driver has to turn steam off, if the signal is against him, and proceed cautiously to the home signal, there can be, I should say, no objection to the continuation of the arrangement. "Nun. Dor." wishes to obviate this, I believe, and thus improve the safety of the line, and no doubt practically it would do so; but trains would be kept waiting at the D. signals when they might be some distance further on—not a mean consideration with a lot of traffic—*e g.*, in the metropolis.

"Nun. Dor's." change could be practically brought into use with the present signals; but keeping the arm within the post I do not like; it does not seem distinct enough for me. In foggy weather a signal-post could not be discerned from any other; but an arm put out horizontally does materially assist discernment.

August 26. **H. Stooke.**

THE CONTINUOUS BRAKES RETURN.

[20446.]—The ninth continuous brakes return (No. C, 3339) for the half-year ending June 30th, 1882, has been published, and the following table gives the amount of stock fitted with those brakes which appear to fulfil the necessary "conditions."

On the 30th June, 1882, there were 5,395 engines used for passenger traffic, of which only 1,819 were fitted with brakes which even appear to be efficient, and this number is further reduced when 727 engines on the Midland and Great Western Railways, which have non-automatic steam-brakes, are deducted.

Statement showing the Amount of Rolling-stock fitted with Continuous Brakes which appear to comply with the Conditions of the Board of Trade, June 30th, 1882.

Name of Continuous Brake.	Name of Railway Company.	Amount of Stock fitted.		Connecting-pipes only.	Miles run by fitted trains in half-year.
		Engines.	Carriages, &c.		
Barker's Automatic (Hydraulic)	Great Eastern	2	12	..	20,701
Eames' Vacuum	Lancashire and Yorkshire	5	8	..	Not given
Fay, Newall, and Eames—combined	Lancashire and Yorkshire	..	10	51	
Sanders and Bolitho Vacuum	Great Western	360*	1,482	721	2,022,779
,, ,, ,,	Midland	367*	1,899	8	3,695,831
,, ,, ,,	Somerset and Dorset Joint Committee	..	..	..	..
,, ,, ,,	Lancashire and Yorkshire	2	2	..	Not given
Fay, Newall, and Sanders'—combined	Lancashire and Yorkshire	..	6	..	
Smith's Automatic Vacuum	Great Northern	2	33	..	28,487
,, ,, ,,	Lancashire and Yorkshire	21	174	..	Not given
,, ,, ,,	London and South Western	17	128	..	25,746
,, ,, ,,	Taff Vale	4	15	..	11,987
W. Parker Smith's (Screw)	Liskeard and Caradon	..	4	..	3,108
Steel M'Innes	Caledonian	3	33	10	25,509
Westinghouse Automatic	Great Eastern	125	1,018	288	1,129,964
,, ,,	Great Northern	2	14	6	18,317
,, ,,	Lancashire and Yorkshire	19	39	..	Not given
,, ,,	London and South Western	2	7	..	20,204½
,, ,,	London, Brighton, & South Coast	267	1,847	337	2,679,483
,, ,,	London, Chatham, and Dover	14	75	9	132,768
,, ,,	Lynn and Fakenham	4	8	..	Not given
,, ,,	Midland	45	94*	152	354,207
,, ,,	Midland, Scotch Joint Stock	..	40*	..	
,, ,,	North Eastern	336	2,174	90	3,386,370
,, ,,	Rhymney	8	14	32	40,980
,, ,,	West Lancashire	3	16	..	25,182
,, ,,	Caledonian	40	675	240	502,642
,, ,,	Glasgow and South Western	60	200	153	374,493
,, ,,	North British	111	736	288	1,169,649
,, connecting pipes only	East Coast, Joint Stock, and Cars.	..	..	124	..
,, connecting pipes only	Somerset and Dorset Joint Committee	..	..	2	..
	Total as above	1,819	10,763	2,511	
	Total December 31st, 1881	1,465	8,535	1,997	
	Showing an increase of	354	2,228	514	

Note.—The 40 vehicles which compose the Midland Scotch Joint Stock, also 60 Midland vehicles (including Pullman Cars) are fitted with both the Westinghouse and Sanders' Brakes; but this fact is not stated in the Return.

The total carriage stock consists of 45,546 vehicles, of which the table shows only 10,763 were fitted with efficient brakes.

One very important and satisfactory feature in the present "return" is that a very large proportion of the engines and vehicles fitted during the past six months have been provided with brakes which are "automatic," and fulfil the conditions, thus clearly showing that the companies are beginning to see the absurdity of spending money upon non-automatic, and therefore inefficient, systems.

Special attention should be directed to the progress made by the North-Eastern Company, not only in the fitting of brakes, but in the refitting of automatic in place of non-automatic brakes.

During the past half-year, Fay's brake has been removed from all the 63 vehicles, Newall's has been taken off no less than 119, and also Smith's vacuum pipes from 35 other vehicles; and the work of refitting the whole of this stock with the Westinghouse automatic brake is nearly completed.

The Dublin, Wicklow, and Wexford Company has abandoned the use of Smith's automatic vacuum brake, and changed it to the simple non-automatic system.

The Caledonian Company has taken the Steel McInnes brake off one engine, and replaced it by the Westinghouse.

With regard to the "failures," it is to be regretted that some companies have again drawn up their replies so that they shall be of no real value for purposes of comparison.

For instance, there have been several cases of trains running past stations in consequence of the Midland Company's two-minute modifications of the Sanders and Bolitho brake "leaking off," or otherwise failing to act when required, and yet *no mention whatever is made of these cases in the return;* this remark also applies to the same brake as modified by the Great Western Company, many failures having taken place, and yet *only one reported.* Col. Rich, in his report upon the Portskewet Pier accident (see page 357 of present volume) gave details of a failure which he witnessed when riding upon the engine of an express train into Taunton Station, and he considered it "a very important failure." The fact that this case is not mentioned in the "Return" proves that the information furnished by the Great Western is (like the Midland) very incorrect so far as it relates to the faults of the brake in question.

These two companies do not give any details of the numerous failures of the steam brakes fitted to their passenger engines and tenders, as they profess to consider that these do not come within the Continuous Brakes Act; but it will be seen that when a steam brake is worked in conjunction with, and is in fact a part of, a continuous brake, its faults and failures should be reported.

The Sanders and Bolitho brake is fitted to the carriages *only*, and any fault in the steam brake on the engine drawing the train is not given; therefore no comparison can be made with any other system in which the whole train, including the engine and tender, is fitted with one continuous brake throughout, as in that case failures are recorded relating to the engine and tender brakes.

Clement E. Stretton.

Saxe Coburg Street, Leicester, Aug. 26, 1882.

STONEHENGE AND SUN WORSHIP.

[24047.]—I am glad to see Mr. Stooke's letter (20386), and shall await with some interest the result of his search for the "grey wethers."

For the second time let me say I have hazarded no opinion concerning the erection of Stonehenge in the Neolithic Age. The extracts given do not exhaust "all the material likely to lead to a just conclusion." Sir John Lubbock, in *Pre-historic Times*, says:—

"No less than 270 tumuli cluster round Stonehenge, and it seems most probable that the dead were brought from a distance to lie near the great temple."

Again:—"It is evident that Stonehenge was at one time a spot of great sanctity. A glance at the ordnance map will show that tumuli cluster in great numbers round and within sight of it; within a radius of three miles there are about 300 burial mounds, while the rest of the country is comparatively free from them. If, then, we could determine the date of these tumuli we should be justified, I think, in referring the Great Temple itself to the same period. Now, of these barrows Sir R. C. Hoare examined a great number, 151 of which had not been previously opened. Of these, the great majority contained interments by cremation in the manner usual during the Bronze Age. Only two contained any iron weapons, and these were both secondary interments, that is to say, the owners of the iron weapons were not the original occupiers of the tumuli. Of the other burial mounds no less than 39 contained objects of bronze; and one of them, in which were found a spear-head and pin of bronze, was still more connected with the temple by the presence of fragments, not only of sarcen stones (grey wethers), but also of the blue stones which form the inner circle at Stonehenge; and which, according to Sir R. C. Hoare, do not naturally occur in Wiltshire. Under these circumstances, we may surely refer Stonehenge to the Bronze Age."

Elsewhere this distinguished author attributes Abury to the commencement and Stonehenge to the close of the Bronze Age.

It is the far ruder and simpler stone circles than either to be found on the Welsh border hills I judge to be of Neolithic Age.

Neo.

THE PRESSURE OF WIND.

[24048.]—I do not make the distinction "F. M. S." credits me with, and if "F. M. S." reads the first paragraph of my last letter he will see that the distinction I there draw is the same which he in the first place pointed out. What I asserted was that with a velocity of 50 miles an hour—supposing the anemometer to be accurate—the pressure on the square foot would not be 49½lb. The possibility of such a high pressure, which I afterwards consider, is another matter. "Velocity of 53lb. on the square foot" should of course be "Pressure," &c.

What does "F. M. S." consider to be "an obstinate fact?" The accuracy of the high pressures which the anemometers register? Even "if the recorded pressures were accurate," I do not think that the pressure, as calculated by a formula, would be actually "useless," though, of course, in any case it is desirable to take the registered pressure in preference to the calculated, which under the most favourable circumstances can only be approximate.

If "no one supposes that we have on the surface of the earth such a storm as Mr. Simmons experienced," then why did "F. M. S." in his letter, speaking of the gale on the 29th April, write, "and may have reached Mr. Simmons's rate on his recent balloon voyage—about 130 miles per hour!" Of course it is not necessary to build a house at the foot of Blackheath Hill so strong as one placed alongside the Observatory; but, nevertheless, there are many houses situated as high as the Observatory, and builders as a rule do not make much distinction, I think, between such comparatively small differences in elevation.

When "F. M. S." asks for "definite information as to the actual pressure," he is asking for what engineers and meteorologists have been seeking for the last century without obtaining; and it is quite a truism to remark "that the question is one which is by no means settled in the minds of engineers and architects," as if it were otherwise such disasters as that of the Tay Bridge would not be heard of.

C. H. Romanes.

Worthing, Augus.

NORTHCOTT'S APPARATUS FOR TURNING IRREGULAR FORMS.

[24049.]—In Mr. Northcott's classical book on "Lathes and Turning," at p. 123 he thus describes the connection of the back-shaft with surface traversing-screw of his slide-rest:—"For every revolution of the back-shaft the worm-wheel will make one-seventh of a revolution, and during one-tenth of a revolution of the screw (E) the slide (D) will traverse one-tenth of an inch." Can this be so? I do not see how it can be, and have come to the conclusion that "*one-tenth*" must be a printer's error. If the screw or the slide-rest is of a pitch of ten threads to the inch, each revolution of the screw would move the slide one-tenth of an inch, and one-tenth of a revolution would move it one hundredth of an inch only, and consequently the surface cut would be only one seven-hundredth of an inch instead of one-seventieth, as stated in the paragraph following the one above quoted.

This bothered me some ten years ago, when I first got his book, and I intended to make this inquiry, but absence in India and other occupations made me lose sight of it.

Would you kindly draw his attention to this, and at the same time ask him to give sectional drawings in your pages, corresponding with Fig. 130 of his book, which would enable persons owning a screw-cutting lathe to add his apparatus to their slide-rest. I have frequently referred to his papers in Vol. IX. of the Mechanic, but find that they are not sufficient to enable me to add his apparatus to my lathe; and several others to whom I have shown his book and the papers in the Mechanic referred to, have come to the same conclusion. I am sure that the details I ask for would be appreciated by many of your readers.

Gereb Admi.

HOT AIR AND VAPOUR BATHS.

[20450.]—Since sending you my paper on the principles on which such should be constructed, I have seen and read a number of pamphlets on the use of gas for various purposes by Mr. Fletcher, of Warrington, the perusal of which has given me much pleasure. I now think that it is not worth anyone's while to make for themselves a special burner, such as I made for myself, and described in above paper. Although it was inexpensive, it involved a good deal of labour, and now that one of Fletcher's burners can be had at a cost varying from 1s. 9d. to 6s., I should be inclined to get one or more of them. His special apparatus for heating water for baths, and his coil for supplying a constant stream of hot water, are well designed and suitable to their purpose; but compared with his burners they are very dear. People, however, are not bound to adopt his apparatus in full, they may purchase his burners and use them under any boiler or coil they may choose to construct, or adapt to their purpose. If I had seen his pamphlets before I left India, I would have had a copper-boiler made for me, by a native copper-smith, to my own pattern, which I would have got at a moderate price per lb. In England, if one requires anything at all different from the usual trade pattern, one is made to pay very heavily for it; but if one enters into a trade or business so as to require a number of the new pattern, it can be procured at the same rate as the ordinary trade patterns, but only from one source, which is not known to the general public. Consequently it is in the power of the tradesman to put a fancy price on his goods, and few can resist the temptation to do so. All desire to get rich rapidly.

Gereb Admi.

TRICYCLES WORKED BY GAS.

[20451.]—Had I been a mechanic instead of being a chemist I should long ago have turned my attention to the construction of a tricycle worked by gas. A mixture of light petroleum vapour and atmospheric air explodes on application of a light. Fletcher, of Warrington, burns this in table furnaces, and has devised a receptacle which furnishes it in a constant stream, why not then explode this behind a piston, or rather two pistons, which, acting alternately by means of cranks, should push forward the machine? The cylinders and other parts, if made of thin steel should, from their weight, add little impediment at least little as compared with the additional force obtained. When not needed, as when going down hill, the gas could be cut off, and turned on when the level or the up-hill was reached. The raw spirit is now generally sold, at least in all towns of any dimensions, as it is used for filling the little lamps used as substitutes for candles. I have been haunted by this idea for some time; but possess too little mechanical skill or opportunity to attempt its carrying out.

P. H.

CHEMISTRY FOR ENGINEERS.

[20452.]—I order a number of castings to be made of gunmetal, of the following composition, for instance, copper 40 parts, tin 5 parts, zinc 2·5 parts. What chemical tests could I apply to a sample bar, in order to find whether my formulæ has been adhered to? Also how can I test white and red lead for impurities? how test oils for acids and other deleterious ingredients; and how determine the quality of the acids (sulphuric, nitric, and hydrochloric) supplied for galvanising iron and soldering purposes.

A description of the qualitative and quantitative analysis of these and other engineer's stores, I shall probably be told, would involve the writing of several articles and cover much space; but what of that? If any correspondent is able and willing to contribute information of such practical value to the engineer and wholesale and retail buyers and vendors of such stores, I feel sure our Editor will not withhold the space so usefully employed.

Glatton.

DEATH NOT UNIVERSAL.

[20453.]—I expect most of us have had the following propounded to us: Suppose a knife with a lost blade, renew the blade and is it the same knife? Answer (invariably), Yes. Now lose the handle and provide a new one, is it still the same knife? Answer (hesitatingly), Well, yes. Now find the first blade and handle, which of the two sets is *the* knife? Some such muddle seems to have been in the brain of the writer of the antepenultimate paragraph of your extract, p. 542, from the *Journal of Science*. He evidently is not aware of, or cares not to acknowledge the fact, that reproduction of infusoria by fission is only a form of parthenogenesis, which takes place only so long as the conditions of existence require or are favourable to it, and that after certain not well defined intervals of time, perhaps seasons, a new order of reproduction is set up to meet the changed conditions, either that of sexual conjugation or the formation of germs in the interior of the individual analogous to that of Zoospores (the emission of which in the form of a cloud I have observed in the organisms mentioned). My only reason for writing this is to protest against the three last paragraphs of the extract, as specimens of imaginative writing, interesting perhaps to the general and uncritical reader, but not at all in accordance with facts or calculated to advance scientific knowledge—such kind of writing being easy enough for those who only care to make a sensational impression.

C. J. B. F.

STRAIGHTENING CROOKED CASTINGS.

[20454.]—I am glad to read "Pattern Maker's" reply (letter 20420) to Thomas D. West's "article." I heartily agree with "Pattern Maker." In my opinion "T. D. W." knows, properly speaking, nothing about the cast-iron "castings" in their various stages of cooling. For instance, he says, for a 5-ton ladle the basin should be not less than 18in. wide, whereas, if he had said 36in. wide, he would have been nearer the size; but any moulder knows that a basin just requires to be made to suit the ladle. A narrow ladle, requires a narrow basin, a wide ladle requires a wide basin. I send my hearty good wishes to "Pattern Maker" for his able letter.

Cast-Iron.

SCIENCE AT SOUTH KENSINGTON.

[20455.]—I am gratified to find that if I cannot make a convert of "Nun. Dor.," I have at least caused him to be more just in his criticisms, for he now admits that "Science teachers there are, I know, who work honestly and laboriously for small pay, having a love for the labour, and an earnest desire to do their duty," so that they are not all crammers. On the other hand, I willingly admit that there are so-called science teachers who are a disgrace to the profession. A case in point is given by Mr. Manock. But there are three things I should like to learn concerning this class: (1st) How the teacher passed the ordeal of the department inspector; (2nd) What was the result of the examination at the end of the session; and (3rd) How many years the teacher thought it worth his while to continue the class on the lines mentioned by Mr. Manock? I am not altogeher unacquainted with such teachers and teaching; but generally the classes came to grief before they had been in existence many years, either through the teacher finding it not worth his while to continue, or because the Department had found out the kind of teaching and stopped the grant. I may also remark that, in my opinion, it is some years since Mr. Manock gained his experience of science classes, for he speaks of twenty lessons having been given, while for a number of years twenty-five has been the minimum number, and for the past year or two twenty-eight has been fixed as a minimum, although each individual need only receive twenty.

Referring to my "friend," as "Nun. Dor." pleasantly calls the gentleman I spoke of as having been trained by the Department, cannot he understand a man having two occupations? If "Nun. Dor." knows anything of the science classes in connection with South Kensington, he must be aware that, as a rule, the lessons do not commence till seven or eight o'clock in the evening. Now, it is not so very difficult to understand how, under these circumstances, a man may be engaged at a given occupation during the day, and turn to a totally different one—viz , science teaching during the evening.

I notice that "Nun. Dor." is concerned because I have not referred more in detail to the ignorance displayed by some of the candidates. What would he have me say? Surely he does not wish me to deny that such answers were given. I have already said that, in my opinion, the teachers are not responsible for such absurd answers, and I give an instance of a student of a competent and conscientious teacher giving a most absurd answer to a question, and this instance, I contend, supports my opinion. I would also remind "Nun. Dor." that no marks would be given for such answers, and since, taking all the papers worked, the percentage of passes was large, it follows that such absurd replies were the exception, and not the rule.

"Nun. Dor." remarks that, "to really educate the masses, born teachers are required." Am I to infer from this that he blames the Department because they do not manufacture such "born teachers"? The uttermost the Department can do in this direction is to exercise care in the selection of the intended teachers, and, having selected them, impart good, sound instruction, and these things, I contend, they already do.

Edward Jackson.

Birmingham, August 26th.

CONCRETE.

[20456.]—It is not often I burthen your columns but I do better—I read them throughout, and notwithstanding that there is here and there a considerable amount of chaff, the grain is far more than sufficient to repay the reader for his time and trouble. I wish, however, some of your writers would follow the advice given in Montaigne's Essays, and only give "what they know, as much as they know, and no more"; and not what they imagine, or what they find in some old recipe book. My hobby is concrete, and if twelve years' working at it, and spending a lot of money on it gives one a right to say something on the subject, I have that right. I have seen in your columns some fearful mistakes in calculations, both as to the proportions of materials, the cost of construction, and the resulting work. The one great error that pervades most of the written articles, is the treating material measured out as producing the same volume of work in situ. Now if any one would take the trouble to weigh a cubic foot of concrete, be that concrete rammed either little or much, he would find that it took considerably more material than a foot cube to produce a foot of concrete. Now, taking a cubic foot of shingle as weighing 88lb., and a cubic foot of sharp sand as 100lb., and a cubic foot of cement at 90lb., my experience has shown me that it takes 150ft. of measured material to give 100ft. of good solid, well rammed concrete in work. My 150ft. of material are composed by measure of

Shingle	108 parts
Sand	27 ,,
Cement	15 ,,
	150

Now, I find my concrete well rammed weighs 139lb. per cubic foot. Now, were this concrete pure silex, it would weigh 160lb. per foot; thus it will be seen that, notwithstanding the ramming the 150 per measure into 100 of work, there would be still 160 − 139 = 21lb., or one-eighth air space in each cubic foot. Now, looking at volume of material and weight of each, and result in work, it will be found wonderfully near the mark:

108 c.ft. of	shingle at 88lb.	weight	9,504lb.
27 ,,	sand at 100	,,	2,700
15 ,,	cement at 90	,,	1,350
			13,554
Producing 100 × 139 of concrete weighing			13,900
The difference being			346

The difference of 346lb. I take to be the water of crystallisation retained.

Now, comparing the weight of a solid block of silex weighing 160lb. per cubic foot with the weight of concrete, there would be 160 − 139 = 21lb., representing the weight of the material required to fill the air-space, or nearly an eighth; so that concrete, as compared to silex is $\frac{1}{8}$ more porous. The result of my work actually comes very close on to these calculations, and therefore, the loose way in which calculations are given as to quantity and cost of concrete is likely to mislead.

So much for materials used and results obtained. Now for the *modus operandi. Clean and free from loam or dirt must your aggregates be.* An ounce of loam neutralises a pound of cement; cement must come into actual contact with silex or hard material, either in shape of sand or stone. The materials must be thoroughly mixed whilst dry, and then only watered out of the rose of a garden watering-can, and never made more wet than very moist sugar; in fact, no more water than is absolutely necessary for the crystallisation of the cement should be given. I have every mixing turned over five times—three times dry and twice wet, and when well rammed, it turns out good work.

In my experiments I have found out a cheap substitute for cement in using a considerable portion of finely-ground quicklime, which I get from near Bridgwater, from Boord and Co., of Dunbell. For cottage walls, garden walls, or sheds, I find half the quantity of cement and the other half lime makes very good work, and I believe in time it will be as good as concrete made with pure cement. But unless the operation is carefully conducted, and the quicklime thoroughly killed, there is a danger of blowing. I put the lime into a large tub, keeping it thoroughly stirred, and mixed with sufficient water to make a thickish cream, and let it stand for half an hour before using. The cement used is mixed dry with the shingle and sand, and then the whole is mixed and moistened by the lime cream; but the master's eyes must be about him. Now, so much for the information I can give. I now come to my turn to ask for information. I may say that I am building a tower, and my intention is to carry it up to 200ft. if I can safely do so. I do not fear the concrete crushing; but I should like to settle the vexed question of the force of the wind. I have made my calculation as to the maximum pressure; but as the force of the wind has produced a little logomachy in your columns, I should like to elicit the opinions of some of the logomachists on the data given. The following are the intended dimensions:—Outside measurement at level of ground, 20ft. square; intended height, 200ft.; measurement at top, 18ft. 6in.; from ground to 20ft. high, 20ft.; from 20ft. to 80ft., 19ft. 6in.; from 80ft. to 150ft., 19ft.; and from 150ft., 18ft. 6in. The tower is built on the square with the cardinal points of the compass, and the strongest gales are from the south-west, which would only catch the building at an angle; but I must base my calculations as if the gale caught it full on the side opposed. I have, in the calculations made by me, got a full one-third more than sufficient weight to stand a wind pressure of 52lb. to the square foot; but the Tay Bridge disaster and the logomachy in your columns have rather disturbed my equilibrium, and made me fear for that of the tower. I cannot understand how the pressure is calculated. The only safe way is to calculate on the strongest gust of wind. I am three miles from the sea, opposite the Needles in the Isle of Wight, and the wind fiend does let out sometimes with a vengeance. With the exception of a typhoon or cyclone in India, I do not think I have ever seen the gusts of wind more severe for a short time than I have seen them at my place. Here is a nice problem to be solved for my advantage. You have plenty of hard-headed contributors, some of whom are not only able, but, on the give-and-take principle, willing, to set my doubts at rest. My days are not many, but I do not want my ghost to be disturbed by seeing my tower lying its length on the ground through the efforts of the wind fiend.

Khoda Bux

INDUCTION COIL.

[20457.]—In accordance with the wish of Mr. J. Brown, of Belfast, "Quien Sabe," and other correspondents (Volume XXXI.), I send an account of a small induction-coil which I have lately constructed. Mr. Brown will notice that the effect of distributing the secondary along the core has not been so advantageous in this instance as he seemed to expect. Perhaps in his abler hands an altogether different result might have been obtained. He will also observe that one of the results has been to enormously increase the amount of condenser required. If Mr. Brown would kindly supply us with a statement of the results he achieved when using a spring contact-breaker, it would be easier to compare his admirable instrument with other coils so fitted. The core of my coil is of No. 22 B.W.G., and was carefully annealed. The length is 8¼in., the diameter about 7-10ths, and the weight 8¾oz. The primary is of No. 16 B.W.G., silk-covered, wound in two layers. Its weight is 12oz., and its resistance about 1-10th of an ohm. The secondary is of No. 16 B.W.G., silk-covered, and contains 2lb. 3oz. of new wire; 1lb. of old wire, unwound from another coil; and 1oz. of old wire of mixed gauge. Its resistance is 3,460 ohms., and its total weight is 3lb. 3oz. It is wound in 26 vertical sections upon an ebonite tube 9in. long, by 1in. internal diameter by 1-16th in. thickness, with separating discs of three-ply blotting paper, steeped in hot paraffin wax, and pressed together. Two of these discs were placed between each pair of sections, and one between the component sections of each pair. The diameter of the discs is 3½in., and the spaces were filled with wire (wound on through hot paraffin wax) to a diameter of about 3in. The average width of the spaces is 3-16ths in. The complete secondary occupies 6½in. of the centre of the ebonite tube; but as cakes of paraffin wax, each ½in. in thickness, were afterwards cast on to the ends of the secondary, to prevent sparking to the primary coil, its apparent length is 7½in. Grooves were turned in the edges of the waxen cakes, and pieces of No. 20 gutta-percha-covered wire laid in, and connected to the ends of the secondary, and brought out for attachment to the discharging points. The two grooves and the vacant intervals between the discs were then filled in with paraffin wax, and the whole turned down smooth to receive a few layers of paraffined paper, and the ornamental covering of velvet. The reel-ends are of baked mahogany, paraffined and ebonised.

At this stage I may inform Mr. Brown, who, a short while ago, was asking our justly honoured "Sigma" for his experience of spring contact-breakers; that after a great many experiments I found the best form to be that made and patented by Apps, and which breaks the battery contact directly at the back of the hammer. The secret of its success appears to lie very much in the handy arrangement of the regulating-screws, which enable the operator to increase the tension of the spring to several pounds if necessary; also the iron hammer is disproportionately small, and, being bored nearly through, is light, and possesses little or no momentum. Perhaps, however, this form would not act so well upon coils containing very large cores, like that of Mr. Brown, as its motion is extremely rapid, and slow vibrations are best where residual magnetism has to be encountered. The following is a table of results obtained with various powers:—

Pint Grove cells.	Spark.	Condenser capacity.
1	1¼ to 1½in. ..	Half a micro-farad
2	2½in.	1 micro-farad
3	3in.	Do.
4	3¼in.	Do.
5	3½in. and over	1 micro-farad and a half.

When the condenser capacity was increased to one and a half micro-farads, the spark from one cell almost disappeared, and with four micro-farads the spark from five cells was reduced to about one inch. The influence of the condenser upon the character of the spark was interesting and suggestive. These latter experiments were made before the instrument was permanently mounted, and cores of No. 24 and 26 B.W.G. were made and tried. Neither gave such good effects, the sparks from No. 26 being very markedly inferior, both in length and quality, to those from the core selected. Primaries of No. 14 and 18 silk-covered B.W.G., were also tried and abandoned in favour of the present gauge. A primary consisting of two layers of No. 18, arranged in multiple arc, had too low a resistance. From the results of some experiments with the mercury break, made before the secondary was completed, it is inferred that with an interruptor like the one devised by Mr. Brown and described by him on p. 611 of Vol. XXX., four inches, or even four and a half inches, of spark might readily be extracted from this small coil; but I fear the inconveniences of the mercury-break more than counterbalance its advantages.

Haverfordwest, Pem. Ernest.

SMALL DYNAMOS—ERROR.

[20458.]—In my letter (20417) last week, 11th line, instead of "resistance was not sufficient," it should have been "E. M. F. was not sufficient to overcome resistance." **Fred. W. Ball.**

COLOUR.

[20459.]—Having been away from home for several weeks, during which I have not seen the "E. M.," I have not replied to various remarks upon my letter (20324), p. 477. "E. H." (20339), p. 499, does not think that letter either an adequate or correct reply to Mr. Smith's. As to the correctness, that is a matter of opinion apparently, but as to the adequateness, he himself says, "It is quite impossible to give a complete or satisfactory explanation of colour vision in the compass of a short letter." The sole purpose of my letter was to show the intentions and explanation of a particular experiment of Tyndall's, which Mr. Smith had misunderstood and misrepresented. As to the general question of colour, discussion is really useless between people taking the scientific line and those dealing with it on artistic principles; it is like a conversation between people using different languages, while each has only a very slight knowledge of the other's.

It is for this reason that it would be waste of time to discuss the subject with Mr. S. Calton, who, in 20340, p. 499, expends four columns in showing that he pays no attention to anything but his own ideas, and from want of understanding them, perverts and misrepresents those views of the subject which may be called scientific, as distinguished from artistic or practical. Hence all his criticisms as to the effects of various pigments, and especially the actions of rotating coloured discs, are valueless, and, in fact, unmeaning. We all know that the effect will be nothing but a rough approximation to a white. As none of the colours employed can possibly be pure colours, and as their proportions in the disc are not likely to be exactly correct, how can a pure white be expected?

The fact is unquestionable, that blue and yellow "lights" do not produce green; but lights do not mean those resulting from passing through glass, *unless the glass cuts off perfectly all but the required light*, and this is scarcely attainable. A scientific experimenter on light-colours derives his lights from the prism, and selects definite colours. He would thus get a range of blues and a range of yellows, and could produce a variety of combinations. But it appears useless to talk of this to a person who insists upon experimenting *in* the light instead of in the dark. Why, in the light, we could never separate single colours; we should always be flooded with the whole components of white light superposed upon the experiment and should need a very intense light indeed, to obtain a visible result at all from the distributed spectrum.

Mr. Calton recognises that a coloured light is an imperfect one. Of course it is, because it furnishes only part of the compound known as white light. The evidence is: That if we pass the white light through a prism we subdivide it into a long series of such imperfect, that is partial, lights; if we receive these upon another prism, we gather them again into the perfect white with the quantity diminished by loss in reflection. If, now, we separate parts of this spectrum on the second prism by stopping off all but the selected portion, we can produce white light by a number of combinations, but obtaining, of course, a feebler light. But these several whites, though optically and artistically alike, are very different, scientifically considered. Let each of these whites be received upon a third prism, and their difference is at once manifested, because only the one will produce a full spectrum, the others showing only their special lines. Mr. E. Holmes, in his last par., p. 549, explains this fairly.

This is, of course, the same thing as happens in the case of pigments, as with the greens in the Venetian blinds mentioned by "E. H.," page 499, where two closely-resembling greens, alike to the artist, are proved by analysis to be constituted of different light or colour elements. I imagine the source of Mr. Calton's misapprehensions is the idea (which I have observed is not uncommon among artists), that black is a colour and white the absence of colour, while science teaches us that black is simply the absence of light, whether it be due to shadow or absorbed light, while white is the united effect of several colours—a harmony, in fact.

Now, let us see the difference between the vague artistic and the exact scientific definitions, p. 500. Mr. C. says, "Pure blue means a certain fixed colour, free from red and yellow, while green, being a compound colour, embraces an unlimited number of hues, &c." How does this define blue? As a mere fact, there are as many hues of blue as of green, and a green can be fixed as definitely as a blue. The scientific definition is that blue is a colour due to wave-lengths, of which the mean is 4·75 ten millionths of a millimetre, while the mean of green is 5·12, and science can prove this by taking a perfectly colourless surface and producing upon it lines of these intervals with the resulting colour. In the face of such facts, Mr. C. must really allow "mere scientists" to pass with a smile such observations as he makes about the manner in which they prepare their discs and work out "dodgey" experiments.

Mr. C.'s further five columns, 20432, p. 575, simply illustrate my previous remark that he perverts my statements of the scientific view of the subject by misunderstanding them. He does so as to my own remarks as to the experiments with the blue and yellow glass: he says "I admit an excess of green in combining blue and yellow lights." I did not: I was dealing with a special case of lights passing through glasses, both of which were stated to pass green, as well as their predominant colour, and I should not think of calling the mixed lights passing through coloured glass, blue or yellow, from a scientific standpoint, whatever I might do in dealing with their artistic effects, or in ordinary conversation. Hence, all his criticism is meaningless.

Students of light and colour should recognise the great resemblance between it and sound, in the circumstances that the colours of the spectrum of white light are to all intents an octave of sound, and the seven colours of the rainbow correspond to the seven notes of an octave of music in the relations of the number of undulations producing each. Each colour has its specific wave-length, just as each tone has its specific period, and in each the harmonies are dependent upon the numerical relations of these wave-lengths. But the perception of wave-lengths of light as colour depends not only upon the external actual light, but upon the organ of sight, as in the other case of sound. Now, the distinction of the scientific and artistic treatment in both cases is this: the sciences of optics and acoustics examine chiefly the external agency, and the artist is concerned only with the action of the living organs of perception. **Sigma.**

The following, for general use as a grease eradicator, is recommended:—Castile soap in shavings, 4oz.; carbonate of soda, 2oz.; borax, 1oz.; aqua ammonia, 7oz.; alcohol, 3oz.; sulphuric ether, 2oz, Soft water enough to make one gallon. Boil the soap in the water until it is dissolved, and then add the other ingredients.

To clean a soiled chamois-leather, make a solution of weak soda and warm water, rub plenty of soft soap into the leather, and allow it to remain in soak for two hours, then rub it well until it is quite clean. Afterwards rinse it well in a weak solution composed of warm water, soda, and yellow soap. If rinsed in water only, it becomes hard when dry, and unfit for use. The small quantity of soap left in the leather allows the finer particles of the leather to separate and become soft like silk. After rinsing, wring it well in a rough towel, and dry quickly; then pull it about and brush it well, and it will become softer and better than most new leathers.

REPLIES TO QUERIES.

**** In their answers, Correspondents are respectfully requested to mention, in each instance, the title and number of the query asked.*

[47050.]—**Hot-air and Vapour Baths.**—I have received eight more letters on the subject, one of which is from Isabelle Stuart. As they all are for personal use, I think the answer contained in No, 904 will be sufficient. A London engineer seeming to entertain the idea of applying largely and publicly my system, I will send him particulars. One of the letters received is from Canada. It contains two three cents stamps, which I am sorry not to be able to give back to the inquirer, as they are quite useless to me, unless I make a trip to Montreal. The specification of my patent was sent to Madame Eugénie Baxter, Nauwoo, Illinois, U.S.A., with whom, perhaps, my Canada correspondent may communicate. I find it singular that some inquirers do not give their real name and address. Some say, Care of.... others, P.O. Box....—Ch. Rabache.

[47144.]—**Bending Wood.**—In connection with the answer to the former querist, much pressure could not be expected to be employed in a steam chest of wood; still, if the present querist has much bending to do, so as to answer his purpose to have a steam generator made for the express purpose, and is careful to select good sound wood for the chest, and makes good sound joints in putting it together, he might use sufficient pressure for all practical purposes, but the less in substance the wood to be bent, the less the pressure required. Safety-valves, such as are used with a moderate sized model engine boiler, would be about the thing.—Collodian.

[47239.]—**Deafness and Vegetarianism.**—Suppose we grant that many vegetarians are thin spare people, this is no argument against that dietary; it merely proves that they have no superfluous fat clogging their limbs, impeding the movements of their muscles, and pressing upon the array of beautiful nerves with which the human system is furnished. If a troublesome member of the House of Commons can "obstruct" longer on Zoedone than on brandy, so can the spare-ribbed vegetarian and pure-liquid-drinker work longer than his neighbour, the meat-eater and beer-swiller. I cannot fully endorse the testimony given in favour of a "vegetarian diet," so called, in the present condition of our city and town markets, in which are offered for sale cabbage, cauliflower, lettuce, and other heads, two to four days old, and which disagree with many a stomach, even when very carefully cooked. To be really wholesome and nourishing, green vegetables should be eaten the day they are cut and sent from the spot where they grew. Necessarily, they begin to spoil at the very moment of separation from the parent stem. The longer they remain uncooked the more they spoil, so that if I buy this morning three nice cauliflowers, one to use at dinner to-day will be perfectly good; a second, used to-morrow, quite passable; the third, used the following day unwholesome, and very probably a cause of severe dyspepsia, yet the illness may be attributed to a totally different cause. The often unavoidable plan of dining at eating-houses in large towns is a fruitful source of stomach complaints. The cooking may be excellent as a rule, but the late-comers get the meat and other articles of diet "all hot," because the cooled joint is used, the customer's "allowance" carved off, and then the plate and its contents goes into a hot oven, and this second warming "soddens" the meat and makes it more or less indigestible to even a healthy stomach. And cooking of the vegetables is often most objectionable. Cannot some correspondents of "ours" benefit many a family by giving us a series of articles on the subject of proper cooking? Were our vacant spaces utilised for the growth of vegetables, and the refuse of towns applied to manure the ground, it would add to both the wealth and the health of our population.—H. O'B.

[47346.]—**Boomerang.**—The description that "H." gives, from Beeton's "Encyclopædia," of the Boomerang itself is quite corect, but the directions for throwing it are not so. It should be held like a reversed scimitar, with the concave edge foremost; moreover, its flat side should be downwards. Professor McCulloch, of Trinity College, Dublin, was not the introducer of the boomerang into this country; he wrote a paper, however, on the dynamics of its flight.—Dubliniensis.

[47369.]—**Preserving Mosses (and Ferns).** These will not long retain their bright colour without being dyed. A bottle of liquid for the purpose costs 6s. or 7s. in London.—H. O'B.

[47439.]—**Cement.**—This querist can hardly expect an answer unless he says what kind of cement he means. Plaster of Paris and fireclay answer the conditions given, but probably there may be something which prevents their use.—T. P.

[47437.]—**Threads for Steam Pipes.** I copy the following from Martin's screw-cutting tables; leading-screw of lathe, two threads per inch. The wheels required for screw-cutting are as follows:—

					Pitch.
1¼in. and all above..	85	80	20	120	11 294
1in.	20	—	—	140	14
¾in.	20	—	—	140	14
⅝in.	30	65	20	85	18·412
Small brass tube	30	60	20	120	24

—A Colliery Mechanic.

[47440.]—**Converting Peat into Charcoal.**—Peat thoroughly dried can be converted into charcoal by heating it in retorts like those used at the gasworks. The gas can be utilised if desired, or the peat can be burnt into charcoal in the ordinary way.—Essar.

[47450.]—**Repairing Mirrors.**—If these have the common quicksilver backing, they can, I believe, be repaired by putting on little patches of the mercury and tinfoil amalgam. The glass must be very clean. I wish some of your clever readers would explain the method fully.—W. T. S.

[47459.] — **Silvering Looking-glasses.**—Brashear's, or any of the other processes of silvering telescope-mirrors are suitable for looking-glasses, but are more expensive than the mercury process used for the purpose. There is no difference in the process, except that you put the silvering on what is the back of the glass, and protect it with a coat of varnish.—J. T. M.

[47463.]—**Change Wheels for Screw-Cutting.**—Suppose 20 teeth in wheel on spindle of lathe required to cut 31 threads per inch; and 125 teeth in wheel on leading screw containing four threads per inch; to find the No. of teeth in stud wheels:—

$\frac{\text{The product of former}}{\text{product of latter}}$, or $\frac{20 \times 31}{125 \times 4}$, or $\frac{62}{50}$ giving the answer. Then, as the wheels from 30 upwards increase by 5, $\frac{62}{50} \times 8$ gives $\frac{496}{400}$, or $\frac{49\cdot6}{40}$ nearest to $\frac{50}{40}$. Or, reversing the calculation $\frac{4 \times 125 \times 50}{20 \times 40}$ or $\frac{25000}{800}$, or $\frac{250}{8}$ = 31¼ threads per inch. *Or, by Double Slide Rule.*—Setting 125 on slide N, B opposite 20 on line A; and 4 on slide *c* opposite 31 on slide N; then the nearest fractions $\frac{25}{20}, \frac{50}{40}, \frac{75}{60}, \frac{100}{80}, \frac{125}{100}$, are visible at one setting.—Buttershaw.

[47463.]—**Change-Wheels for Screw-cutting.**—Will T. F. Gell, who replied on p. 552, kindly explain himself on the matter of change wheels. The instance he gives does not bear out his rule. Besides, his rule only gives the number of threads that will be cut if the driving and driven wheels are known; whereas, what is generally wanted is, what the driving and driven wheels are to be when the number of required threads are known. But I cannot make head or tail of his rule as it is. The number of teeth in driven wheels are 155, of driving wheels 105. The former multiplied by 4 and divided by 105 does not give 30 10·11, yet that is his rule. It is a most useful subject. Can no one give a plain intelligible rule for finding the stud-wheels and mandrel-wheel when the only known quantities are the threads on the leading screw, and the required threads on the work?—S. P.

[47463.]—**Change-Wheels for Screw-Cutting.**—I beg to inform my brother reader, "Try Again," that the rule I gave him in my reply to his query will calculate any train that may be required. Now, a screw of 31 to the inch cannot be cut exactly with a set of wheels from 25 up to 125, each wheel increasing by 5; but, nevertheless, a train can be found that will cut one sufficiently near for all practical purposes. Now, to begin. The leading screw has 4 to the inch, and the screw to be cut is to have 31 to the inch. These give a ratio of 1 to 7·75. Let us now put a wheel of 25 on the mandrel, and one of 50 on the stud; these have a ratio of 1 to 2. Now, the ratio of the other two wheels must be such a number which, multiplied by 2, would be equal to 7·75; therefore 7·75 ÷ 2 = 3·875 the ratio required. Now, let us put on the stud along with the 50, any wheel you chose—say 30. Then multiply 30 by 3·875, and we have the number 116 25; therefore, the train 25 / 50 30 / 116 will cut very nearly 31 to the inch. Now, our stock of wheels does not contain one with 116 teeth; therefore, we must try and arrange them so that they will suit the numbers in stock. Let us take the train 20 / 40 35 / 135, and we will find they will cut very nearly 31 to the inch. Thus the ratio of 20 to 40 is as 1 to 2; that of 35 to 135 as 1 to 3·857; then 2 × 3·857 × 4 = 30·856 very nearly the required pitch.—Thos. J. O'Connor, Dundalk.

[47463.]—**Change-Wheels for Screw-Cutting.**—The rule for finding the wheels to cut a thread of any pitch is very simple; but as the wheels supplied with most screw-cutting lathes are confined to 22 in number, it is impossible in many instances to cut a thread of the exact pitch required, as is shown in your issue of August 18th by T. F. Gell and "J. K. P." in reply to query 47463. In very many instances, a mere approximation is sufficient for most purposes, and makes a working fit; but if you are constructing a mathematical instrument, where absolute exactness is necessary, it would, as no one can doubt, be a very great advantage to be able to pick out the wheels to cut the very pitch you require. I have a number of small books containing tables for screw-cutting, showing the combinations of wheels which produce a number of pitches. The best of these tables is undoubtedly by Lord Lindsay; they are calculated to a leading screw of one thread to the inch, consequently, a very simple calculation renders them available for use with any screw-cutting lathe whatever. For some time, having been confined to bed with an attack of gout, I have been unable to occupy myself in my workroom, but have, for amusement, been calculating out a set of tables for use with my own screw-cutting lathe. Seeing that the pitch depends on the ratio existing between the first and last wheel—namely, between that on the mandrel and that on the screw, which can be multiplied or divided as required by compound wheels as intermediates—I did not confine my calculations to the change-wheels in my posssssion, but have calculated the ratios of every wheel from 15 to 200 and upwards. 15 on screw, multiplied by 4, the pitch of leading-screw, and divided by each number from 15 to 200 on the mandrel, gives the ratio between the two wheels; thus 15 on mandrel and 15 on screw cuts 4, increasing by each tooth added to the screw-wheel in regular series till 30 is reached, when a whole number is again reached, and it cuts 8. After this, the calculation is easily carried out up to 200, or more, as the series of decimals are the same between each multiple of 15. The same is carried out for 16 on the mandrel, and here the series is still more simple, the rise for each tooth on the screw-wheel being ·25, or 1-16th of 4, the pitch of leading-screw, and so on up to 200, both ways. With 15 on mandrel, a change of each tooth on the wheel of screw gives a rise of ·26, till a multiple of 15 is arrived at; thus 15 on mandrel gives, with 15, 30, 45, and 60 respectively, 4, 8, 12, 16 threads; with 16, 31, 46, and 61, 4·26, 8·26, 12·26, 16·26, and so on; with 16 on mandrel, a change of each tooth on screw-wheel, gives a rise, as already stated, of ·25. With 17 on mandrel, a change of each tooth of screw-wheel gives a rise of ·2352, the whole numbers being reached at each multiple of 17; thus 17 = 4, 34 = 8, 51 = 12, &c. I have gone far enough to show the effect of a rise or fall of one tooth on the screw-wheel. I shall now make the changes on the mandrel-wheel. In the former case there is a gradual rise, in the latter there is a gradual fall. With 15 on the screw, and 15 on the mandrel, as before, you cut a thread of 4 to the inch, 15 will now remain permanently on the screw; 16 mandrel will cause a diminution in the pitch of the screw, thus:—$m / 16 = 3\cdot75$, $m / 17 = 3\cdot5294$, $m / 18 = 3\cdot3$, $m / 19 = 3\cdot15789$, $m / 20 = 3$, $m / 21 = 2\cdot857142$, $m / 22 = 2\cdot72$, $m / 23 = 2\cdot608695$, $m / 24 = 2\cdot5$, $m / 45 = 1\cdot3$, $m / 48 = 1\cdot25$. $m / 50 = 1\cdot20$, $m / 60 = 1$, $m / 61 = 0\cdot9830$, $m / 100 = 0\cdot6$, $m / 200$ 0·3, and so on. I have gone far enough to show that a table of simple ratios between wheels for every tooth from 15 to 200 would be very useful, and as you can get wheels of 14 pitch from Lloyd, of Birmingham, with almost every tooth from 15 to 200, there is no reason for any possessor of a screw-cutting lathe not being able to cut exactly any pitch whatever. It is quite true that most 5-in. lathes are fitted with wheels of 10 pitch, but for light work those of 14 pitch are sufficient; and as a complete set of 22 change wheels only costs 12s. 6d., and odd wheels of all numbers can be had at prices, ranging from 4d. to a few shillings, no one requiring to cut a screw of special pitch need be without the means of doing so. In making this table of ratios, I only thought of my own lathe, but if I had intended publication I would have calculated the series for a screw of 1in., from which, by simple multiplication or division any person could apply the same easily to his own lathe, whatever the pitch of the leading screw might be. To make such a table complete, a similar one showing the multiplying or dividing power for each tooth on stud-wheel one pinion would be useful. Thus, if you had 15 on the mandrel, and any number on the screw connecting the pair by any number of simple wheels, the latter would only serve to convey the motion and to cut a right or left-handed thread, dependent on the number of intermediate simple wheels being odd or even; but if you introduced anywhere into the series, a pair of compound wheels, say, a 20 and 100, it would have the effect of either dividing or multiplying the ratio by 5, according as the wheel or pinion was a driver or driven. If such tables were fully calculated and carried out, we would have a wonderfully minute rising and fallng series of pitches, from one requiring a microcope to see it to a pitch of several feet.—Gereb Dmi.

[47482.]—**Telephone.**—The Edison loud-speaking receiver is, I think, the best to hear all over a room, but you must be near to turn the chalk cylinder, or else work it by means of a clock train. There are not many loud-speaking receivers, but possibly some readers may know of something better than Edison's.—Essar.

[47486.]—**Euclid's Axioms**—If $A + C = B + D$, then, surely, no one need be shown the step to deduce $A - D = B - C : A + C - D = B$? This method, it may be urged, is algebraic; but, from the nature of the question, it is the only way I can suggest.—C. H. Romanes.

[47489.]—**Storage Battery.**—There is nothing more to be said than the oxygen at one plate produces peroxide, while the hydrogen at the other reduces it to to a lower state of oxidation. When the battery is at work, the oxygen of the peroxidised plate is transferred to the other plate, and when they are equally oxidised (speaking roughly) the action terminates. I don't think anyone has yet put the action into formulæ, unless, which is likely, you can find it in Gladstone and Tribe's papers.—Nun. Dor.

[47491.]—**Lantern Slides** are very difficult to colour well, and it requires practice and some experience before satisfactory results are arrived at. You can get transparent water-colours, and you will find them more manageable than oil or varnish colours; but you should buy a good slide from Mr. Lancaster, or any other of our reliable helpers, and with this before you copy the intensity and tints. No amount of written instruction will aid you so truly.—E. B. F.

[47491.]—**Magic-Lantern Slides.**—The engravings I used were about the size of the printed portion of a page of the "E.M.," they were pinned to a board, which was propped in an upright position at one end of a table near a window. A camera was placed at the other end, and was moved backwards and forwards until the image of the picture on the ground glass was the proper size to cover a quarter-plate, or about 3¼ by 4¼in. A negative was then taken on a gelatine plate, and a transparency printed from it. Almost any lens will do, if it is stopped down sufficiently. In copying oblong pictures there is this difficulty—that the transparency having to be square or circular, the ends of the picture have to be sacrificed, or else the picture taken on a smaller scale to get it into the 3¼in. square; but in that case there will be a blank space above and below. This must be left to taste. My transparencies, although so much reduced in size from the original, show every line of the engraving (seen through a glass), although the picture itself was a fine steel engraving.—M.I.C.E.

[47494.]—**Speed of Small Steam Vessels.**—There is no rule for finding the speed of steam-vessels, small or large, because so much depends on the power exerted, the manner in which it is applied, and the lines of the vessel, to say nothing of the kind of propeller used.—Launcher.

[47540.]—**Measuring Flow of Water.**—In correcting my answer to this query Mr. Bell has omitted to state that the coefficient of contraction, "c," varies under different circumstances. In the case of a uniform stream it is one, and I assumed this for the case given, as the query does not give particulars on the point.—Ditton.

[47553.]—**Problem in Dynamics.**—The answer to this problem is very simple. Whatever the monkey does as to changing his elevation, whether upwards or downwards, the counterpoise will do the very same. If the monkey ascends 1ft. the counterpoise will ascend 1ft. and so on. Of course, that the monkey may ascend 1ft. he must climb 2ft. on the rope. This will be easily seen by considering the more simple case of two stationary boats, which, including their loads, are of equal mass, on a calm sheet of water. If an occupant of one boat proceeds to draw the other one towards his by a rope, the two boats will advance equally towards each other, since their common centre of mass is stationary. The simple principle involved can be easily applied, *mutatis mutandis*, to the monkey and counterpoise. It is true that the monkey's weight varies inversely as the square of his distance from the centre of the earth; but, in the first place, the effect of this is quite imperceptible; if the monkey ascends 1ft. he will lose less than 1-10,000,000th part of his weight; and in the second place, what he loses in this way the counterpoise will lose likewise, since it will ascend as much as he.—Dubliniensis.

[47553.]—**Problem in Dynamics.**—"Tam o'Shanter" is wrong in supposing that the monkey cannot exert a downward pressure greater than his own weight. So long as his upward velocity is increasing, the tension of the rope must be greater than his weight; for if it were equal to it, the resultant force acting on him would be zero, and therefore by the first law of motion he would remain in his original state—viz., at rest. The tension of the rope, at any instant, is the same throughout its length, because the pulley is smooth, and therefore the same force always acts on the ball as on the monkey—viz., the tension of the rope minus the weight of either. Therefore, the velocity of the ball receives exactly the same increment in any period as that of the monkey, and at first they are both at rest. Hence, at any subsequent time they must be moving with the same velocity. As soon as the velocity with which the monkey is climbing the rope ceases to increase, his upward velocity also ceases to increase, and the tension of the rope must have again become equal to his weight. So that the upward velocity of the ball will also cease to increase. They will then each of them continue to move upwards with constant velocity, so long as the monkey continues to climb the rope with the same velocity. In short, no matter how the monkey climbs up the rope, he will always remain on a level with the ball, supposing, of course, that he was originally on a level with it.—Vesuvius.

[47558.]—**Water-Closet Seats.**—The hole in w. c. seats of best construction are perfectly round, not egg-shaped, as often seen in common closets. Of course, nothing is required for setting these out but a pair of compasses. Some may perhaps be seen that are slightly oval, but this is effected by bevelling away more at the sides than at the front and back; even then the hole itself is round, and the upper edge oval.—Grapho.

[47586.]—**Pure Silver.**—Dissolve in a mixture of pure nitric acid and water, equal parts, with aid of a gentle heat; dilute largely with distilled water and allow to settle three or four days, till quite clear; pour off the clear solution, and add pure hydrochloric acid till further addition ceases to precipitate; all the silver is hereby thrown down as chloride of silver; let stand till clear, decant, and wash once or twice with distilled water. Collect precipitate on a calico or paper filter, and further wash until the filtrate ceases to give any precipitate or cloudiness with nitrate of silver solution. Dry the chloride of silver carefully; when dry, mix with four times its weight of a mixture of equal parts of sodium and potassium carbonate; introduce this mixture into a crucible, and fuse at a good red heat; when cold, the silver will be found in a button at the bottom of the slag, and should be quite free from all impurities generally found in scrap silver. If required absolutely pure, I will give "Ape" further particulars.—A. E. Robinson.

[47628.]—**Private Study of French Language.**—If "Nemo" will procure Prendergast's French Manual of the "Mastery Series," published by Longmans and Co., Paternoster-row, London, price 2s. 6d., and conscientiously adhere to the instructions there given, I have reason to believe that he will be satisfied with the progress he makes. If he requires any further assistance, and will advertise his address, I shall be most happy to give him any in my power.—J. W. Fleming, Kirkwall, N.B.

[477641.]—**Rhubarb Wine.**—Cut up fruit into short pieces, 2in. long; to every gallon of such add 1 gallon of water and 3½lb. loaf sugar. Fermentation will soon commence; stir up twice daily when the pulp ceases to rise, wring out a quart at a time in a piece of thin canvas, cork down in stone bottle or cask. Ease the cork for a minute twice daily the first week, as an after fret (fermentation) may occur. Good to drink in about six months. P.S.—To please fancy you may add a little cut up dandelion root (fresh) or a handful of the leaves per gallon; but it must be all put together at commencement. Nearly all other fruits may be treated in the same way.—Meliora.

[47646.]—**Human Milk.**—Dr. Frankland's process for the manufacture of imitation human milk from cows'-milk consists in the removal of a certain portion of the casein, and the addition of a certain portion of sugar. On reference to the table:—

	Woman.		Cow.
Casein............	2·7	....	4·2
Butter............	3·5	....	3·8
Milk-sugar........	5·0	.....	3·8
Salts	·2	....	·7

It will be seen that by the addition of one-third more milk-sugar, and the removal of one-third the casein, woman's milk is closely approached, the percentage remaining then:—

Casein	2·8
Butter	3.8
Milk-Sugar	5·0
Salts	·7

The following is the method by which Dr. Frankland has accomplished this effect:—Allow one-third of a pint of new milk to stand 12 hours; remove the cream, and add it to two-thirds of a pint of new milk as fresh from the cow as possible. Into the one-third of a pint (from which the cream has been abstracted) put a piece of rennet about 1in. square, and set the vessel in warm water till the milk is curdled fully (5 to 15 minutes required, according to the activity of the rennet). As soon as the curdling commences, the rennet should be removed, and put away for subsequent use. Now break up the curd, and carefully separate the whole of the whey, and rapidly heat to boiling; separate the casein, and dissolve in the hot whey 110 grains of powdered sugar of milk, and mix it with the two-thirds of a pint of new milk, to which the cream abstracted from the one-third was added. Should be used within 12 hours after preparation. Although appearing on paper a somewhat complicated process, in practice nothing is more easy, and results in as effective a substitution of a mother's milk as could be possibly desired.—A. E. Robinson.

[47647.]—**Boiler.**—I must say that in my opinion the boiler shown on page 578, and described by "Grapho," is a very bad arrangement for generating plenty of steam. A boiler ought to be so designed as to have the greatest amount of heating, as well as the least amount of radiating surface. Having been engaged for a considerable time experimenting with a 5ft. model boat, and trying to get up steam with paraffin, colza, benzine, and spirits of wine, I have now adopted a charcoal furnace in preference to any of these. The form of boiler which I use is made thus:—Take a sheet of copper not quite 1-16 thick, and say 16in. broad; if the boiler is to be 10in. long, let this sheet be 13in. in length; bend this into a cylinder, lap over, say, ⅜, and rivet every ½in. with the little ½in. brass wire nails used to tack down stair-rod eyes, then sweat the joint with solder; make the ends out of the same sheet of copper, strike a circle of the inside diameter of the cylinder, and another, allowing ¼in., which must be beat up into a flange all round, and riveted all round at 1½in. from each end of aforesaid cylinder; make also a tube of the same stuff 1½in. inside diameter, riveted and sweated with solder; fit this through the ends, at one-third of diameter from the bottom, nicely turn over the ends and sweat. Now prepare two false ends, which may be of tinned sheet-iron, and having previously cut an aperture near one end at the bottom, and a similar one at the other end at the top, on this latter fit a flanged ring, preferably a casting, to fit the chimney on, then rivet and solder in these false ends, and the heat being applied along the bottom, travels to the end, turns up and back through the flue, then up and through the chimney. Next, for the furnace, take some sheet iron, say, 1-16in. thick, and cut two sides, allowing if possible 3in. from bottom of boiler to firebars (in mine, this is a piece of the same stuff punched full of ¼in. holes, with a bridge ¾in. from the door). Solder these sides along the sides of the barrel from one end to the other, at its greatest diameter (they will not melt off if the water supply is attended to); flange, fit, and rivet in the ends, one of which contains the door, also the part of the bottom plate from bridge to the end, which of course must be air-tight (some putty mixed with red lead will be found handy, should there be any orifices in the affair awkward to stop); let the sides extend below the bottom of grate, so as to allow of sufficient airway, and then you can use either the lamp of "Grapho," or the charcoal furnace. I have omitted to state that I found that in the open air it was necessary to fit on a tin jacket over the top of the boiler, allowing ⅜in. space, except where it is soldered to the sides of the sheet-iron at the greatest diameter, as aforesaid.—J. J. A., Liverpool.

[47654.]—**Printing.**—Although not entirely devoted to colour-work, you would do well to purchase "The Letterpress Printer," published by Joseph Gould, Middlesbro'. The following are all good books:—"Printer's Practical Every Day Book," "Printing for Amateurs" (published at the *Bazaar* Office), "Eclectic Handbook of Printing" (published by Birmingham Machinists' Company). For plenty of "dodges," "wrinkles," "tips," and "eye-openers," subscribe to *The Paper and Printing Trades' Journal.*—J. Hezmalhalch, Jun.

[47655.]—**Cotton.**—In my reply to this query, read "bast" instead of "best" in "Jute is the best of several Indian herbaceous plants, generally Corchorus capsularis and Corchorus olitorius."—W. Stuttard.

[47657.]—**Railway Signal Boxes v. Thunder and Lightning.**—Is lightning a source of danger to the signalman, and are the electrical wires and instruments a safeguard against that danger? This is a question which might be answered both affirmatively and negatively if left to mere theory: some would support one side, and some the other; but we will revert to practice and facts first, and comment upon theory and probabilities afterwards. Out of about 5,000 pieces of apparatus the following are, as near as possible, the number of casualties which took place in one year. Coils simply fused, and no other damage done, 150; lightning protectors fused, and no other harm done, 50; instruments slightly burnt only, 1; instruments entirely burnt up, although no other harm done, 2; fused leading in wires (covering burnt off in some instances, leaving wires in contact, and in others the wire also severed), 20; line wires severed by flash (probably consequent on flaw, which presented resistance to the flash, thus causing wire to be melted, gauge about No. 10, 1; signal-box struck, roof knocked off, and one side damaged, flash entered box and escaped *viâ* levers and earths, one or two coils fused, signalman luckily escaped unhurt, coils included in figures above: total casualties, 224. Thus, we see that we get about 4 12-15ths per cent. of the instruments damaged; but no serious effects ensue therefrom. About 1-26th per cent. are seriously damaged per annum, and might result more seriously for the signalman than has been the case during the year I am considering. About 1-50th per cent. of accidents occur which are liable to prove fatal to the man in the box. The flash in the instance before me did not enter *viâ* the wires, but struck the roof of the box. A part of it escaped *viâ* the levers, a part by means of the earth-wires of the instruments, and, the flash being strong, a part escaped away to "line," fusing two of the coils, thence getting to earth at the other terminal station. Here the wires proved a safeguard, as they helped to conduct away the flash. Generally speaking, the electrical earth conductors are of sufficient capacity to carry off any flash; and while any of the wires are liable to be charged by lightning, which is conducted to the box, there is an earth escape at both ends, which guards against "flying." By preventing "flying," I mean that they open up a ready path to the current, away to earth, thus stopping the flash from leaving the instrument, and entering the first earth conductor near—probably the levers—which might prove dangerous. But, still, there is the probability, but the chances are quite 99 to 100 against it. In the case where lightning protectors were provided, the instruments were saved from fusion. If wires are attached to soft metal for earth—a gas pipe, for instance—it is quite possible that it will be melted, and that the flash will "fly"; but all these probabilities are rare. In the course of five years, I have not heard of one fatal accident consequent upon the electrical apparatus; it has proved rather a safeguard than a source of danger, owing to its supplying such a ready road to earth. It may be well to remark that during thunderstorms, when working the instruments, whether block, single-needle, or otherwise, the operator should only touch the wood, or other insulating material of the handle, or he may get a fine shock, in itself not very desirable. I have noticed that it is quite a common thing to place the thumb on the metal of the handle where it joins to the barrel, in the S.N. instrument.—H. Stooke.

[47671.]—**Institute of Chemistry Exams.**—I am greatly obliged to "F. G. S." for his kind reply, on p. 556 to my query; but, as I am quite ignorant of the modus operandi of the Science and Art Department, I would thank "F. G. S." if he could tell me where, in London, the exams. are held? If I can take all the necessary subjects at the sitting? and to whom I must give notice of my intention to present myself?—Old Subscriber.

[47684.]—**Tin-plate-Working.**—You will require a hatchet stake, half-moon stake (two sizes), mallet, groove punch, bick iron, and small hammer for tapping down the joints. I quote the above names from memory. Turning up edges is done with the mallet; straight edges over the hatchet stake, and circular ones over the half-moon stake. Nothing but plenty of practice will bring proficiency in this. I forget the name of the plates I used, but I think it was XX charcoal. Size was, I think, somewhere about 15 by 22in., and price 3½d. per sheet. You would do well to procure a little work from the *Bazaar* office, entitled "Working in Sheet-Metal," price 7d., post free. For a fully illustrated price-list of tinman's tools, write to Messrs. Manoah Rhodes and Sons, Wakefield. —J. Hezmalhalch, jun.

[47694.]—**Taking Top off Violin.**—"Cremona" must carefully insert the blade of a thin table-knife, and gently and patiently prise it off all round. When replacing the head, do not rub off the old glue, but with strong and fresh glue go over it again, and having ready a number of clamps bind all together until dry. The clamps are made like the letter E, with the central stroke taken out, and are tightened in the work by a little wedge.—E. B. F.

[47699.]—**Distillation.**—The usual process for making oil of peppermint and similar oils is to use a retort with a steam-pipe attached to the under surface. The retort is half-filled with the herb in question and steam passed in; this volatilises the oil, which passes over with the steam, and condenses into the receiver. The oil being the lightest, rises to the surface, when it can easily be siphoned off when enough has collected. The oil can also be prepared by simply mixing the herb with water in an ordinary retort, and distilling by means of a fire; about 1lb. herb to 3lb. or 4lb. water. The other preparations of peppermint are made from the oil essence. Mix oil one part, rectified spirits of wine four parts. Water—mix 1½ drachm oil with 1½ gallon water, and distil till one gallon is collected, which is the peppermint-water of the British Pharmacopœia.—Junior Pharmacist.

[47703.]—**Darkening Mahogany, &c.**—If "S.W." will kindly refer to Vol. XXXIV., No. 882, page 573, he will there find a reply (penned by the writer), to his query, giving him full instructions what to do and how to do it.—A. Manock.

[47705.]—**Incandescent Lamps.**—It is a pity some readers do not read up what has been said on a subject before putting queries. It has been stated many times that unless you want to waste both time and money you must not use the Leclanché battery. Bunsen's battery is one of the best. You will find it a very messy and costly game, literally "not worth the candle." There are the Swan, Maxim, Lane-Fox, all good, and "best"—in their maker's estimation.—J. Hezmalhalch, jun.

[47709.]—**Ague.**—Your occupation may cause the disorder to hang about you. It is very detrimental to be much in the damp. Sleep in a dry room, with a more or less southern aspect, on elevated ground; wear a suit of flannel next the skin, including woollen socks; change at least once a week, put on thoroughly dry; live moderately on good, wholesome, fresh food—not too sloppy. A fire in your bedroom occasionally (daytime) will do no harm.—Meliora.

[47714.]—**Tests.**—"Pro Bono Publico" will find the following about the simplest method of estimating potash in the chrome or bichromate of that salt. Weigh off about 5grm. of the salt, dissolve in a little water, and add a little hydrochloric acid and alcohol to the solution; boil till the salt is completely reduced, and then add a slight excess of ammonia; boil till free from ammonia, filter off the precipitate of chromium trioxide, and evaporate the filtrate and washings in a platinum basin down to dryness over the water-bath; carefully ignite the residue to drive off ammoniacal salts; dissolve in a little water; add excess of platinum chloride, and again evaporate over water-bath to dryness; treat residue with strong alcohol, and transfer the precipitate to a weighed filter paper; wash well with alcohol, and dry at 100° C. till constant. The precipitate is $PtCl_4 + 2KCl$, from which the amount of potassium present can be readily found. This method is applicable to either the chromate or bichromate.—Ernest A. Brookes.

[47717.]—**Problem.**—Will "C. W. B." kindly work out the solution to $\frac{1 + x^5}{(1 + x)^5} = a$. His solution (No. 909, page 579), is too abstruse for a novice. It would be esteemed a personal favour. —Amicus.

[47720.]—**Oilstone.**—Wash your oilstone with paraffin-oil, afterwards with soda and hot water, and pour upon it equal parts of spirits of salts and water, or hydrochloric acid.—Jack of All Trades.

[47721.]—**Studying for the Medical Profession.**—You will find it exceedingly difficult to commence a medical career at the age of 30; but it will not be the first time that great things have been accomplished after such a maturity, should you be successful. In the first place you cannot prepare yourself by "private study," unless by this you mean that you can learn from *books* certain replies, which would be equivalent to certain questions of an examination. In order to qualify for the medical profession, you must have a good preliminary education, and about four years' attendance on lectures, hospital training, &c., and during this period you must pay every attention to the perfection of your education, and give special attention to *Latin*. If you were in a city something like Manchester, and could attend the medical classes at the Victoria University you would find it a great help. You say you have a "knowledge of chemistry;" but I cannot gather from the statement to what extent. Certainly it will be useful to you, and the more you know about it the better.—A. Manock.

[47731.]—**Killing-Bottle.**—As cyanide of potassium is extremely poisonous, it is a dangerous article in the hands of anyone who is not a chemist, and for that reason is not, or ought not to be, easily obtainable. The following, however, is a simple method of making a thoroughly good killing bottle with materials which are almost always at hand, and one which can be easily replenished whenever desirable. Get a large wide-mouth bottle, a French-plum bottle with a good sound top answers admirably, cut a piece of thick cardboard to fit as nearly as possible the inside of the bottle, and just so tight that it will stick firmly, and not slide up and down. Next pick a quantity of laurel leaves, young ones are best, see that they are quite dry, and chop them up into small pieces; then bruise them well, which is easily done by rolling them up in a piece of rag and hammering with a mallet; turn them at once into the bottle, and press them down; enough should be put in to be about an inch deep when pressed. Over these put the round piece of cardboard, so as to keep them in their place, and fix the lid or stopper on the bottle to keep in the fumes. Such a killing bottle will last fresh, if well stoppered, a whole season, and kill insects almost instantly; at the same time moths put in overnight will be found in a beautifully relaxed state the next morning for setting. It is well to avoid breathing the fumes, which are those of prussic acid. It is not advisable to leave chip boxes long in the laurel bottle, as they are apt to become thereby undesirably relaxed. Instead of laurel leaves, "stone ammonia" (ammonium carbonate) can be put under the card in the bottle, but it has the disadvantage of spoiling the colour of green-tinted moths.—A. Lloyd.

[47734.]—**Microscopic.**—If I may be allowed to differ with the previous replies to this question, I should advise "O. O." to purchase as follows:—A monocular stand (a binocular is simply waste money for use with the high powers he requires). I have recently had one constructed by Bulloch, of Chicago, which he calls the "Biological," and this is quite the best moderate-priced stand I have seen. As to a stage, Bulloch's is admirable, as it has concentric motion, and, by turning a small screw, the whole stage-plate lifts out, and will allow any sized slide or a plate of glass to be laid in its place. Do not get a mechanical stage; the movements of infusoria are much easier followed by hand on a glass stage. As to objectives, I should advise Zeiss' lenses; Mr. Baker, 244, High Holborn, is agent for them, and they are wonderful for the money. You will require 3-5, 1-4, and 1-9 of 24, 50, and 110 degrees aperture respectively, and probably after some time you will go in for a 1-14. The practice of using deep eyepieces, though convenient, is very bad for the eyes, and I should not advise you to try it much. You will notice I have named objectives of very low aperture; these will give you great penetration, which is quite indispensable for your work. I have a 4-10 of 100°, and a ¼ of 150° aperture, and neither is useful for bodies of appreciable thickness. You could procure a stand such as I describe for about £9, and the three objectives would cost £7 14s. I have worked on infusions myself, and shall be glad to assist you further if you will advertise your address.—P., F.R.M.S.

[47735.]—**Cataract.**—Don't eat anything at all. Notes would be superfluous, as, if you follow the advice, you won't want them. That is just as sensible and as much to the purpose as "don't eat salt." Can anyone—a chemist and physiologist preferably—say what is meant by "supersalinity" of the blood? The quantity of chloride of sodium found in human blood is about 4·6 in 1,000 parts, and somewhere about the same proportion is found in the blood of many of the domestic animals. The cat and the hen have over 5. Chloride of sodium is not the only salt found in the blood, so that it is necessary to know what is meant by supersalinity, both qualitatively and quantitatively. However, what with one thing and another being condemned as food, you will find it safest not to eat anything; but, perhaps, after all it will be more agreeable to enjoy yourself as much as possible, and throw the quack notions, as you would physic, to the dogs.—One Who Likes Salt.

[47737.]—**Black Shellac Varnish.**—If "Raj Mistry" will dissolve ¼lb. of shellac in 1 pint of methylated alcohol, and add ¾oz. camphor, and subsequently ½oz. of lampblack and ¼oz. of Prussian blue, both finely powdered, he will get a thin black varnish which dries with a high gloss. If too thin, use less spirit, but heat it to dissolve the lac, and if scent and high gloss are of no importance, omit the camphor. The recipe above given is the well-known blacking, but probably ivory black might be better, for some purposes, than lampblack. I have made the recipe above, and found it useful in many ways, notably for dressing black leather bags.—Nun. Dor.

[47738.]—**Analysis of Paint.**—Bisulphide of carbon will remove the oil from paint mixtures.—R.

[47739.]—**Tallow.**—Mineral adulterants may be detected by digesting the sample of petroleum spirit. With regard to the detection of foreign fats, Allen, in his "Commercial Organic Analysis" says they "can only be recognised by the altered physical characters of the sample."—R.

[47748.]—**Pickles.**—Take a gallon jar, put in it, without boiling, two quarts of the best brown pickling vinegar, 2oz. of ground ginger, 2oz. of flour of mustard, ½oz. of turmeric, these three to be mixed smooth with a little of the vinegar, and put into the jar; then add 2oz. of eschalots, 2oz. of mustard seed, 2oz. of salt, 1oz. of lump sugar, and as much cayenne as will lay on a shilling. Put into it a hard white cabbage, cut into slices; vegetable marrow, peeled, and cut into fanciful shapes; cucumber, peeled, and cut up; small onions, peeled; small French beans; large onions, sliced, and cut in quarters; cauliflower, broken into branches. Nothing to be washed or dried, but all put in fresh cut, and quite clean; stir it all well up together every other day for a fortnight, and keep it tied securely from the air. From No. 336. —Josiah Berry.

[47744.]—**Trigonometry.**—Tan. $\frac{a+B}{2}$ + tan.

$$\frac{a-B}{2} = \frac{\sin.\frac{a+B}{2}}{\cos.\frac{a-B}{2}} + \frac{\sin.\frac{a-B}{2}}{\cos.\frac{a-B}{2}} = \frac{\sin.\frac{a+B}{2}\cos.\frac{a-B}{2} + \cos.\frac{a+B}{2}\sin.\frac{a-B}{2}}{\cos.\frac{a+B}{2}\cos.\frac{a-B}{2}}$$

Multiply each expression in the numerator and denominator by 2.

$$= \frac{2\sin.\frac{a+B}{2}\cos.\frac{a-B}{2} + 2\cos.\frac{a+B}{2}\sin.\frac{a-B}{2}}{2\cos.\frac{a+B}{2}\cos.\frac{a-B}{2}}$$

$$= \frac{(\sin. a + \sin. B) + (\sin. a - \sin. B)}{\cos. a + \cos. B}$$

$$= \frac{2\sin. a}{\cos. a + \cos. B}.$$—C. H. Romanes.

[47744.]—**Trigonometry.**—

$$\text{Tan.}\ \frac{a+B}{2} = \tan.\left(\frac{a}{2}+\frac{B}{2}\right) = \frac{\sin.\left(\frac{a}{2}+\frac{B}{2}\right)}{\cos.\left(\frac{a}{2}+\frac{B}{2}\right)}$$

$$\tan.\ \frac{a-B}{2} = \ldots\ldots\ldots\ldots\ldots\ \frac{\sin.\left(\frac{a}{2}-\frac{B}{2}\right)}{\cos.\left(\frac{a}{2}-\frac{B}{2}\right)}$$

develop the sines and cosines of the binomials, and add the two terms together by bringing to a common denominator, and we get

$$\tan.\ \frac{a+B}{2} + \tan.\ \frac{a-B}{2} = \frac{2\sin.\frac{a}{2}\cdot\cos.\frac{a}{2}\left(\sin.^2\frac{B}{2}+\cos.^2\frac{B}{2}\right)}{\cos.^2\frac{a}{2}\cdot\cos.^2\frac{B}{2} - \sin.^2\frac{a}{2}\cdot\sin.^2\frac{B}{2}}$$

The first half of the numerator = sin. a, and the second half in brackets = 1, which therefore disappears, and the numerator becomes sin. a. In the denominator bring the second term to cosines (remembering $\sin.^2 A = 1 - \cos.^2 A$) the denominator then becomes $\cos.^2\frac{a}{2} + \cos.^2\frac{B}{2} - 1$. Now, $\cos. a = 2\cos.^2\frac{a}{2} - 1$, and $\cos. B = 2\cos.^2\frac{B}{2} - 1$, therefore, the denominator becomes $\frac{\cos. a + \cos. B}{2}$, divide the numerator by the denominator, and the expression becomes $\frac{2\sin. a}{\cos. a + \cos. B}$.

—M. I. C. E.

[47744.]—**Trigonometry.**—

$$\text{Tan.}\ \frac{a+b}{2} + \tan.\ \frac{a-b}{2} = \frac{\sin.\frac{a+b}{2}}{\cos.\frac{a+b}{2}} + \frac{\sin.\frac{a-b}{2}}{\cos.\frac{a-b}{2}}$$

$$= \frac{\sin.\frac{a+b}{2}\cos.\frac{a-b}{2} + \sin.\frac{a-b}{2}\cos.\frac{a+b}{2}}{\cos.\frac{a+b}{2}\cos.\frac{a-b}{2}}$$

$$= \frac{\sin.\left(\frac{a+b}{2}+\frac{a-b}{2}\right)}{\cos.\frac{a+b}{2}\cos.\frac{a-b}{2}}\ \text{Multiply num. and den. by 2}$$

$$= \frac{2\sin. a}{2\cos.\frac{a+b}{2}\cos.\frac{a-b}{2}} = \frac{2\sin. a}{\cos. a + \cos. b}.$$

—Square

[47745.]—**Palpitation of the Heart.**—Much has been said and written on this disease, which, unfortunately, is a common one, and one which often produces a nervous fear and unnecessary anxiety on the part of the patient. Palpitation is no proof of the existence of disease of the heart, as it may arise from many different causes. Indigestion is a common cause of palpitation of the heart. Persons of a nervous temperament are mostly subject to it, particularly if they get in the least excited. The blood being too weak or watery is another cause of palpitation. Persons possessing an irritable or passionate temper often have it when their passions are aroused. Palpitation may arise purely from constitutional weakness. These are some of the principal causes of palpitation of the heart, and the treatment entirely depends on the cause from which it proceeds. The cause must be removed before the cure can be effected. When palpitation arises from organic disease of the heart, it cannot be radically cured, only relieved. It must not be supposed from this statement, that heart disease is always accompanied with palpitation; on the contrary, many persons have heart disease who have never felt the least palpitation. It is therefore not a necessary symptom of disease of the heart. Valvular heart disease may produce, and often does, a violent palpitation, which is greatly aggravated and increased when the patient gets in the least excited, which should always be avoided in such a case, as it is dangerous. People with weak hearts should be very careful in their consideration of that weak part, and avoid everything which tends to increase or embarrass the action of their hearts. The heart is an organ liable to many forms of disease. It may be fatty degeneration, ossification, or valvular disease. There are few people, indeed, that possess hearts in a sound and healthy condition. Palpitation of the heart should be treated only by a qualified medical man. It is a disease which should not be tampered with by non-medical persons. It is not very dangerous in its nature, but still, it requires and demands skilled and careful treatment. Some people attach but little importance to this disease, while others attach too much importance. It is of some importance in every case, as, if neglected, it may lead to very serious consequences. Persons subject to palpitation need not imagine that they have heart disease, until they know for certain that they really have it; and when the unpleasant information reaches them that they have got the organic disease of the heart, they should, if possible, take the information in a quiet way, and not, even then, frighten themselves unnecessarily, as it is a well known fact that there are many persons who have organic heart disease who do not die from it. As "A Subscriber" evidently suffers from palpitation of the heart, he naturally asks, Is it heart disease or not? In answer to this question I must say that it is impossible for any reader of "ours" to give a definite reply. Personal examination by a qualified medical man is necessary in order to ascertain from what cause it proceeds, and in prescribing for palpitation many things have to be taken into consideration. It is, therefore, impossible to suggest any certain cure for this one particular case of palpitation. Consult a physician, and give every attention to the treatment he recommends.—G. Fryer.

[47745.]—**Palpitation of the Heart.**—If you have had rheumatic fever, the symptoms may indicate a diseased state of the heart; if not, they may only indicate indigestion, flatulence, or general debility. Persons of a nervous disposition and those troubled with much fat, get palpitation of the heart from the smallest excitement or exertion; but this symptom must not be deemed one of disease of the heart. —Edwin.

[47750.]—**Polishing Wardrobe.**—Never use putty; take some fine sawdust of the same wood, and whiting, and mix into a paste, either with some pale polish, gum, or glue, and well press home. When set, paper off. This is scarcely perceivable.—Jack of All Trades.

[47753.]—**Polishing Piano-Keys.**—To Mr. Davies.—The frame would not hold the keys sufficiently level or firm A better way would be to hand-screw a few at a time on a board, and scrape them in that position. They should be finished with flour-paper, care being taken that they do not get too hot during the process. Unless the keys are very hollow, or much discoloured, it would perhaps be better to dispense with the scraper altogether, using a coarser glasspaper in its stead They should be polished singly, on a board covered with several thicknesses of cloth; this should be placed on a bench, and the ivories vigorously rubbed (lengthwise and face downwards), until a good polish is obtained. Putty-powder is the best polishing material, though pumice might first be used to take out any marks left by the paper. A very brilliant polish may be got by finishing the keys with a similar board covered with wash-leather, and sprinkled with rouge. A liberal supply of water is necessary during either process.—W. H. Davies.

[47754.]—**Tin Cans.**—Down in our part of Lancashire they command a ready sale. They are used for covering small outbuildings. They are cut up into one flat sheet, one thickness of stiff brown paper tacked upon the slabs, the tin is then tacked firm. They fetch 2d. per sheet.—Tom B.

[47754.]—**Tins.**—Some time ago I had 10 tons of bad tinned meat, salmon, &c., to convert into manure, and after that process was accomplished, there was a perfect pyramid of tins, occupying space, and emitting a very unpleasant effluvium. I therefore took a piece of corrugated iron roofing, 6ft. by 6ft., placed it at an angle of 45°, bricking up round with common bricks, loose laid, with a few iron bars across, upon which I built a fire, using coal and wood for a start, but subsequently utilising the cinders from the stokehole. I placed as many tins upon the iron as would lie upon it, and made a clay mould, so that the solder and tin would fall into it. The tins were tapped with a stick occasionally, and all the solder and tin came from them in the shape of thick bars, in the mould. As the tins opened in the course of this process, they made a good bottom for a new road that was then in progress. The product from the mould was remelted in a ladle and cast in thin bars, being separated from the dross, and fetched about 7d. per pound, paying well for the operation.—Fred. Walker.

[47756.]—**Electro-plating.**—The mere intensity or E.M.F. of the current may be shown by a common current detector, price about £1; but this instrument will be of little value in estimating the proper current for electro-plating. An instrument for this purpose should have two coils, and will cost about £3. An illustrated article would be required to properly describe the instrument.—Edwin.

[47756.]—**Measuring Electric Current.**—The instrument most used for this purpose by electricians was Siemens' dynamometer, but recently Profs. Ayrton and Perry have brought out an am-meter, or galvanometer, measuring in ampères (or nearly so), and this we mostly use now, because of its great convenience. There are other measuring galvanometers similar in action, and notably a French one by Duprez. As "Galvanometer's" currents are for electro-plating, I scarcely think he requires an instrument like the above, for I have been told by a gentleman connected with Elkington's well-known electroplating establishment at Birmingham that they measure the strength of their currents by the amount of deposition obtained in a given time. Others that I have heard of could not tell me the power of their currents in the technical terms.—Tried

[47757.]—**Manganese.**—The most important manganese ores are (1) The dioxide, or pyrolusite, MnO_2 (2) Braunite Mn_2O_3: (3) Hausmannite Mn_3O_4. These higher oxides are both reduced to MnO_2 when heated to redness, and from this latter substance metallic manganese is obtained by intensely igniting it in a wind-furnace with soda-lime, glass, fluor spar, and lampblack. Other manganese ores are psilomelane (MnBa) O + MnO_2: rhodocrozite or manganese-spar, $MnCO_3$: manganite, $Mn_2O_2(OH)_2$: alabanite, MnS: and hauerite, MnS_2. "Chlorine" will see from this that (sulphur and barium excepted) there are very few real impurities in the ores of manganese. If he wishes to obtain an exact qualitative or quantitative analysis of any ore, he can do so by the methods given in the ordinary textbooks; too long to be inserted here.—C. Harris.

[47759.]—**Archæological.**—Presuming the cruciform structure to be ancient work, it seems to be comparable with the buried crosses found on the wolds of Yorkshire between 1866 and 1874. These were composed of chalk sides filled up with clay, the four arms pointing to the cardinal points. Leading antiquaries suppose them connected with Roman agrimensorial operations—division and assignment of estates among the colonists in Roman Britain. See *The Archæologia*, vol. xlii. pp. 127 and 151.—H. S.

[47760.]—**Tinning and Galvanising Iron.**—This is being done by Mr. Elmore, of Blackfriars-street, London, S.E.—Edwin.

[47766.]—**H.M.S. "Ajax."**—The engines of this vessel, made by Messrs. Penn, are twin screw engines of 6,000 indicated horse-power, and are on the steam-hammer principle, with cylinders 54in. in diameter, and 39in. stroke, and are six in number, three on each side of ship. They are compound expansion engines, the expansion slide working on the back of the main slide, and are set to cut off steam from 1-10 to 6-10 of stroke. The engines are made to work compound by an arrangement of valves fixed on side of cylinders, the forward cylinder on each side being the high pressure, so that one cylinder may be worked high pressure, and the other two low, or all three worked low pressure. The crank shafts are made in three lengths, so that either length may be disconnected in case of a breakdown. The boilers are ten in number, and work at 50lb. per square inch.—Taffy.

[47769.]—**Wire for Induction Coils.—Incandescent Lamps.**—The wire can be thus used as the secondary wire to a No. 22 primary. Platinum wire has been used, but it cannot be compared in usefulness with carbon filament. All the best lamps have carbon filaments.—Edwin.

[47769.]—**Wire for Induction-Coil—Incandescent Lamps.**—No. 36 cotton-covered wire might do for an induction-coil of a certain size if well insulated. I should not risk it, however. Use silk-covered wire, and see that you get it properly covered. Both platinum and carbon are used largely by the different makers in the manufacture of incandescent lamps. The carbon filament in my opinion is the best, platinum being liable to fuse.—W. R. HICKS.

[47769.]—**Wire for Induction Coil—Incandescent Lamps.**—Cotton-covered wire will not do for intensity coils, unless each coil is insulated with thin twine, and then well covered with hot paraffin wax. I do not advise "Amateur Electrician" to use the wire; he had better try some silk-covered, and not have any further trouble. Carbon filaments are used for lamps, the preparation of which has been explained in back numbers. —W. T. W.

[47769.]—**Wire for Induction-Coils.**—Platinum is now seldom used for the old filament in incandescent lamps. All the well-known lamps, including Edison's, Swan's, and Maxim's, are made of carbon. The Gatehouse patent, I believe, uses a carbon filament with platinum wound round it; and a new invention, the patentee I forget for the present, is one in which a platinum wire is used, round which glass is made to fit closely, so that no air intervenes. This is supposed to make the filament last a longer period, but it is open to objections.—TRIED.

[47769.]—**Wire for Induction Coils.—Incandescent Lamps.**—No. 36 wire is used for induction coils, but it is bad economy to use cotton-covered in place of silk. Much more silk-covered can be got in the same space. As you have the wire, perhaps it might pay to use it. Carbon filaments are used for incandescent lamps, platinum filaments being no good.—J. HEZMALHALCH, JUN.

[47770.]—**Preventing Rust.**—If "W. P. M." will line his show-case with waterproofed carbolised paper he will avoid the rusting of his steel goods. The theory of its action seems to be the formation of a chemical atmosphere counteracting the causes of rust and tarnish. A similarly-treated tissue-paper, "anti-tarnish paper," is made for silversmiths and jewellers' use.—E. L. S.

[47770.]—**Preventing Rust.**—Never put a case with cutlery or polished goods against an outside wall. You might prevent rust by having your case painted, or give it a coat of patent knotting and line with zinc.—JACK OF ALL TRADES.

[47770.]—**Preventing Rust.**—If "W. P.M." can place a vessel containing a small quantity of sulphuric acid in his case, I think that will prevent his articles from rusting. The action is that sulphuric acid has a great affinity for moisture, therefore, keeping the air perfectly dry. The acid should be changed now and then.—W. R. HICKS.

[47770.]—**Preventing Rust.**—Rust can be totally prevented in a close case by putting in a small cup or wide-mouthed bottle without cork an ounce or two of fused chloride of calcium. If the case is not perfectly tight this will require renewing at intervals when it becomes fluid. Common fused chloride of calcium can be obtained at the rate of about 1s. per lb.; it prevents rust by its strong affinity for water, which it rapidly removes from the air, and is constantly used for preserving steel and iron specimens, and delicate balances in cases. It is useless in the open air, becoming rapidly saturated with water. A gas-flame is worse than useless for the purpose.—THOS. FLETCHER, Museum-street, Warrington.

[47771.]—**Dead Black for Brass.**—Heat the brass till you cannot touch it; dip it, by a brass wire, into nitric acid for four or five seconds; then heat it till it turns quite black, and is covered with green blisters. When cold, brush with a hard brush. The operation should be performed in a well-ventilated room, and a Bunsen's burner will give the requisite heat, if the article is not large.—J. F. E.

[47771.]—**Dead Black for Brass.**—If the articles are small, place them near the fumes of burning straw for a little while, and they will be covered with a very adhesive pure black colour; or else tint them in silver solution AgCyKCy, and then rub them over with a hot solution of potassic sulphuret in water. Use as hot as you can, and plenty of sulphuret. You will get a fine colour this way, though it, of course, costs more than the straw method. This is what is falsely called oxidising in the trade.—GIRDLESTONE WRIGHT.

[47775.]—**Staining Sycamore.**—I generally dye my sycamore and beech veneers in logwood and a little common soda. For staining, soak red wood in wood-naphtha for imitation birch or mahogany.—J. LEWIS, Brushmaker, Swansea.

[47775.]—**Staining Sycamore.**—You will never make it look like birch for grain, but you may colour it with water and burnt sienna, or lick it over with aquafortis.—JACK OF ALL TRADES.

[47776.]—**Reading the Morse Code.**—The end of one letter is distinguished from the commencement of another by a short pause of the needle if on the machine itself; if printed by the instrument, there should be short spaces between each letter, and longer ones between each word.—W. R. HICKS.

[47776.]—**Reading the Morse Code.**—After signalling one letter a space is made before commencing the next. Thus, A N would be ·— —· and W E ·— — · A greater space is made between each word than between each letter.—TELEGRAPHS.

[47778.] — **Whitewashing.** — Very likely the walls want sizing and papering, so that the stains will not strike through.—W. T. W.

[47779.]—**Soda-Water Siphons**—Are filled from a soda-water machine, the water being under a pressure of from 130 to 160lb. The siphons are inverted and filled through the tap, the air inside being sniffed out.—B. M. S.

[47779.]—**Soda-Water Siphon.**—Soda or potash-water siphons are charged with carbon dioxide gas under pressure from a reservoir; the gas is not generated in the bottle. At the ordinary temperature, the gas is soluble in about its own bulk of water, and its solubility increases directly as the pressure, according to Henry's law; but when this is suddenly removed, the gas escapes with brisk effervescence. Advantage is taken of this circumstance in the preparation of soda-water, as it is called. For this purpose, the water, which may or may not contain soda or other salts in solution, is mechanically charged with a large quantity of carbon dioxide, by the use of a condensing-syringe attached to a reservoir filled with the gas. The excess of the gas thus forced into the liquid occasions the briskness and pungency so much prized in this beverage.—C. HARRIS.

[47780.]—**Chemical Diplomas.**—In order to become a Fellow of the Chemical Society, a candidate has to be proposed by a "Fellow," and supported by a certain number of other "Fellows" (I think four). It is a question of influence rather than knowledge. The Institute of Chemistry requires a candidate to pass two examinations, the first in general and theoretical chemistry, physics and elementary mathematics, and the second a practical examination in all the details of analytical chemistry—this examination extending over five days. Write for a prospectus to the secretary, Somerset House-terrace, W.C.—W. CORDUKES STABLES.

[47781.]—**Gold-Dust Varnish.** — Take some pale copal varnish (oil), and add about six times the quantity of turpentine (oil of turpentine if you like, but there is no difference between oil, spirit, and essence); then get some slaked quicklime, and put about a thirtieth of the whole bulk of your varnish into the bottle; shake violently a good many times and put aside to settle. Decant the clear, and there you have the liquid for painting with gold-dust, or any of the bronze powders. —T.P.

[47784.]—**Cistern.**—10 × 24 = 240, difference in quantity run by C and A + B. Then, 1200 / 2 − 120 = 480 gals. run by C. And as 480 : 1200 : : 24 : 60 minutes, time which C will take to fill cistern ∴ 60 + 30 = 90 minutes, time taken by A. Hence. $24/60 + 24/90 = \frac{2}{3}$ part of cistern filled by C and A. And $1 - \frac{2}{3} = \frac{1}{3}$ part filled by B ∴ 24 × 3 = 72 minutes time B takes; so answer is, A 90 minutes, B 72 minutes, and C 60 minutes.—SCOTCH WORKING MECHANIC.

[47784.]—**Cistern.**—A + B + C pour in cistern 50 gallons per minute. Manifestly A + B pour 30 gallons per minute, and C 20 galls. per minute. Then C would fill cistern in 60 minutes; A in 90 minutes. A + C fill 1-60 + 1-90 per minute = 1-36 of cistern. But A + B + C fill per minute 1-24 of cistern. Then B fills 1-24 − 1-36 = 1-72 per minute of cistern. Therefore B would take 72 minutes to fill cistern. Ans.: A, 90; B, 72; C, 60.—MACHEN.

[47787.]—**Black Shellac Varnish.**—Gas-black is best; mix with about 1 in 10 of finely powdered rosin, and rub well up with spirits of turpentine to a stiff paste, and put in the shellac in pellets; shake up well, and it is done. But naphtha is better than methylated spirit.—JACK OF ALL TRADES.

[47789.]—**Tank.**—Make a solution of curd soap with boiling water; to this mix a little linseed oil, in which a little camphor has been dissolved. Pour over inside, and go over outside with a solution of sugar of lead, sulphate of zinc, or alum.—JACK OF ALL TRADES.

[47793.]—**Electro-plating.**—The cyanide used by you must have been utter rubbish. One ounce of good cyanide would have been more than enough. Get some really good cyanide at 7s. per lb. Add nitrate of silver to your present solution until no more precipitate is thrown down. Pour away supernatant liquid. Wash p.p. in distilled water, then dissolve in solution of good cyanide, add one-fifth more cyanide than it took to dissolve p.p., and the plating solution will be formed.—EDWIN.

[47793.]—**Electro-Plating.**—When you had your cyanide of silver, you should have made a saturated solution of potassium cyanide, and added it to the white precipitate until it was all dissolved, and then added a little more for free cyanide; and then added water according to the class of work you intend to do. For electrotyping, about a pint; for general plating, half a gallon. You had better now evaporate a good deal of the water, then add a little solution of potass cyanide, and try with battery. If it does not act, add some more, and try again. Try this; and if it does not answer, write again, and I will tell you how to cover silver. Never despair.—GIRDLESTONE WRIGHT.

[47793.]—**Electro-Plating.**—"A Beginner" probably owes his failure to the use of the commercial cyanide of potassium. Cyanide of silver (like the chloride) is easily soluble in a solution of potassium cyanide, with which it forms a soluble double salt (KAg) $(CN)_2$. Had the cyanide been pure all would have gone well; but commercial cyanide of potassium (by Liebig's process) always contains about 1-5th of potassium cyanate, since it is prepared by heating a mixture of potassium carbonate and potassium ferrocyanide according to the following equation:—$K_2CO_3 + K_4Fe(CN)_6 = 5KCN + KCNO + Fe + CO_2$. The iron is easily separated by means of its superior specific gravity, but the cyanate is allowed to remain, as for most purposes its presence is immaterial. The undissolved precipitate, therefore, probably consists chiefly of cyanate of silver, which, though soluble in ammonia, is insoluble in potassium cyanide, therein differing from silver chloride. A cyanate can be reduced to a cyanide by heating it with charcoal in a covered crucible. "A Beginner" might try this: If he wishes to purify the commercial cyanide, it can be done by dissolving it in cold dilute alcohol in which the cyanide is soluble—the cyanate only very slightly so; filter off from cyanate, and evaporate the solution down. —C. HARRIS.

[47795.]—**Riveting China.**—By tempering, I mean hardening too soft, and softening too hard metal. There are two kinds of wire sold, hard-drawn and soft-drawn. If you use the hard it must be heated a little, or, in the act of bending an angle, it would be almost sure to crack or break. The very soft needs only a little hammering to make it more firm or springy. The wire should be flattened and faced off with a file on both sides, and the length of the rivet should be accurately adjusted to the length required—i.e., the distance between the holes. If the metal is not left too thick, you will find, on pressing the rivet to its place, that there will be just sufficient "give" or "spring" to admit of the ends passing the edges of the holes and closing in afterwards. This can, of course, only be attained by accurate fitting. You may not succeed at first.—ALFOJOE.

[47804.]—**Model Engine Cylinders.**—Presuming that the cylinders are cored, I think that the best way to do the above would be to obtain a piece of hard wood about 1in. thick, fasten it firmly into the face-plate of the lathe, then turn a hole large enough for the cylinder-flange to fit tight, then fasten the tool in the rest, and take a light cut right through; finish off with a smoothing-bar. I should not advise you to use a twist-drill if you are not a good hand, for they are likely to run out of centre, and it is next to impossible to get them right again. I have made a good many cams, rollers, &c., in my time, and have always bored out the small things in the above way. Shall be happy to give any further information, if required. —W. T. W.

[47810.]—**Heating Soldering Irons.**—Would not a small, tinman's charcoal stove answer your purpose? or, if only wanted for a short time, why not use a spirit-lamp.—W. T. W.

[47816.]—**Silicate of Magnesia.**—"Magnesite" may not, perhaps, be aware that talc, meerschaum, asbestos, and French chalk are all of them silicates of magnesia, possessing the following empirical formulæ:—French chalk, $Mg_3Si_4O_{11}$; meerschaum, $Mg_2Si_3O_8$; talc, $Mg_3Si_4H_2O_{12}$; asbestos, $MgCaSiO_3$; meerschaum and French chalk are, perhaps, the purest. Would not one of these answer the purpose?—C. HARRIS.

[47817.]—**Rapid Electro-Plating.**—Solution of cyanide of copper and potash, and cyanide of silver and potash. (See answer to "A Beginner," 47793.) The copper cyanide is precipitated from a solution of the sulphate with a solution of potassium cyanide. The green precipitate is washed with water, and dissolved in a solution of potassium cyanide in the same manner as the silver solution. In use to be kept warm; however, it is not always necessary. It is only wanted for pewter, zinc, iron, or steel, or articles pewter-soldered. The articles must be thoroughly clean and free from grease of any kind. If you know nothing of the subject, you had better get a book of chemistry or electro-metallurgy, and understand what you are doing.—GIRDLESTONE WRIGHT.

UNANSWERED QUERIES.

The numbers and titles of queries which remain unanswered for five weeks are inserted in this list, and if still unanswered are repeated four weeks afterwards. We trust our readers will look over the list and send what information they can for the benefit of their fellow contributors.

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QUERIES.

[47818.]—**Horizontal Windmill.** — Will some reader give a design for a horizontal windmill, and best way to fix it at gable end of house to work a force-pump? Please give size and shape of sails, what material, and length of arm, and supposed power of mill represented in design.—CONSTANT READER.

[47819.]—**Electrical.**—I have a Griscom motor, the armature of which, when the current is applied, only turns a short distance—about $\frac{1}{3}$ of the circumference of the magnet. Will some kind reader tell me the cause, and how to remedy it? I use a 6-cell Bichromate, supplied by the makers. Also, the cause of my battery running down after about three minutes' working? How can it be rectified, and what are the best proportions of materials? Also, what number and size of bichromate cells are required to work a 10-candle power Swan lamp? Any hints will be gratefully received.—RHEOSTAT.

[47820.]—**Legal.**—Can I compel the property owners in a private street to put grates and a channel down to take the top water beyond my property, as it is a great nuisance to me, or what course can I take to remedy it? I have a grate, and it has to take the water from the whole street?—Q.

[47821.]—**Rainwater.**—I should be glad to know how small tadpole-like creatures can be kept out of a waterbutt? Although the butt was well rinsed and scrubbed before the last spell of wet weather, the water is already swarming with these creatures.—W. P. M.

[47822.]—**Tempering.** — I am turning up some bicycle hubs, and my tools will not keep any edge for more than about two minutes. Having heard that tools are sometimes hardened in lead, I should like to try it, but do not know how to do it. Can any reader assist me? I make my tools red-hot, and plunge them into water, but still they will not keep a good edge, and after a few minutes' use they cease to cut altogether.—ANXIOUS.

[47823.]—**Drink.**—Will some of ours tell me what I can take when I feel a craving for alcoholic drink coming on me?—M. P.

[47824.] — **Fuller's Mercury Bichromate Battery.**—To H. STOOKE.—Thanks for your proffered recipe to make the above, but I wish to know what proportion of sulphuric acid to water is used in both the inner cell and outer jar, and what quantity of mercury is used? Also, how often the battery should be replenished, and how? I made one according to your formula which worked exceedingly well at first, but soon deteriorated in intensity, and apparently seemed worn out. I shall be pleased if you will kindly answer the above queries. I have used a Leclanché cell for over two years to ring a night bell, and also in connection with a door contact, but now it has ceased to work, although I have thoroughly washed both the carbon and porous cell in vain. The connections are good, and the muriate of ammonia is sufficiently pure. Can you please inform me what may be wrong, and how to remedy it?—GEO. W. TEA, Pittsburg, Pa., U.S.A.

[47825.]—**Legal.**—Will Mr. Wetherfield kindly give me his advice on the following?—A. leases a farm of B.; lease stands three years when A. complains that it is too dear, whereupon B. reduces his rent. Shortly after B. dies. B.'s son, C., now comes in as landlord. Now the lease mentions nothing as regards the game. C.'s son, D., who has shot over the ground, now hears that A. has leased the game to a person who advertises the ground, and says all former leave withdrawn. Now, has D. (through his father, the landlord) any power to shoot on the ground, and would not the alteration in the lease (reduction of rent) bring it under the Ground Game Act? That is, could D. be prohibited from shooting hares and rabbits?—J. F.

[47826.]—**Dandelion Beer.**—Will any correspondent be kind enough to inform me how to make dandelion beer so as to drink "sharp"? The following is the manner in which it has hitherto been made, but each time it has been a failure:—1. Boiled dandelion, and then added a little ginger, sieved, and allowed to cool down, and then 1oz. German yeast, or 1 gill of brewer's yeast instead, to every 5 quarts, and sugar to sweeten has been put in and allowed to work for 12 hours, after which it has been sieved again, and put into a large stone bottle; but at the end of about three days it invariably turns sour. Will any one say where the mistake comes in, and oblige?—ONE IN LODGINGS.

[47827.]—**Grist Mills.**—Will some practical readers of the "E. M." kindly give me a little information as to the best kind of grist mill for a farmer's use who has a 4-h.p. steam-engine? Whether one would be profitable to a farmer grinding for neighbours, &c.? I have heard a great deal of Barford and Perkins' machines, Nicholson and Sons, and lots of others, but every maker claims to be the best, and to be able to beat mill-stones. I shall be very glad indeed if I can get some really useful information as to the above, as I cannot afford to waste money on experiments.—AMATEUR FARMER.

[47828.]—**Microphone.**—What is the best one to use for transmission of speech, &c., to a telephone receiver? How should same be arranged at the transmitting end of wire, with telephone and battery there?—J. H.

[47829.]—**Lantern Slides**—Wishing now to prepare some magic-lantern slides for coming winter, wanted best method of developing gelatine plates for same. Also, particulars of chromos for transferring to glass?—J. H.

[47830.]—**Plating Solution.**—Would some correspondent kindly give a method of determining the percentage of free acid in solution of $CuSO_4$ used for plating, or say if there is an instrument for the purpose?—P. B.

[47831.]—**Milk Analysis.**—Will Mr. Allen kindly give the process usually adopted for analysis of milk, and calculation necessary to adduce the probable amount of added water? Also, if any process will detect milk which is the product of a diseased animal?—R.

[47832.]—**Nickel Analysis.** — Will Mr. Allen kindly say what is the usual process now adopted for analysis of nickel and cobalt ores, and nickel regulus, &c.?—R.

[47833.]—**Coil.** — To MR. F. WALKER. — Having referred to back numbers for a form of medical coil, and seeing yours, I wish to ask if you would explain to me the way the small powers or wires are soldered to helix's, as, of course, there would be several rows one above the other?—ONE IN A FIX.

[47834.]—**Married Woman's Property Act.**—Can a married woman hold real and personal property over £200 falling to her from an intestate, for her separate estate, and can she legally will the same without the consent of her husband? Is it necessary to do anything to prevent the husband claiming it? The woman was married in 1880. The intestate died in June last. Will the Act passed during the present Session affect the above?—MAUGHOLD HEAD.

[47835.]—**CheapTent or Workshop.**—Will any of ours assist me? I am about to erect a rough shed for a smoothing-room of about 14ft. by 14ft. by 9ft. high. Whether would wood, bricks, or stone be the cheaper, or is there any such thing as all metal tents? A friend told me he had seen some such thing advertised. The place would be unusually warm, as there would be a stove inside. I have plenty of room to build on, and I want to know which of all these would be the cheaper. I would require a great many windows, as the shed would have to be well lighted.—J. M. L.

[47836.]—**Pott's Patent Irons.**—Will any fellow-correspondent kindly oblige me by saying what purpose these irons were specially designed to fill? The handle is of polished hard wood, and is separate from the iron, and the latter is packed inside with something like tow, to retain the heat, I suppose. Are they superior to the old 12 or 14lb. irons cast all solid? They are made up in "sets" of three different-sized irons and one handle. Can three or four all large ones be had? Why are they in "sets"?—J. M. L.

[47837.]—**Legal.**—I am a candidate for a situation under a town council, two or three of whose members are bankrupt, but have compounded, and have retained their seats in the corporation, notwithstanding their being bankrupt. I want to know, as those members will vote against me, a son of one of them being a candidate, could I challenge the votes of those members who are or have been bankrupts, and who never resigned, but kept their places in the town council? Have they a right to vote? The situation is as head of a large department, and my principal opponent (the son of the councillor) is only 23 years of age. It is in Ireland.—CANDIDATE.

[47838.]—**To Mr. Wetherfield.**—A friend in the west of Ireland has proposed to assign me some lands there which he holds by lease. I fear, however, this lease cannot be valid, for I find included in the area or acreage are the public highways which partly border the farm. Surely the landlord who gave the lease had no more right to the public roads of the country than he has to the space of Trafalgar-square. It is as though I let our Editor the house, 31, Tavistock-street, and put in the agreement the space of half the street in front. Now, if he were foolish enough to accept a lease from me of what does not belong to me, and in the same document accepts of something which I have an honest power to dispose of, can the document and the agreement be valid, and is not part of it fradulent? You may think, perhaps, that I ought not to accept of such foolish bargains, nor do I think I would if I had the power of refusing; yet I find in Ireland such transactions are quite common between landlord and tenant, and my friend has actually been paying rent for the public roads for 20 years and county-cess also.—A PUZZLED SAXON.

[47839.]—**View Lens.**—I have an opportunity of getting my choice of three view lenses, each of 6in. focus: the first measures 1in., the next 1¼in., and the third 1½in. diam. I want the glass for a pocket camera, and desire faultless definition. What is the advantage of the larger lens? Shall I be able with it to use a larger stop, and so shorten exposure? Does it help the definition—or what?—FOCUS.

[47840.]—**Microscopic.**—I have been examining that most curious object, the Volvox globator, with a ½in. and ¼in. objective, yet I cannot see the reticulations on the globe, or the vibratory filaments which move it. Will some friend say what power is necessary, and if I must have a wide-angle objective? My Volvoces seem small, and are rolling about in company with another variety of 16 little balls which are attached together like a raft, and go lurching through the water. I do not see their cilia either.—VOLVOX.

[47841.]—**Sifting Machine.**—Will any reader inform me what kind of sifting-machine is the best for sifting washing-powder?—DRY SOAP.

[47842.]—**Electric Light for Workshop.**—Will any reader of ours give his opinion as to the advisability of adopting the electric light under the following circumstances?—Our ironfoundry is about 90ft. by 40ft. and about 24ft. high to underside of the beams. A traveling crane running the full length of the shop prevents us fitting up with gas except side brackets, and these are of little use for floor-work in the middle of the shop. We have ample engine-power, and I thought with, say, two lights, we should be able to illuminate the place well. Respecting the dynamo, would it be possible for us to construct our own? We have a capital engineers' shop. Any suggestions as to the best system to employ under the circumstances, and the probable cost, will be thankfully received by—IRONFOUNDER.

[47843.]—**Acoustics.** — Can any reader kindly answer the following?—Has the material of which a case containing air is formed any influence on the intonation of the mass of air? For instance, I make a hollow case, put into vibration the air contained in it, and find that I get a certain note. I now make a second case, similar in all respects, but of an entirely different material. Will the note rendered by the vibration of the air in this second case be the same as in the former instance? Or, to give the special example to which I wish to apply the principle. I find the intonation of the mass of air contained in the body of a violin, and then replace the ordinary sides by steel or brass ones of the same dimensions. Will the intonation of the mass of air be affected?—A. E. TEBB.

[47844.]—**Tricycle-Riding.**—Mr. W. G. Cresswell, L.R.C.P. Ed., replying in the *Lancet* of Aug. 25 to a querist, seems to think the bicycle not at all likely to cause hernia; but at the end of his reply, he says:—"I should like to point out that I do not wish my opinions to be taken as extending to the tricycle, since the conditions which attend the rider of that machine are widely different in some important points, as I soon found out on the only occasion I have ridden one." Will Dr. Edmunds when he returns, or some other medical reader, say if tricycle-riding causes more strain on the abdominal muscles, &c., or those portions likely to be ruptured, than bicycle-riding?—Q.

[47845.]—**Canaries.**—I have been unsuccessful in rearing my last two broods of canaries, owing to the old birds killing their young ones from over-feeding them and pecking the top off their beaks when they are a few days old. Will some one tell me the cause of this? I give my birds clean sand, fresh water, and baths every day, and a clean nest the day before the young are hatched.—JULIA.

[47846.]—**Electro-Plating.**—In a work on electro-metallurgy I find it recommends using a solution of nitrate of mercury to dip articles in, previous to plating in the silver bath. Is this plan injurious to health—e.g. in the case of electro-plating tablespoons which are used frequently in dishes at a high temperature? Is there not great danger of the mercury volatilising or becoming incorporated with the food in which the spoon is placed?—A BEGINNER.

[47847.]—**Electro-Plating.**—I have been trying to plate silver direct on some "Nevada" silver spoons with a bath made of cyanide of silver dissolved in cyanide of potassium, but without success. The deposit of silver on the spoons has a white frosted appearance, and contains a number of blisters, so that when I try to scratch-brush, the silver at once strips from the spoons. Will "Os," or some other kind reader, say what is the cause, and how to remedy the evil?—A BEGINNER.

[47848.]—**Replating Worn Steel Pickle Fork.**—I wish to replate a pickle-fork from which the silver has been worn, exposing the steel. Will some one give me a receipt? I succeed in replating old forks and spoons, but fail here.—G. T. J.

[47849.]—**Strength of Pipes.**—I find a curious rule in Rankine's "Rules and Tables" (p. 268, fifth edition) which I should like to have explained. The rule is one for determining the least proper thickness for a cast-iron pipe of a given bore to bear a given pressure from within. "First, divide the greatest pressure, in feet of water, by 12,000, and multiply the bore or internal diam. of the pipe by the quotient. Secondly, take a mean proportional between the internal diam., and $\frac{1}{48}$in.: the greater of those two quantities will be the required thickness." It seems to me that the latter quantity must always, or nearly always, be far in excess of the other, and, further, far in excess of what is reasonable. Fancy a 24in. tube with a thickness =

$$\left(\frac{24 + \frac{1}{48}}{2}\right) = 12^1/_{96}\text{in.}$$

!—GLATTON.

[47850.]—**Sensitised Paper.**—Would a brother-amateur or Mr. Lancaster tell me why the ready-made sensitised paper that I use for photographic prints, after being kept for a little time, becomes covered with black spots or specks, and please state how I can prevent these spots from appearing?—A. L. V.

[47851.]—**Sewing-Machine.**—I have a chain-stitch sewing-machine, manufactured by James G. Weir, London, which does not feed well. Can anyone kindly tell me how it can be remedied?—J. J. V.

[47852.]—**Misconduct of Apprentice.**—To MR. F. WETHERFIELD.—I have an apprentice who absents himself from work just when he chooses. I have stopped him heavily for it—as much as 5s. 6d. per day. Would it not be best to take him before a magistrate? If so, which Court should it be? The indenture states that all lost time is to be stopped for, but I take it that staying away altogether is a different thing from losing a little time through being late and so forth.—W. A. R.

[47853.]—**Erector for Microscope.**—Will Mr. Lancaster, or some other reader acquainted with the subject, explain how this very useful addition can be cheaply made to an ordinary microscope for botanical work? The pancratic power which an erector gives, as well as the erection, is most convenient in dissecting minute objects; yet I am told that erectors are very seldom made, and are, perhaps, for that reason, expensive. On an emergency, lately, I used the first two joints of a pocket telescope with a 2in. micro. objective at the end; but the contrivance, though better than nothing, was naturally not very satisfactory.—Nomad, Carlsbad, Bohemia.

[47854.]—**Reaping-Machine.**—In working an ordinary reaping-machine, how much of the energy expended is utilised in the cutting? I suspect a large percentage must be lost in friction.—A. J. F.

[47855.]—**Gas-Engine for Dynamo.**—I have a 1½-h.p. gas-engine of Crossley's make, vertical pattern. Have I sufficient power to drive a dynamo, large enough to work six or eight incandescent lamps of 20-candle power each? If so, what would be the probable cost of the dynamo? The current would have to be conveyed about 35 yards. Will "Anglo-Dane" or "Tried" inform me?—B. M. S.

[47856.]—**Preserving Meat.**—Would any reader of the "E. M." kindly inform me of the best process for packing cooked meat in hermetically sealed tins (giving the modus operandi)? Also, if meat can be preserved in above manner in whole joints and larger quantities?—P. M.

[47857.]—**Defective Sewing-Machine.**—Would Mr. E. Martin kindly answer the following?—I have a boot machine, the stitches of which are very irregular in length. If the feed-wheel is kept free from oil, it works better for a short time.—F. E. T.

[47858.]—**The Berliner Violin.**—I have read with great interest the previous letters on this subject. In one of them "Fiddler" states that the Berliner resonator improves only the tone of common violins. From this arises the question: For what reason should it not even improve the tone of the best violin? I fail to understand why it should not improve the tone of the better class as well as those of the inferior class. Logically speaking, the improvement should be greater in the higher class violins.—G. Fryer, Swansea.

[47859.]—**Dirty Oil.**—I have about 80 gallons of oil which I have obtained by cleaning dirty and greasy cotton-waste and sponge-cloths, as used in engine-cleaning, &c. Will any of your very numerous and generous readers kindly inform me by what means or process I can clean the above, so as to make it useful and saleable, or to what purpose it can be applied? I have heard it can be used in making printers' ink.—Stamford.

[47860.]—**Mounting Diagonal for 6½in. Glass Reflector.**—Would "Orderic Vital," or some other of your correspondents, describe the best and newest method of mounting the diagonal for a 6½in. silvered glass reflector, with its adjusting screws or means of adjustment?—R. E. C.

[47861.]—**Photography.**—What is the reason that the ordinary 15-grain iron developer used with wet plates will not do for dry plates? Also, why will not cyanide of potash do to fix dry plates, instead of hyposulphite of soda? What is absolutely the best developer for studio use for dry plates, and the easiest and most under control?—Ouvrier.

[47862.] — **Painting and Gilding Wooden Letters.**—Would some one inform me how to gild the above sort of letters? Also, what colour the sides should be painted to suit a black ground on which the letters are to be put? Size of letters, 7in. from top to bottom, and 1in. broad.—Church-Hill.

[47863.]—**Aniline Dyes.**—Can any of our readers inform me which of the following dyes is the least fugitive—magenta, fuchsine, or violet? Which would be the better dye (magenta or fuchsine) to use with ultramarine for bringing up a lively white colour in paper pulp?—W. O. T.

[47864.]—**Chemistry Examination.**—Will any reader kindly recommend me one or two books to use for the South Kensington examination in organic chemistry, advanced grade?—W. O. T.

[47865.]—**Utilisation of By-Products.**—Can any fellow-reader help me in the following difficulty?—On an extensive farm some small gasworks have been erected. The tar is most useful in a variety of ways, also the "gas-lime" as a manure; but the ammoniacal liquor merely collects in a pool near the works, and is said to be useless. The supply of it is not great, there being only two retorts; but as it is beginning to run down the field, something must be done. Is there any cheap practical way of utilising it as a manure? How would it answer to mix it with the offal of a neighbouring slaughterhouse?—Puzzled.

[47866.]—**Landlord and Tenant.**—I let furnished apartments, and, unfortunately, got bad lodgers, who run a bill of nearly £20: gave them notice to quit, they took no heed of notice. I took first opportunity of locking them out of apartments after notice to quit had expired, and retain their boxes, papers, &c. Can I dispose of these and sue for balance? I may say they (the lodgers) are working a patent through an agent: the agent manufacturing and securing orders, and paying patentees, after deducting commission, &c. Any information gratefully received.—Landlord.

[47867.]—**Magnetic Sands.**—I should be much obliged if anyone could give me any information respecting magnetic sands. These are found largely in Canada and New Zealand. I am not aware that they have ever been worked in the Dominion, but some time ago a company was formed for making steel therefrom in New Zealand. Can you tell me if such a company is still in existence, and what it is called?—Philip Taylor.

[47868.]—**Deep-Sea Cables.**—Will somebody kindly answer the following question, which is one asked in the last examination by the City and Guilds of London Institute?—The conductor of an Atlantic cable broke inside its insulating sheath without making any earth whatever. How was the locality of the rupture determined?—Telegraphis.

[47869.]—**Induction Coils.**—Will Mr. Lancaster, or any of ours, kindly give me, if possible, the best size and amount of wire to use for a miniature shocking coil about 2¼in. long? Also, the plates used with sulphate of mercury for battery? Can he also give me the best sizes for a 1in. spark coil, with thickness and length of coil?—Phenyl.

[47870.]—**Desmids.**—Wanted recipe for a medium that will preserve desmids and delicate algæ in their natural colours?—H. A.

[47871.]—**Power for Churning.**—As a rule, my wife wants to churn an hour or two after my men and I have gone from the homestead, and it is often inconvenient to spare a man just at the time. Would some mechanical reader of your journal be good enough to tell me of any simple arrangement for storing energy that the wife could turn on when wanted?—some arrangement the carpenter and I could rig up would suit me best; and I suppose a big weight which a couple of men could wind up, like winding a clock, would be the handiest way of making a start, as we could do the winding up before leaving home. The power required is about ½-m.p. for, say, two hours at the outside. The churn is a barrel of the old-fashioned style.—Yokel.

[47872.]—**Boiler.**—I have a locomotive boiler which I have had much trouble with, on account of the tubes leaking at the smoke-box end. They are soldered in with soft solder. In the firebox they remain perfectly tight; at the other end, although I have done them over and over again, after using a few times, they become as bad as ever. I thought of brazing them, and should be very glad if some kind reader would tell me how, and what I should require? Any hints on brazing would oblige.—M. C.

[47373.]—**Revolving Shutters.**—Can any correspondent living near the sea-coast inform me if they find revolving shutters for shop-fronts expensive to keep in repair, as I am informed by a neighbour that his has to be sent to London nearly every year for repairs, costing from £5 to £7 per annum in repairs? Also, how are they fixed, and what space do they require for a window about 7ft. square? Would it be any advantage to have them in two widths?—W. L. P. P.

[47374.]—**Plastering Rooms.**—Can any one inform me of an expeditious way of plastering rooms three coats so as to be dry in a week or ten days, and would it be safe to occupy the rooms in two or three weeks after being finished? Will any of the patent cements answer for the purpose?—if so, which will be the best, and in what proportions should it be mixed, and what will be about the cost per yard on wall and laths? Will the cement answer mixed with ordinary lime? Shall be pleased if anyone can inform me the best and quickest way to get the plastering to dry off.—W. L. P. P.

[47875.]—**Concrete Floor.**—I was pleased to see our old friend, "Khoda Bhux's" kind offer to give further information on concreting on p. 17 of last volume. I will thank him to assist me with his advice: I am about to put a galvanised tank over w.c., 10ft. long 6ft wide, supported on the two sides, one end and middle with 9in. ashlar wall, and one end recessed in the main building 4in. I am told this is not sufficient support, so should like to put a concrete floor over all to support the tank. Will "K. B." kindly inform me what thickness I should put it, and in what proportion the concrete should be mixed, broken stone, coarse sharp gravel, and will it be necessary to arch it under?—W. L. P. P.

[47876.]—**Irish J.P.'s.**—I should feel obliged if a correspondent would please say what are the necessary qualifications for a Justice of the Peace in Ireland?—Nemo

[47877.]—**Photographic Dusting-on Process.**—Can any reader oblige me with the details of this process? I have looked through the back numbers, but can only find one in which the powder adheres to the parts of picture not acted on by light. Now it happens I require just the reverse. I wish the powder to adhere to those parts of the print which have been exposed under the clear parts of the negative. From hints gathered here and there, I think there is such a process, but I have been unable to find it. It seems to be so little thought of, that in photographic manuals it is only mentioned to be at once dismissed. I do not know whether the powder adheres firmly or not. For my purpose it would do best if it adhered very lightly, in fact, just what would keep it from falling off when shaken face downwards.—Try Again.

[47878.]—**Electro-Gilding.**—I want to electro-gild parts of a silver cup—viz., the name-plate and lines down the handle. How should I proceed?—An Amateur.

[47879.]—**Silversmiths' Work.**—What is the shape of hammer-head that silversmiths use to finish their work—that left with the facets on it?—George Eversley.

[47880.]—**Liquid for Binnacle.**—To Mr. Lancaster.—Querist being desirous of putting fresh liquid to float the compass in the binnacle of a small yacht which has recently come into his possession, would feel much obliged for information as to the composition of same, and whether it should completely cover the compass card. On unscrewing the glass top, it would appear that it had been cemented on, but that the cement (red putty) had given given way in places, admitting dust, and thus discolouring the contents, so as to make it difficult to read the points of the compass.—Jim.

[47881.]—**Tricycle-Making.**—Does the tricycle with two front steerers and the large driver behind connected by rods to the treadles work well? I have a 50in. and an 18in. wheel, and I wish to utilise them in constructing a tricycle. Would it be better to get another 18in. or another 50in., and what would be best design, so as to get it through door 27in. wide? Any hints as to making will oblige—Henry Ward.

[47882.]—**Amateur Engraving.**—Would some reader kindly give the names and how to work the different tools used in engraving monograms, initials of names and scroll-work only? Having put a pair of polished oak covers on a large photo album, I want to put a German silver monogram in the centre and corners with some scroll-work on them, wishing to do the engraving myself. I have plenty of time for practice, and as tools and materials are cheap, I can put up with a lot of failures. I inserted a query in the "E. M." about six or eight months ago on this subject, and got no reply. I am sure there are a number of readers who can give a few simple directions which will suffice for a beginner, and will, I am certain, be as acceptable to others as well as—Young Amateur.

[47883.—**The "Vicar of Bray."**—Can any literary reader kindly inform me what was the name of the "Vicar of Bray," celebrated in song, and at what date and for how long he held his benefice?—M. R. C. S.

ANSWERS TO CORRESPONDENTS.

⁂ *All communications should be addressed to the* Editor *of the* English Mechanic, 31, *Tavistock-street, Covent Garden, W.C.*

HINTS TO CORRESPONDENTS.

1. Write on one side of the paper only, and put drawings for illustrations on separate pieces of paper. 2. Put titles to queries, and when answering queries put the numbers as well as the titles of the queries to which the replies refer. 3. No charge is made for inserting letters, queries, or replies. 4. Letters or queries asking for addresses of manufacturers or correspondents, or where tools or other articles can be purchased, or replies giving such information, cannot be inserted except as advertisements. 5. No question asking for educational or scientific information is answered through the post. 6. Letters sent to correspondents, under cover to the Editor, are not forwarded; and the names of correspondents are not given to inquirers.

⁂ Attention is especially drawn to hint No. 4. The space devoted to letters, queries, and replies is meant for the general good, and it is not fair to occupy it with questions such as are indicated above, which are only of individual interest, and which, if not advertisements in themselves, lead to replies which are. The "Sixpenny Sale Column" offers a cheap means of obtaining such information, and we trust our readers will avail themselves of it.

The following are the initials, &c., of letters to hand up to Wednesday evening, Aug. 30, and unacknowledged elsewhere:—

W. Stanley.—Adams and Francis.—R. E. Quinn.—A Driver.—An Amateur.—A Templar.—A. S. L.—H. A. Wassell.—H. B. T. S.—J. W. J.—Steeple Jack.—S. B.—S. H. Salt.—E. S. Beaven.—Countryman.—Jack of All Trades.—Wm. Harris.—G. E. Bonney.—A Fellow of the Royal Astronomical Society.

A NEW VOLUME.

This number is the last of volume XXXV. Readers willing to oblige us by recommending "ours" to new subscribers should do so now, when a new volume is commencing. The index to Vol. XXXV. will be published in the number dated Sept. 22, and cases and bound volumes will be on sale shortly after. Readers desirous of making up their sets for binding the present volume are recommended to do so at once, as the back numbers soon run out of print.

Oatmeal. (Certainly. See p. 360 for method of using them.)—Double Dragon. (You can try the effect of a solution of chloride of lime; but you must wash carefully with two or three waters afterwards; or expose to the fumes of burning sulphur. A little bichromate of potash has been recommended for fixing the ink. The light so acts upon it that it renders the vehicle in which the carbon is mixed, insoluble.)—Bodge. (See p. 381, No. 874. They are mostly thin brass, and are held by rubbing the edge into a saw kerf on the outside.)—Au Desespoir. (For "Photography on Porcelain," see p. 85, No. 680, or any of the recognised textbooks of the art.)—Electrician. (The E.M.F. is the same whatever the size of the plates. 2. Not that we know of. 3. The E.M.F. is about the same; probably the mixture of acid and bichromate giving a decimal or so more volt than the plain acid. Why do you not learn the rudiments?)—Tam O'Shanter. (See the lessons on blowpipe analysis in Vols. XXX. and XXXI., and the subsequent discussion on the merits of various handbooks. Landauer's book, published by Macmillans, is one of the most recent.)—Eureka. (We did not misunderstand. You can drink gallons of such a distillate without putting a fraction of a grain of phosphorus into your body. Hypophosphite of quinine is, like other preparations containing phosphorus, useful in nerve diseases; but it should be taken only under the direction of a physician. You can easily learn the price by consulting a list to be obtained at any of the dealers in chemicals. We cannot possibly say how much two inches is worth, but we have no doubt it is quite "pure" enough.)—Collodian. (The process is almost exactly the same as that described in the book mentioned. A mould is taken in plaster, guttapercha, or wax; that is coated with fine plumbago and metallically connected with one of the conducting wires. It is then immersed in a tank, and the current put on. When the deposit is sufficiently thick the shell is removed, heated on an iron plate, tinned at the back and filled up with the usual metal, lead and antimony alloy. 2. You want what is known as a copper-plate press, two rollers through which the plate is passed. The ink is cleaned off by means of whiting and a leather—in fact, the surface is so polished that it takes very little, while the ink in the lines takes a fresh supply at each application. By looking through the indices you will find that both subjects have been fully treated many times.)—T. Wye. (For hæmorrhoids, see pp. 329, 338, 361, this volume.)—W. E. K. (Answered on p. 407. The directors could not prevent you taking photographs outside of their grounds, but they certainly could object to your taking them inside.)—A. M. (See p. 96, No. 810; p. 539, No. 776; p. 610, No. 700. Illustration and directions for cutting the gores, &c., on p. 566, No. 594, and p. 613, No. 596.)—M.R.C.S. (It is usually ascribed to the protosalt of iron contained in the shell becoming a persalt through absorbing oxygen in the process of boiling, but nothing very definite is known.)—A. M., Peterborough. ("Lead" is the width of the steam port when the piston has arrived at the end of the stroke; that is, the amount of opening for the admission of steam for the piston to cushion against. "Lap" is the extent to which the face of the valve overlaps the port, and produces a fixed amount of expansive working. You should read up the subject in one of the treatises on the steam-engine, or in many places in back volumes.)—George Eversley. (See several replies in recent volumes for the solution. As to the second question, a sand-bath is used for placing vessels in which cannot be treated by direct application of flame. It is simply a pan of sand heated by a fire beneath.)—A. J. F. (One has been worked by a trick rider. He used a machine that resembled the front half of a bicycle, the backbone being cut just behind the saddle.)—Tom B. (Not that we know of.)—Simple Simon. (Look through the indices.)—A Beginner. (Suppose you look through the back volumes. Answers to your questions would occupy a page or two, and be of interest to only a few of our readers, especially as they are on such elementary matters.)—Caloric. (We do not think the suggested course would have produced the desired result. It would be anything but "simple information.")—W. J. G. (We do not see what definite answer could be given to so vague a question; but suppose you adapt one of the ordinary stoves.)—Ignoramus. (Get the catalogue of the Tonic Sol-Fa Agency, Warwick-lane, E.C.)—Vulcan. (You will find articles on the subject in back numbers. There is no good book on the art, but you could find useful information in the specifications of the patents.)—Irishwoman. (The only way is to put it up in air-tight tins, or mince very fine and press down close in jars, covering with a layer of melted fat, not forgetting the pepper.)—E. O. Simmonds. (You do not say in what respect you failed. If you mean the glass fails to indicate storms, that is not news. The usual recipe is as follows:—2½ drachms of camphor, and 11 drachms of spirits of wine. Dissolve, and add a solution made of 9 drachms water, 38 grains of saltpetre, 38 grains of sal-ammoniac. Shake well, cork the top of the tube, and wax it, then make a pin-hole through it. Then hang it up, and by diligently studying you *may* be able to foretell storms.)—City of Rome. (We have given all particulars many times. See p. 100, No. 836. The situations can be obtained only on application to the owners of steam vessels, and in the navy only by going through a course of training at one of the dockyards. Get Ainsley's "Engineer's Manual of the Local Marine Board Examinations," of the author, South Shields, or apply for particulars to the superintendents of the Marine Board at any of the large shipping ports.)—Locomotora. (You can see them at the Patent Office Library or the British Museum. Perhaps Mudie's keep them. 2. Second query incomprehensible.)—A. B. C. (Porcelain, fireclay, plaster of Paris.)—R. S. S. (We gave the authority for the statement. We have not tested it, but should use a saturated solution. Hyposulphite of soda can be had of any seller of photographic chemicals.)—Subscriber. (See recent numbers, and almost any back volume.)—Y. Z. (We cannot spare space for repeating recipes for making blacking and vinegar. You must consult the indices.)—Romeo. (Look through recent back numbers, and you will find that Dr. Edmunds has fully treated the subject of indigestion.)—J. F. (Wright's book on Fowls, published by Cassell's; or "Management of the Poultry Yard," L. Upcott Gill.)—Machinist. (Maxton's "Manual of Engineering Drawing" (Lockwood and Co., Stationer's Hall-court, E.C., 3s. 6d.), or one of the series of books on drawing published by Cassells.)—L. J. (Longmans, Lockwood, Macmillan, and Collins all publish books of the kind; but you will find some recommended if you look through back volumes.)—Electrician. (You want just the same arrangement as is adopted between two telephones, which has been several times described. The arrangement depicted would do.)—J. N. Unwala, Bhannagar. (Paid to Sept. 28, 1883, inclusive.) Dejon. (No examination is necessary. The British Government allows anything to be sold under cover of a three-halfpenny stamp.)—F. W. B. (Nobody doubts that there are many able and conscientious teachers doing splendid work in spite of the discouragements offered by the Department. We have attacked the *system*, which is calculated only to produce bad teachers, while highly-paid officials at head-quarters absorb the money that ought to provide good teachers and good teaching.)—J. T. E. (Hardly, we fear, unless you have plenty of money to spend, and can afford to commission one of the large art furniture makers to pay an artist to design a case for your pianoforte. We agree entirely with you that pianos are generally hideous things to look at; the old "squares" that our grandmothers thrummed were far more comfortable-looking pieces of furniture, though, of course, not to be compared musically with modern instruments. The "grand," especially, is an awkward customer to make presentable. anyhow. A good attempt may be seen in a piano designed for Mr. Alma Tadema, the celebrated painter, illustrated in to-day's *Building News*.)—Inquirer, Newcastle. (Dr. Edmunds will not—and, really, *could* not without personal examination—advise in such cases. Skin diseases are among the most difficult and tiresome to cure.)—Constant Reader. (Inquiries as to individual crests are inadmissible.)—One Doubt. We cannot spare space to reprint leases, &c., for our legal querists. If you wish further information, you had better send the copy direct to Mr. Wetherfield.)—Amateur. (Any builder will supply such a chimney top. Boyle's is one of the best.)—Thos. Lees (Ihlee and Horne, Aldermanbury, London, E.C.)—Electron. (It is not a fact.)—G. S. H. (Very likely; hair-dressing is out of our line.)—J. F. Wm. Baucke, Chatham Island, South Pacific. (We cannot undertake to obtain protection for inventions or to negotiate the sale of patents. Possibly one of the patent agents who advertise in these pages might take the matter up. We will preserve your specification and drawings and hand them to any one on your behalf, or return them, as you may direct.)—J. H. Huxley, Ch. Rabache. (In type.)

A new Government graving dock, to be made at Cockatoo Island, Sydney, at a cost of £150,000, will be excavated almost entirely out of sandstone rock.

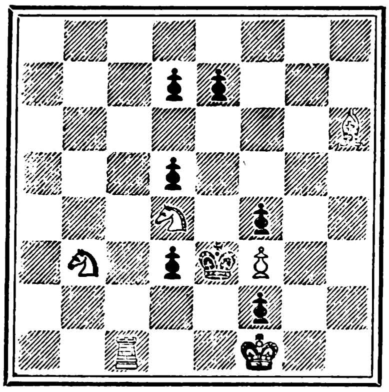
CHESS.

◆◆◆

All Communications for this department must be addressed to the Chess Editor, at the office of the English Mechanic, 31, Tavistock-street, Covent-garden. W.C.

PROBLEM DCCLXXVII.—By C. Callander.

Black.



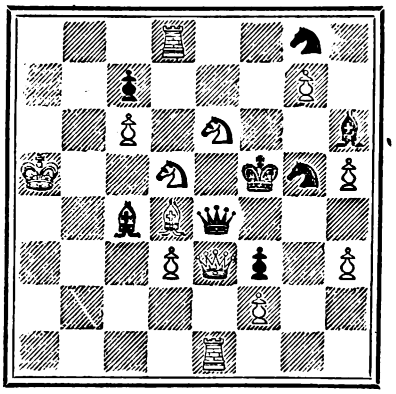
White.

White to play and mate in four moves.

PROBLEM DCCLXXVIII.—By Fidèle Jusqu' à la Mort."

From the *Leed's Mercury*

Black.



White.

White to play and mate in two moves.

Solution to 773.

White.	*Black.*
1. Q to Q R 3.	1. K to K 2 (a).
2. Kt to Q B 6 (ch).	2. K to B 2.
3. Kt mates.	
	(a) 1. K to K 4 or (b) B 4
2. Kt takes B (ch.).	2. K moves.
3. Q mates.	
	(b) 1. K to Q B 2, or anything else.
2. Kt to R 6 (ch.).	2. K moves.
3. Q mates.	

Solution to 774.

White.	*Black.*
1. K to Q B 4.	1. Anything.
2. Mates.	

NOTICES TO CORRESPONDENTS.

Correct Solutions to 773 and 774 by Celsus and Schmucke; to 771 and 772 by Celsus.

T. P. T.—Thanks for the problem.

W. T. P.—We have entered your name on tourney-list.

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⁂ Subscribers are requested to order Cases and Vols. through their booksellers, and not to send direct. The regulations of the post-office prevent their transmission through the Post.

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⁂ It must be borne in mind that no Displayed advertisements can appear in the "Sixpenny Sale Column." All advertisements must be prepaid; no reduction is made on repeated insertions, and in cases where the amount sent exceeds One Shilling the publisher would be grateful if a P.O.O. could be sent, and not stamps. Stamps, however (preferably halfpenny stamps), may be sent where it is inconvenient to obtain P.O.O.'s.

The address is included as part of the advertisement and charged for.

Advertisements *must* reach the office by 3 p.m on Wednesday to insure insertion in the following Friday's number.

NOTICE TO SUBSCRIBERS.

Subscribers receiving their copies direct from the office are requested to observe that the last number of the term for which their subscription is paid will be forwarded to them in a Pink Wrapper, as an intimation that a fresh remittance is necessary, if it is desired to continue the Subscription.

OUR EXCHANGE COLUMN.

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The charge for Exchange Notices is 3d. for the first 24 words, and 3d. for every succeeding 8 words.

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Splendid pair of **Horns**, 6ft. from tip to tip, and 11in. at base. Exchange for good 52in. Bicycle; or what offers?—Address, W. T. P., Poundisford, near Taunton, Somerset.

Amateur Small Iron **Lathe**, Printing **Press**, or offers for good electrical goods. List sent. No offers refused. Must be sold.—Walter Wells, Watchmaker, Malvern Link.

Superior silver Geneva **Watch**, in perfect condition, cost 35s. Bill shown. Exchange. Trial allowed.—John Williams, 62, Stephenson-street, Canning Town, London.

Will exchange splendid Box of **Drawing Instruments**, Templeton's "Engineers' Common-Place Book," Templeton's "Millwright and Companion," 14 numbers of Working Drawings and Designs, for a 50in. Bicycle, on approval.—Address, S. E., Post Office, Aberkenfig, near Bridgend, Glamorganshire.

Model Engine.—Brass Horizontal Steam Engine and Boiler, with taps, safety valve, &c., finely finished off by an engineer all complete. Exchange.—Rigby, Aughton Park, Ormskirk.

Microscope wanted, value of £9, in exchange for 52in. Special Challenge Bicycle, new, in perfect order; cost £15.—The Retreat, Chudleigh.

Lathes. 1 3ft. 6in., with chucks, and two drawers, £7. One 4ft. back-geared, £8. Both in good order.—U. N., 15, Oxford-street, Reading. What in exchange?

Dexter **Fret Machine**, with Patterns, &c., cost over £3 10s. Exchange 3in. Slide Rest, Electrical Apparatus, or offers.—Walters, 50, Watlington-street, Reading.

Wanted, **Photo. Card Lens**, 5 to 6in. focus, French or English. Exchange brand-new superfine cloth Frock coat, never worn, 38in chest measure. Also Gold Jewellery.—Horton, 26, Caroline-street, Cardiff.

Wanted, young **Cock Canaries** and waggon-shape Cage. Exchange ten volumes "Design and Work," and good Conjuring Tricks, professional.—Horton, 26, Caroline-street, Cardiff.

Mounted or unmounted **Micro. Objects** for good gatherings of Campylodiscus, Costatus, Meridon Circulaire, Achnanthes Longipes, &c. Liberal exchange given.—W. White, Warden-place, Nottingham.

"**English Mechanic,**" 851 to 876, less Nos. 870, 871, 874. Ditto, 851 to 901. What offers?—D. J., 6, South-street, Bethnal Green, E.

Locomotive, 2½in. cylinders, link motion, pump, 6 wheels, four coupled, 9in. gauge.—16, Catherine-terrace, Ashton-under-Lyne.

Wanted, "**Hopkins and Rimbault** on the Organ." Will exchange "Cassell's Technical Educator."—W. McEwen, Builder, Kirkcudbright.

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